INSOLVENCY PROFESSIONALS: A CRUCIAL PILLAR OF THE INDIAN INSOLVENCY REGIME

S. K. Maity Datta
Faculty of Law, Sureswar Dutta Law College, Mourigram, Howrah (University of Calcutta), India
Adamas University, Barasat, West Bengal, India
maitydatta.samitkumar@gmail.com

ABSTRACT

The profession and regime of Insolvency Professionals (IPs) a new class of regulated professionals came into existence in India in late 2016, following the Insolvency and Bankruptcy Code, 2016 (IBC/the Code) was enacted. IPs can act as Resolution Professionals (RPs) or Interim Resolution Professionals (IRPs) and play an important role in the resolution, liquidation, and bankruptcy of business, Limited Liability Partnerships (LLPs), partnership firms, proprietorship enterprises, and individuals who are in trouble financially. The IBC 2016 has resulted in a shift from a "debtor in control" to a "creditor in control" regime, and it provides a mechanism for the Adjudicating Authority (AA) to appoint an IP as a neutral person to take control of a financially distressed company as a component of the resolution process and coordinate its management and operations with its financial creditors. In this article, the author discusses the role of IPs in the Corporate Insolvency Resolution Process (CIRP), Liquidation Process, and Bankruptcy Process under IBC. In addition, the article makes an attempt to comprehend the practical issues and problems that IPs confront, as well as provide some suggestions.

Keywords: *Insolvency and Bankruptcy Code, 2016, Insolvency Professionals, Adjudicating Authority, Corporate Insolvency Resolution Process, liquidation, bankruptcy.*

Today, certain people file for bankruptcy, businesses and individuals,
and it no longer has the stigma it once had.
Now it's almost considered wise, a way to
regroup and come back again.
- David Norman Dinkins

Introduction

After scrapping, amending, and consolidating plethora of laws relating to Insolvency, resolution and liquidation of individual and business enterprises the Indian government introduced an innovative piece of legislation i.e. the IBC 2016.The Indian Contract Act, 1872, The Code of Civil Procedure, 1908, winding-up provisions under the Companies Act, 1956, Sick Industrial Companies (Special Provisions), Act, 1985, Recovery of Debt Due to Banks and Financial Institutions Act, 1993, Securitization, Securitization and Reconstruction of Financial Assets and Enforcement of Security Interest Act, 2002(SARFASI) and the Corporations Act of 2013 was not proving to be very helpful for companies in respect of debt restructuring, asset seizure and sale for repayment of outstanding loans, or company reconstitution. Moreover, the Presidency Towns Insolvency Act of 1909 (PTI ACT) and the Provincial Insolvency Act of 1920 (PI Act), which govern individual insolvency resolution, did not fulfill the changing needs of the time. This has hampered the lender's confidence and the development of India's credit markets. To address the troubling inadequacies in India's existing staggered Insolvency laws, the government enacted the Code, a single piece of legislation that allows debt-ridden businesses to reorganize and resolve their debts in order to maximize the value of their assets in a reasonable timeframe. The Code would enhance legal clarity and make it simpler for stakeholders who are affected by business failure or debt incapacity to enforce consistent and coherent provisions. IPs is a regulated team of experts, who perform a large number of activities to complete the Insolvency Resolution Process, are among the most important pillars of the Code.

Role of IPs: Historical Perspective

Insolvency laws in India were created initially for individuals and subsequently expanded to cover businesses. Individual insolvency in India is governed by two British-era Statutes: the PTI Act which governs the Presidency

Towns of Calcutta, Bombay, and Madras, and the PI Act which governs the whole of India outside of these towns. The body of the legislation as set forth in the two Acts is similar. The court may appoint an official assignee/official receiver under Section 17 of the PTI Act and Section 57 of the PI Act, to carry out insolvency procedures. Official Liquidators connected to the High Court are appointed in the case of companies under Companies Act, 1956 (Section 448), to carry out the liquidation of companies ordered by the High Court to be wound up, Companies Act of 2013 (Section 275), made certain changes.

A "company liquidator" must be selected from a team of professionals maintained by the central government, whether the company is being wound up by NCLT or voluntarily.

The Sick Industrial Companies (special provisions) Act of 1985 established an 'operating agency' to assist in the formulation of a scheme for the sick company's rehabilitation. Any governmental financial institution, state-level institution, scheduled bank, or other person designated by the Board as its operating agency by general or special order.[1] The Companies Act of 2013 contains measures for the revival and rehabilitation of sick businesses under Chapter XIX.[2] The National Company Law Tribunal is permitted by section 259 of this Act to appoint an Interim Administrator or Company Administrator from a data bank maintained by the central government or any institute or agency authorized by the central government, which includes the names of company secretaries, chartered accountants, cost accountants, and other professionals, in the manner prescribed. For the appointment of interim and corporate administrators, the Tribunal may impose specific terms and conditions. These provisions have now been abolished by the IBC.

However, as a consequence of the above discussion a specialized professional has always been a participant in the resolution or liquidation process; there has been a progressive trend to increase professional engagement in the insolvency procedure. The IBC, 2016, meets this requirement by incorporating IPs into the insolvency resolution processes for individuals and corporations,

Eligibility Criteria for IPs

The criteria for becoming an IP are, an individual must be a resident of India, a major, of sound mind, and not insolvent, as well as having the qualifications and experience specified by the Board.[3] He has not been found guilty of a crime punishable by a term of imprisonment of more than six months or any crime involving moral turpitude, and his sentence has not been imposed for more than five years.[4] Within twelve months of the date on which he submitted his application for enrollment with the Insolvency Professional Agency (IPA), he must clear the IBBI's Limited Insolvency Examination. He must have undergone a pre-registration educational course, as well as the National Insolvency Program and Graduate Insolvency Program, all of which have been recognized by the Board. He must have fifteen years of managerial experience or chartered accountant with ten years of experience, company secretary, cost accountant, or advocate after receiving a Bachelor's degree from a university.[5] If the IBBI is satisfied with the documents provided by the application, they will issue a certificate of registration to the applicant to carry out IP operations.[6]

Role of IPs under the IBC

In India, the IBC 2016 created the profession and regulatory framework for IPs. The IBC has opened a new era in the Indian economy, with a shift from debtor-in-possession to creditor-in-control frameworks, in which IP take over management and control of the Corporate Debtor (CD) as component of the resolution process and coordinate its management and operations with its financial creditors. A person who is enrolled as a member of an IPA under section 206 of the Code and registered with the Board as an insolvency professional under section 207 of the Code is referred to as an IP.[7] Only an IP is eligible to operate as an IRP,[8] RP, liquidator, or bankruptcy trustee under the IBC.[9] Without being a member of an IPA and being registered with the Insolvency Bankruptcy Board of India (IBBI), no one can render IP services.[10] The IPs is regulated by a two-tier regulatory system, with the IBBI acting as the prime

regulator and IPAs serving as frontline regulators.

The IBBI is responsible for monitoring the activities of IPAs, which regulate and monitor the performance of IPs in conformity with the IBC.[11] No one may render IP services unless they are a member of an IPA and have registered with the IBBI, according to the Code.[12] After being a member of an IPA, an individual should next register with the IBBI in the manner prescribed by the regulations, after paying the required fee.[13] The IP Regulations,[14] which control the registration, regulation, and supervision of IPs, and the IPA Regulations,[15] which govern the registration, regulation, and oversight of IPAs, both have been notified by the IBBI. IPs that has been registered will carry out their responsibilities in both corporate and individual insolvency and bankruptcy cases.

Role of an IP in CIRP

An IP can act as an IRP or a RP to conduct the CDs overall CIRP.[16] During this period, he will manage the functions of the CD, exercises the Board of Directors powers,[17] and complies with all relevant laws on behalf of CD. To facilitate the CIRP, the RP shall immediately take control and charge of all assets of the CD, including all business records.[18] He protects and preserves the CD's assets and also the CD's ongoing business operations,[19] including public announcements, claim verification,[20] information memorandum preparation,[21] interim financing,[22] appointment of Valuers,[23] inviting prospective lenders, investors, and other interested parties to put forward resolution plans, [24] verifying each claim, and maintaining a list of creditors along with their amount of claim.[25] The Supreme Court of India, in *Committee of Creditors of Essar Steel India Limited v. Satish Kumar Gupta and Others,*[26] stated unequivocally that the role of the RP is simply to collect and admit claims, not to adjudicate. In *Swiss Ribbons Pvt. Ltd. & Anr Vs Union of India,*[27] SC stated that the RP's sole responsibility is to collect all creditors' claims. The Apex Court pointed out that the RP only has administrative instead of quasi-judicial powers. It is only in her administrative role that she uses her discretion in verifying claims. That implies he/she can't determine whether or not to accept the creditors' claims. The Company of Creditors (COC) is responsible for negotiating and deciding on these claims. So, under the IBC, the role and responsibility of the RP is administrative instead of adjudicatory. RP can also appoint accountants, lawyers, and other experts to help him,[28] enter into contracts on CD's behalf or amend contracts entered into prior to the beginning of the CIRP,[29] and look for orders from the AA if he finds any favorable, undervalued, extortionate, or fraudulent transaction.[30] IBBI and IPA are now able to monitor IP performance according to the Code.[31] In CIRP, the RP's functions will include ensuring process transparency and fairness, as well as protecting stakeholders', companies', and the public's interests, as well as ensuring process compliance with the IBC. He works as a liaison between the AA and the COC, as well as other stakeholders.

Role of IPs in Liquidation Process

The IP, who has been appointed by a CIRP, will act as a liquidator. [32] The liquidator has full power over the board of directors, key management personnel, and partners of the CD form the date of appointment.[33] He must publish notifications in the newspaper, on the CD's website, and on the IBBI's website inviting claims in order to carry out his duties as a liquidator.[34] He shall receive or assemble the claims of creditors,[35] verify all claims of creditors[36] and he may admit or reject the claims.[37] He takes custody or control of the CD's assets and forms a liquidation estate,[38] evaluates the assets and property of the CD.[39] In collaboration with the Stakeholder's Consultation Committee, he offers to sell the assets of the liquidation estate at public auction,[40] and if necessary, seeks professional support in carrying out his responsibilities, obligations, and tasks.[41] The sale profits will be distributed to the stakeholders according to the waterfall process by the liquidator.[42] He is required to maintain cash book, ledger and various registers for assets of CD prepare reports and submit before AA. In the event of a preferential, undervalued, extortionate, or fraudulent transaction, he may file a complaint and seek directions from the AA.[43] When the liquidation procedure is over, the liquidator

submits an application to the AA, together with the final report, to either close the liquidation process or dissolution the CD.[44]

Role of IPs relating to the Individual and Bankruptcy of Individuals

The provisions relating to the insolvency and bankruptcy of individuals and partnership firms are enshrining in part III (section 78 to 187) of the Code. These provisions will replace the century old legislation PTI Act and PI Act. The Code sets three procedures for resolving individual insolvencies - fresh start process, insolvency resolution and bankruptcy process.[45] Debt Recovery Tribunal (DRT) will be the AA and Debt Recovery Appellate Tribunal (DRAT) will be the appellate authority for individual and firms.[46] The 'fresh start' will apply to individual whose gross annual income is not more than sixty thousand rupees,[47] assets value does not go beyond twenty thousand rupees,[48] debt amount does not go beyond thirty five thousand rupees and do not have a dwelling unit.[49] An IP in capacity of RP can examine the application of debtor who has committed default and present a report before the AA by recommending acceptance or denial the application.[50] After considering the report of the RP, the AA passes an order, whether the application is accepted or rejected.

In case of insolvency resolution process (the process), debtors and creditors collectively renegotiate a refund plan under the management of an RP. The debtor or a creditor may make an application for commencement of the process.[51] The RP shall examine the application of debtor or creditor and present a report to the AA recommending for approval or refusal of the application.[52] If the AA approves the application, a public notice is issued inviting all creditors to file claims.[53] In consultation with the RP, the debtor then sets a repayment plan.[54] If the repayment plan is accepted by more than three-fourth in value of the creditors,[55] and thereafter by the AA, the RP oversee the implementation of the repayment plan.[56] On implementation of the refund plan the RP shall apply to the AA for discharge order in relation to the debt and the AA may issues a discharge order.[57]

In case of failure of resolution process or refund plan is not implemented, a creditor independently or mutually with other creditors or by a debtor may make a submission for the initiation of bankruptcy process to the AA.[58] If the submission is admitted the AA passes a bankruptcy order and appoints an IP as the Bankruptcy Trustee (BT) for the bankruptcy process.[59] On the passing of the bankruptcy order the estate of the bankrupt shall vest in the BT.[60] In case bankruptcy order passed on an application by creditor the bankrupt shall submit statement of financial position to the BT.[61] Thereafter BT, prepare a list of creditors of the bankrupt on the basis of the information disclosed by the bankrupt.[62] He investigates the affairs of the bankrupt, realizing and distributing the proceeds in accordance with the provision of Chapter V of the Code.[63] On completion of the administration and distribution of the estate of the bankrupt, he shall arrange a meeting of the COC and present a report for approval.[64]

On expiration of one year from the bankruptcy commencement date[65] or within seven days of the endorsement of the COC the BT shall submit an application to the AA for a release order[66] and the AA shall pass a release order.[67] The release order shall discharge the bankrupt/debtor from all the bankruptcy debts.[68]

Disciplinary proceedings against insolvency professionals

Even though a proper investigation is conducted prior to any IP being appointed as an RP, IRP, or Liquidator, there is reason for concern when the IP violates any of the IBC's provisions after being appointed. The power of the IBBI to initiate disciplinary measures against IP's reduces the risk of abusing their powers or mandate. The IBBI may initiate such action in response to a complaint or on its own accord. The IBBI accepts complaints from anyone who has been affected by an IP.[69] When the board receives a complaint, it may appoint any person or individuals to function as Investigating Authority,[70] which is responsible for presenting a report to the IBBI and forming an opinion on whether the Code's requirements were violated. If the IBBI is satisfied with the findings of such report as well as other

materials on record, it issues a show cause notice to the IPA or its member[71] for adjudication by the board's disciplinary committee.[72] The disciplinary committee may take any of the following actions against the IP if it finds sufficient reason after examining the report:

- Suspend or cancel the registration of the IP or, IPA or Information Utility.[73]
- Three times the amount of loss caused, or likely to be incurred, to those affected as a result of the violation.[74]
- Three times the amount of the unlawful profit made as a consequence of the violation, whichever is greater.[75]

The total amount of the penalty inflicted should not exceed one crore rupees in cases where the loss or unlawful profit is not quantifiable.[76]

The IBBI has the authority to order any person who has made unlawful gain or averted loss by engaging in any activity in contravention of this Code or its rules or regulations to disgorge an amount equal to such gain or aversion of loss.[77] It's important to note that an IP, who has been issued a show cause notice by the IBBI, initiating disciplinary proceedings, is not allowed to accept any new assignments until the disciplinary proceedings against him/her are completed.[78] The power provided to the COC to replace or remove the concerned IP at any time during the CIRP is another protection in this regard.[79]

Some challenges faced by IPs and suggestions:

Despite of various safeguards placed into the Code to enable and facilitate IPs functions, IP's have encounter problems in the day-to-day management of companies undergoing a CIRP in few circumstances.

- Workers, suppliers, promoters, and person associated with the management of the CD have refused to cooperate with Resolution Professional (RP) in certain cases, particularly where payments and salaries of workers have been due for a long time, even before the start of CIRP. IBC may impose a punishment of minimum three years and maximum five years imprisonment and/or a fine of minimum 100,000 (ten thousand) rupees and maximum 10, 00,000 (ten million) rupees when RP has filed a non-cooperation petition before the AA against the Company's suspended management during CIRP. Another significant challenge for IPs during CIRP is dealing with incomplete information and records, as well as completing extensive and time-consuming compliance checks and corrections within tight timeframes. The government should enhance the penal provision under IBC to facilitate the functions of RP.
- .IP's are responsible of the whole CIRP and the operations of the CD, not the creditors on whose instance IP is appointed. If a loss occurs as a consequence of a failure to sell goods on time or for any other cause that damages CD assets, the IP in charge of the CD's business has responsibility. To meet these challenges, IPs would need to appoint management professionals from various sectors.
- The RP is immediately vested with the powers and responsibilities of the CD's Board of Directors or partners, as well as management of the CD's affairs. He can appoint accountants, lawyers, and other experts to protect and look after the CD's assets, including the debtor's business operations. The RPs has been constrained by a lack of clarity on who can be appointed, what the nature of such appointments should be, their remuneration, and so on. The IBBI may consider issuing guidelines on such appointments in order to ensure that this provision is efficiently applied and that such appointments are fair.

Conclusion

In Insolvency Resolution processes the function of IPs are extremely significant, because they act as agents of the state. These professionals must be regulated, and a lack of trust in their services will weaken confidence in the overall insolvency resolution process. IP's are in charge of managing the debtor company and are accountable for their activities to the COC and the AA. Thus, IPs must carry out their duties fairly and within well-defined barriers of the profession. They should report on their assignments to IPA and IBBI on a routine basis. They must also have

the required skills, knowledge, and competence to ensure that processes run smoothly and fulfills the obligations and responsibilities that have been given to them. The IBBI may provide IPA's enough flexibility to compete on parameters including member quality, entry requirements, code of conduct, and grievance resolution procedure. This profession will be shaped only by the continuous interaction between IBBI and market forces. As the Code is still in its early hours, and its success will be measured in large part by the quality of IPs and how efficiently they perform their duties under the Code.

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GENDERING THE DIGITAL DIVIDE IN INDIA

A. Samudra
Department of Economics, RTM Nagpur University, Humanities Building, MJP University Campus, Amravati Road, Nagpur
acsamudra@gmail.com

ABSTRACT

This paper describes the digital divide between men and women in India. The recent pandemic has digitalized the world faster than was anticipated. It has been found that women are somewhere at a loss as they have inequitable access and skills to use digital devices. There is scarce gender disaggregated data available in India on access and usage of digital devices in India. The paper has uses the data published by National Family Health Survey 5 published by Ministry of Health & Social Welfare, Government of India to analyze the growth of access of digital devices by women in India and also the gender gap in access and usage of internet. The first and second order digital divide is further explored by correlating the significant factors that have an impact on gender digital divide in India. The paper has also divide the states in four to identify and reduce this gender digital gap and achieve meaningful outcomes.

Keywords: *gender digital divide, India, gender gap, mobile access, internet usage*

Introduction

"I measure the progress of a community by the degree of progress which women have achieved"- opined the architect of the Indian Constitution Dr. B.R. Ambedkar. India today aspires to become a 5 trillion dollar economy and intends to exploit its demographic advantage. Women form 48 percent of Indian population and the call for including women in the growth process of the economy has been advocated by all quarters. To a large extent, our nation has been successful in empowering women and ensured their active participation in the growth trajectory of the economy and also tried to ensure that the gains from it are equally shared by Indian women.

Inspite of various initiatives taken up at the global and national level, new challenges emerge in attaining equity and equality of women in the growth process hindering their inclusive growth. The latest challenge in achieving this goal being: fast evolving Information Technology and its adoption at all levels. World Economic Forum estimates that by 2022, 60% of global GDP will be digitized. Digital technology has brought a sea change in the life of people in all walks of life. The availability of low cost devices and the exponential growth of internet due to cheap data plan have ensured the penetration of this technology at the grass root levels.

Internet and Mobile Association of India in their report "Internet for All" in 2017, apart from highlighting the exponential growth in internet penetration particularly through small screen devices, has also reported the gap in use of this technology between men and women. The report states that only 30 percent of internet users in India are women and the situation may be probably more unequal in the rural areas. The grey area lies in the overwhelming variation amongst the men and women users of the digital technology in India.

OECD (2001) has defined "digital divide" as the gap between individuals, households, businesses and geographic areas at different socio-economic levels with regard to both their opportunities to access information and communication technologies (ICTs) and to their us e of the Internet for a wide variety of activities. Latimer (2001) in his report to New York State Forum for Information Resources said that social gaps in the society cause digital divide, but the digital divide in turn may intensify existing social gaps and may create new ones as well. UN Women (2005) defines the term "digital gender divide" as the types of gender differences in resources and capabilities to access and effectively utilise ICTs within and between countries, regions, sectors and socio-economic groups.

Mossberger et al. (2003) suggested three different manifestations of digital inequality: first, a skills divide related to the individual ability to handle computers and the Internet and to get access to information; second, an economic opportunity divide resulting from people's inability to participate in Internet-

based education, training, and employment opportunities; and third, a democratic divide due to the inability to engage in e-government. Since 2014, India has experienced the implementation of government's various programs through extensive use of technology.

The concept of e-governance has taken center stage in India. Indians today own more digital devices than a decade back and the access to internet is to a great extent through mobile devices. Having said that, it is also observed that women are less assimilated in this digital transformation and probably because of this the desired outcome of inclusion may not be achieved. Owning a digital device which can be a Computer/laptop, Tablets, Notebooks or smart phones, is still a household decision and women are generally neither a user or a dormant user nor an influencer in the decision making process of purchase of these devices. They are equally reluctant to use digital technology be it for education e.g. various MOOCs being conducted by MHRD, economic opportunities e.g. using this technology for entrepreneurship through Mahilaa e-Haats maintained by Ministry of Women and Child Welfare or for digital financial transactions e.g. using BHIM for money transfer.

This divide gets further accentuated in the rural areas where many times women and girls are not even allowed to have a personal mobile phone. Even though in urban areas the first order gender digital divide i.e. difference in access to digital devices may be less but the second order digital divide i.e. difference in the use and functionality is of great concern. The digital literacy and usage amongst women in urban areas to a great extent has got itself limited to use of social networking apps only. Hence probably the outcomes of digital literacy and the opportunities associated with it leave much to be desired.

Ministry of Health & Family Welfare in the recently released National Family & Health Survey -5 has for the first time collected data on the internet usage by men & women in various states of the country along with the data on mobile phone ownership by women and measures of women empowerment. The objective of the paper is to research on this secondary data to measure the gender digital divide in ownership, ability and access of ICT devices and tools. The survey which was conducted in 707 districts of India with an approximate sample size of 610,000 households is being used to understand the gaps and disparities in digital connectivity in urban and rural Indian women.

Literature review

Antonio A and Tuffley D (2014) have reported that in developing countries women have the desire and capacity to engage themselves more in ICT but the socio-cultural factors inhibit these women to exploit their full potential. They have advocated the need education of women to address this issue and have also explained that how free online education can play a decisive role in bridging this divide.

The gender divide in usage of ICT is not limited to less educated but can be clearly seen at all levels .Tsvere M et al(2014) in their research on university academia in Zimbabwe have found significant difference in usage of intent in university context. The study found a significant relationship in gender and internet usage where male academics in the University used more internet for research, communicating with students and information seeking behaviour than female teachers.

The world is seeing a structural transformation with Industrial Revolution 4.0 moving the world of work towards automation, platform businesses and increased used of artificial intelligence. This digital transformation can lead to many leapfrogging opportunities to women. But the challenge remains of gender digital gap around the world. OECD (2018) have identified various factors inhibiting reduction of this gap, some of thembeing: hurdles to access, affordability, lack of education as well as inherent biases and socio-cultural norms curtail women and girls' ability to benefit from the opportunities offered by the digital transformation. Apart from these the Report also adds that the girls' relatively lower educational enrolment in those disciplines that would allow them to perform well in a digital and information and communication technologies along with women's and girls' limited use of digital tools and relatively scarcer presence or activity on platforms – e.g. for business purposes – suggest a potential

scenario of widening gaps and greater inequality, especially in disadvantaged areas.

Using a Van Dijk's causal model Maseih (2018) brought out a causal relationship leading to gender digital divide in India and China. The personal and positional inequalities, inequalities in distribution of resources leads to difference in access to ICT and hence the level of participation in the society. Policy initiated by these two countries were studied to understand that how these policies address the issues of digital divide. India's digital divide was mainly attributed to vast geographical diversity which leads to rural/urban division, vast gender divide with 41 percent of India women reported to have limited internet access and the challenge of language barrier as most of the software, websites and other resources are in English.

United Nations University (2019) has brought out very meaningful insights in gender digital divide. The report states that the gender digital divide can no more limit itself in only understanding the extent of availability of ICTs but has to translate into a meaningful access for women. The research also concluded that the difference in mobile phone ownership and use by women are two most important indicators to disadvantage ofwomen in access to ICTs. The report has stated that as per the GSMA estimates that in low- and middle-income countries, women are 26% less likely to use mobile internet than me

The use of digital technology by women can be considered as a novel way of empowering them. Successful ICT based micro enterprises like DTP works, ICT education managed by poor educated women of the region under the Kudumbashree Project in Kerala has proved that the digital technology offers many opportunities to all sections of the society and can go a long way in poverty alleviation and women empowerment(Prasad, P. N. and Sreedevi, V. 2007).

Paul A. et al (2015) found that the use of ICT by women is essentially determined by the social and cultural context rather than the demographic factors, the length of time of use of ICT and the extent of access to ICT. The results also pointed out the women preferred more user friendly devices in order to increase their use and greater role of support systems in encouraging women to increase their ICT know how.

Women face a lot of barriers studying in ICT field and they lag behind men in adopting ICT for their business (Bala, 2017). The study also proved that there is a difference in usage of internet and ICT based on the place of residence and the gender. There is also significant difference in making digital financial transactions between men and women in Uttar Pradesh as per the study.

Digital access and literacy can go a long way in empowering women through meaningful outcomes like self employment opportunities and access to education and information to health issues (Vishwanath, 2017) in even states like Uttar Pradesh which is known for its patriarchy.

Pioneering work on gender digital divide in India by Gurumurty and Chami (2018) has brought to notice that even though Digital India program has been showcased as a social revolution but lack of gender disaggregated data on access and usage of internet has made it difficult to quantify the outcomes of the program. The research has found a distinctive gender gap in access which further increases the existing divides in education, employment and income between women and men.

Tapashi D (2018) found digital divide in India at various levels. A secondary data base study a digital divide dos found in internet usage between man and women where rate of Internet use of males is higher than that of females and significant gap between rural and urban. The impact of Digital, India program was however not calculated under this research.

Impact assessment of National digital literacy Mission reported the gap between the number of male and female trainees to the extent of 23 percent even though the scheme prefers training a female household member to be digitally literate. The outcomes of the NDLM as per this report conducted by Council for Social Development (2019) were divides in the purpose of usage of digital device, day to day application of digital device and overall benefit of the training. Maharashtra got a score of 0.39 in the overall outcome as compared to the national score of 0.41.

The digital capability divide is greater between men and women as it is found that the men are more likely to be using advanced applications and those which require internet access and the pattern gets repeated for rural and urban divide as well (Singh, 2019)

Methodology

The objective of the research is to determine the meaningful usage of the digital devices by women in India. It has been documented by grey literature that there definitely exists a gap in ownership digital devices known as the first order gender digital divide. This divide gets further accentuated in rural area. However, the problem of this divide does not end with the ownership of a digital device, but the usage of the device and internet for meaningful outcomes is of greater importance. The gap in meaningful usage of the ICT is known as second order digital divide.

Recently released data by Ministry of Health and Family welfare on National Family Health Survey is being used to determine the gap in the eighteen states of India.

The following research questions are addressed:

1. What is the status of access to digital devices by women in India which can be termed as device opportunity?
2. What is the gender gap in usage of digital devices for internet access?
3. What factors are predominant in ownership and usage of digital devices?
4. To what extent ownership of devices is related to Internet use and its outcomes?
5. Is there equitable access and usage of the digital devices by women across India?

The following are hypothesized to answer the research questions and the available NHFS-5 data is explored accordingly.

H1: Income contributes positively to device opportunity and device usage.

H2: Educational level of attainment contributes positively to device opportunity and device usage

H3: There is a gap between the access and effective usage of devices by women across India.

Result & Discussion

Access to digital/ mobile devices of women:

A comparison of the data of both NFHS 4 and NFHS 5 on ownership of mobile phones indicates an increase in the mobile phones owned by women. Table 1 gives the growth in mobile phones owned by women in different states on India from NFHS 4 to NFHS5.

Across a period of 5 years from NFHS 4 which was published in 2015-16 to NHFS 5 published in 2019-20 there has been an appreciable rise in the ownership mobile phone as a digital device by women with an average growth of eighteen percent across India.

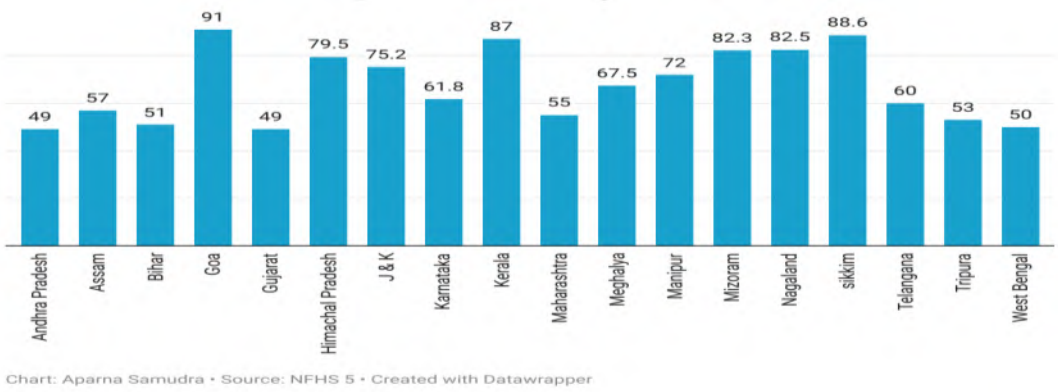
Table 1: Percentage Growth in mobile phone ownership by women

State	Percentage growth in mobile phone ownership
Andhra Pradesh	35%
Assam	24%
Bihar	25%
Goa	12%
Gujarat	2%
Himachal Pradesh	8%
J & K	40%
Karnataka	31%
Kerala	7%
Maharashtra	20%
Meghalaya	5%
Manipur	14%
Mizoram	7%
Nagaland	17%
Sikkim	11%
Telangana	27%
Tripura	21%
West Bengal	20%

Source: Authors calculation using NFHS5 Data

The access of digital devices is however uneven across the eighteen states as can be seen from Figure 1, wherein Goa has 91 percent of its women owning a mobile phone and with only forty nine percent of women in Andhra Pradesh and Gujarat having one.

Figure 1: Uneven access to digital devices by women in India



Source: Authors calculation using NFHS5 Data

The economic and social factors are an important determinant of the digital inclusion of women across the globe (van Deursen, A. J., & van Dijk, J. A. (2019); Barboni G *et al*(2018)). The hypothesis of this research was to find out whether these factors play a significant role in device opportunity amongst women in India. To study device opportunity, the percentage of women owning a mobile phone is taken as a variable which is then correlated with the per capita state domestic product as in indicator of level of income. The correlation coefficient between these two variables indicates that income positively affects the device access by women. Income and mobile phone ownership by women were found to be positively correlated, r (18) =0.487, p = .04 at 0.05 significance level.

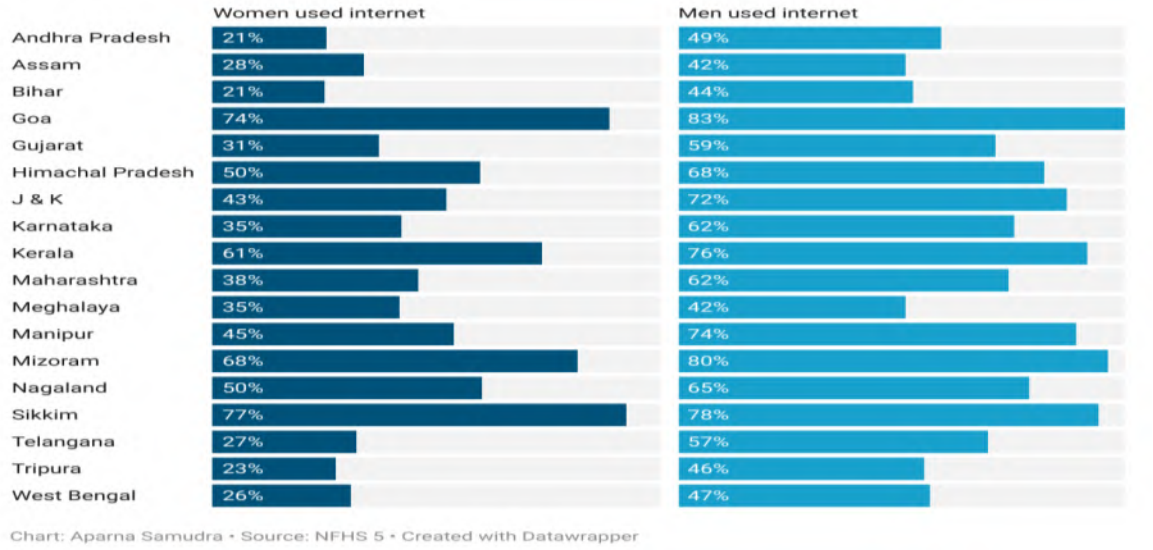
Educational attainment of not only women but also men is considered as an indicator of women empowerment and progress. Barboni G *et al*(20180 classified education-related barriers as economic and not social as human capital is typically an important input to economic activity (Becker, 1962). Even NHFS in its survey has found that mobile ownership increases with educational attainment of women across India.

Coefficient of correlation was calculated for mobile phone ownership by women and women literacy rate and male literacy rate. Both female literacy rate and male literacy rate were found to be highly positively correlated with mobile phone ownership by women. As per the data published by NFHS5, the women literacy rate and women mobile phone ownership was strongly positively correlated, $r(18) = 0.776$, $p < .0001$ at 0.05 significance level. There was also strong positive correlation between male literacy rate and women mobile phone ownership $r(18) = 0.772$, $p < .0001$ at 0.05 significance level.

Internet usage gap between men and women

Equitable device opportunity is advocate so that it can translate into meaningful outcomes for women. These outcomes may be in form of economic or social equality through employment outcomes or educational outcomes. NFHS 5 has for the first time collected and published data on percentage of men and women which have ever used internet. Gender gap in usage of internet calculated as a difference between men and women who have ever used internet and is pervading across India. Figure 2 illustrates the gender gap in usage of internet in various states of India. This digital gender gap is as wide as thirty percent in Telangana, Manipur and Jammu & Kashmir as top three stated with highest gender gap in internet access.

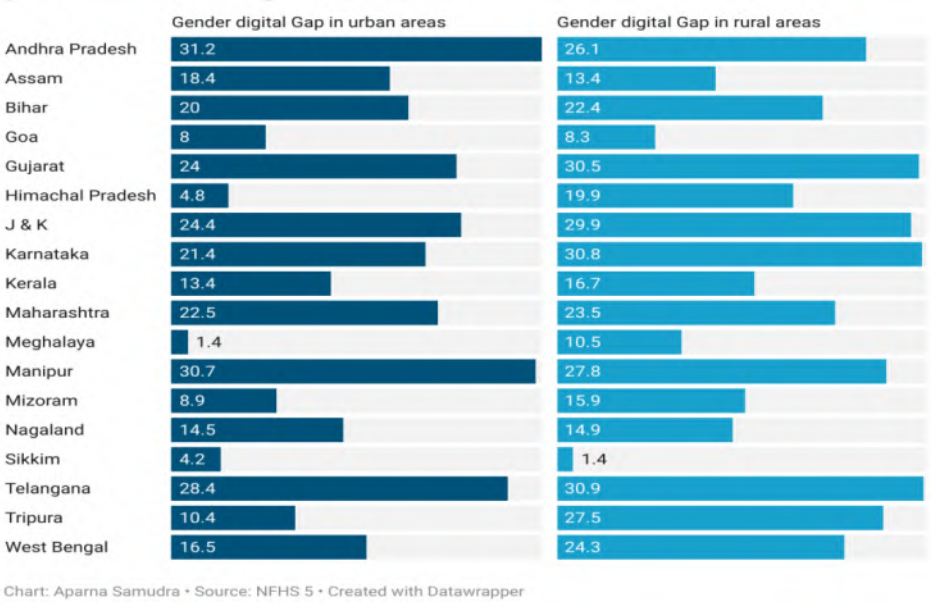
Figure 2: Gender Gap in Usage of Internet in India



Source: Authors calculation using NFHS5 Data

The gender digital divide gets further accentuated between rural and urban areas of the same state. This gap is exceptionally in rural areas on Telangana, Gujarat and Jammu & Kashmir as depicted in Figure 3.

Figure 3: Gender gap in rural and urban areas in usage if internet



Source: Authors calculation using NFHS5 Data

Knowing the reasons for this internet usage gap is of greater importance as plugging these problem areas. Various factors can be considered to be responsible for creating as well as bridging this gender digital divide in usage of internet. Some of these factors for which data has been collected by NHFS 5 can be related to mobile phone ownership, women literacy rate and parameters like households headed by women, women employment rate, participation of owned in household purchase decision making and freedom to use money by women.

In order to evaluate the relationship of the above mentioned factors with the internet usage gap, coefficient of correlation was calculated. Table 2 records the various coefficients of correlation between internet usage gender gap and the above listed factors

Table 2: Coefficients of correlation between internet usage gender gap & probable factors

	Own mobile phone	Women who are literate	Percent of population living households headed by women	Freedom to use money by women	Participation in decision in major household purchases
Internet Usage gender gap	-0.615	-0.602	-0.498	-0.255	-0.639
P value at 0.05 significance level	0.006*	.008*	.0354*	.307	.004*

indicates that the result is significant at $p < .05$
Source: Authors calculation using NFHS5 Data

Mobile phone ownership, literacy rate of women, women head of the household and participation of women in major household purchase have a strong and significant impact on reducing the gender digital divide in internet usage.

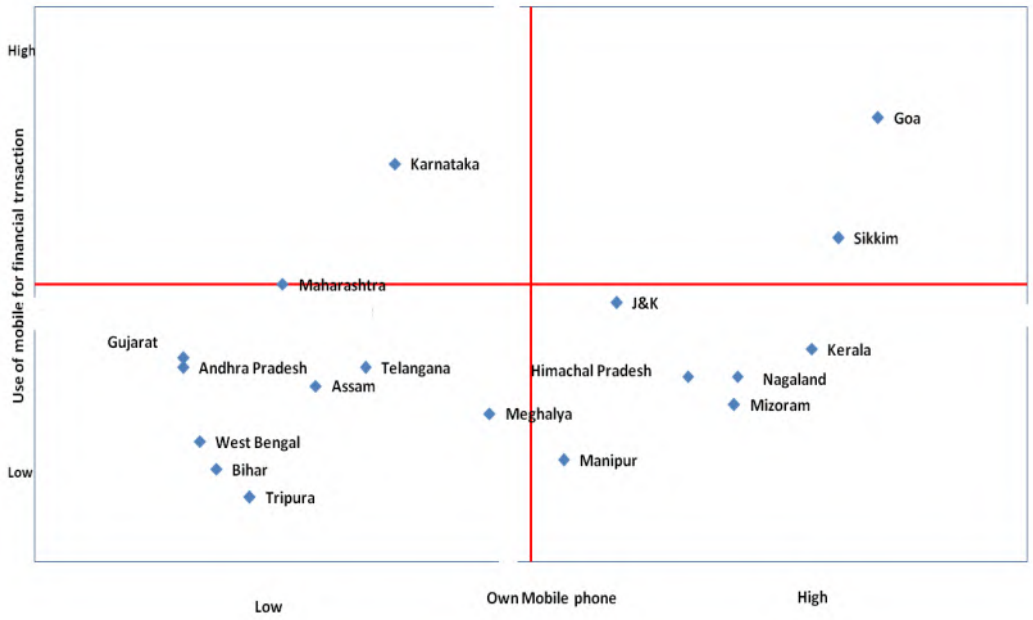
Meaningful usage of internet by women

A pertinent research question is- "Does connectivity always results in meaningful outcomes for women?" As discussed in the previous part of the paper, the access to digital devices (in this case mobile phones) with women has increased but there exists a gender gap in usage of internet. The gap is further higher in rural areas of the country. However it would be interesting to know that do women who have skills to use internet use them for desired outcomes or not?

Global Findex Report 2017 published by World Bank has also highlighted the importance of using mobile phones for financial transactions to ensure financial inclusion and economic independence. As per the report in 2017, 5 percent men used internet to pay bills or buy something online compared to 3 percent women in India.

NFHS 5 has collected data on how many women use mobiles for financial transactions as a parameter for women empowerment. The results of comparison of ownership of mobile phones by women and its use for making financial transactions across the eighteen states are illustrated in figure 4.

Figure 4: Four quadrant approach for gap in usage and meaningful usage by women in India



Source: Authors calculation using NFHS5 Data

The relationship between ownership of mobile phone by women and its use for financial transactions is divided in four quadrants. The quadrants are divided on the basis of level of access to mobile phones and use of these for financial transactions. As visualized in the

Figure 2, the states can be seen in clusters. These quadrants are as follows:

- Quadrant 1: states with low mobile phone ownership and low use of them for financial transactions
- Quadrant 2: states with low mobile phone ownership and high use of them for financial transactions
- Quadrant 3: states with high mobile phone ownership and low use of them for financial transactions
- Quadrant 4: states with high mobile phone ownership and high use of them for financial transactions

Interesting insights are derived by classifying the various states in these four quadrants. States like Bihar, Tripura and West Bengal which lie in Quadrant 1 are those where relatively less proportion women have mobile phones and naturally its use for financial transactions is also low. Whereas states which lie in Quadrant 2 are those where even though women own less mobiles but most of them use it for making financial transactions. On the other hand states like Kerala, Mizoram, and Nagaland are those where women have proportionately higher ownership of mobile phones but counter intuitively use them very less for making financial transactions.

The states on the basis of these four quadrants can be labeled as:

- Strugglers (Low ownership, Low use): Bihar, West Bengal. Tripura, Assam. Telangana, Andhra Pradesh
- Rising stars (Low ownership, High use): Karnataka, Maharashtra
- Laggards (High ownership, Low use): Kerala, Nagaland, Mizoram, J&K, Himachal Pradesh, Manipur, Meghalaya
- Performers (High ownership, High use): Goa, Sikkim

Important policy decisions can be taken keeping in mind the above four quadrants for internet access and usage by women. The four clusters as classified need to have a targeted approach. The states which are strugglers need to have more focus on initially increasing the mobile phone ownership with women whereas the laggard states need to focus more on training for internet usage for meaningful economic and social outcomes.

Conclusion

This study confirms that the gender digital divide is a reality and if not addressed adequately is here to stay for a reasonable time frame. This study has proved that the gender digital divide is not only in a result of economic but also social factors. The first level digital dive in terms of ownership has been documented but the second order divide should be of more concern. A mere adding subscriber for mobile phones does not and will not translate into the desired outcomes by its usage by women. There is an urgent need to priorities targeted policy formulations and frameworks that focus on digital empowerment of women. Digital equity will be an enabling platform for equality an inclusion in a developing country like India.

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PROPERTIES AND CHARACTERISTICS OF NANO PARTICLES IMPREGNATED ALKALI TREATED CALOTROPISGIGANTE A FIBER REINFORCED EPOXY COMPOSITES

R. Jeyapragash[1], V. Srinivasan[2], S. Sathiyamurthy[3] and G.Swaminathan[4]

[1,2]Department of Mechanical Engineering, Bharath University, Chennai, Tamilnadu, India.

[3]Department of Automobile Engineering, Easwari college of Engineering, Chennai, Tamilnadu, India.

[4]Department of Mechanical Engineering, SRM institute of Science & Technology, Ramapuram Campus, Chennai

[1]jaip007@yahoo.com, [4]ssnathan79@gmail.com

ABSTRACT

The presence of particles and fibersas reinforcement in polymer matrix enhances the mechanical behaviours abundantly. The agricultural residues and natural fibers are familiar nowadays due to the fact that the decomposition of materials after life time and eco friendly in nature. The fiber which is extracted from stem of the King's Crown Plant, Calotropis Gigantea is selected as reinforcement in the present investigation. Initially the fiber is treated with sodium hydroxide solution and the CG fiber –epoxy composites was prepared. The properties of alkaline treated CG fiber reinforced epoxy composites were further improved by the addition of nano particles such as Chitosen, Red mud and Rice husk. The properties such as tensile strength, flexural strength, impact toughness, hardness, water absorption, thickness swelling behaviour, specific wear rate and friction coefficient were evaluated and compared. The XRD pattern for chemically treated and particle added CG – EP was illustrated in the present investigation.

***Keywords**:Rice husk particles, tensile strength, flexural strength, impact toughness, hardness, water absorption, thickness swelling behaviour,specific wear rate, friction coefficient.*

1. Introduction

The green fibers and natural particles are effectively used as reinforcement materials in polymer composites in recent years. The three different bio particulates were selected in the present investigation after the detailed literature survey. Chitosan is a sugar that is enriched with natural calcium and obtained from the hard outer skeleton of shellfish, including crab, lobster, and shrimp. The reinforcement of chitozen in composites was done by various researchers in different time (Fan et al(2010) & Arumugam et al(2020)). The introduction of red mud particle influenced the mechanical, damping and chemical resistance properties of banana/polyester hybrid composites and it was studied by Uthayakumar et. al(2014).

The required properties are to be evaluated in polymer composites before using their domestic and industrial applications. In addition to mechanical behaviours, thickness swelling behaviour of particulate composites was also studied (Prithvirajan et al (2016) in previous studies.Balasundaret al (2019)developed eco friendly composites which initiated the introduction of bio particles in polymer composites.The agricultural residues also influenced dimensional stability and tensile behavior of green composites (Chen et al(2020)&Nourbakhsh et al (2014)). The strength of the natural fiber reinforcement is improved by chemical treatment of natural fibers.

Madhu et. al(2020) studied the effect of various chemical treatments of ProsopisJuliflorafibers as composite reinforcement and the physicochemical, thermal, mechanical, and morphological property of composites. The most of the recent studies used red mud particles as reinforcement in composites due to enrichment of alumina and silica in red mud particles (Oiu et al (2020) & Chen at al(2020)).

The friction and wear behaviour composites are studied in addition with mechanical and water absorption studies to state the the effective applications of composites (Aigbodion et al (2012) &Samal et al (2020)).The evaluation of Mechanical and Water Absorption Behavior of Natural Fiber-Reinforced Hybrid Biocomposites was studied by Sekar et al(2020).These previous studies created interest on the development of new variety of nano particles impregnated natural fiber reinforced epoxy composites.

2. Materials, Manufacturing and Testing

2.1. Fiber extraction and treatment

The CG fibres from the one-year-old plant are taken from the stem, and the leaflets are peeled. The stems are bent to the desired length and cured for 5 days at room temperature. The fibres are separated from the dried stems using the manual de-cortication technique, which involves first removing the outer bay, then scraping the fibres out with a knife and drying it. Finally, the fibres are cured for two days before being cut into the necessary length for composite lamina production. The CG crown fibre is washed in water and allowed to dry for two days at room temperature. The fibre is alkali treated with a 5 percent sodium hydroxide concentration for 30 minutes to modify the surface. This treatment removes a certain amount of lignin, oil, and wax from the fibre cell wall's exterior surface. The alkaline treatment increases surface imperfections, resulting in improved mechanical interlocking and more cellulose exposed on the fibre surface, increasing the number of potential reaction sites.

2.2 Particulates preparation and epoxy system

MALCO (Madras Aluminium Company Limited) in Salem, India, produces red mud. When reinforced with an epoxy matrix, the addition of natural organic materials such as more iron oxide, aluminium oxide, and silicon dioxide in red mud increased the value of mechanical characteristics (Vigneshwaran et al) (2019). The usage of calcium oxide enhanced particles may help to increase the composites' static and dynamic mechanical strength. Natural calcium material, such as Chitozen, was used as particle reinforcement since it is abundant and often discarded in landfills. Natural calcium will aid in the efficient utilisation of bio waste in engineering applications. Rice husk (RH) is a waste product produced during agricultural operations that is plentiful in rice-growing nations. It is a natural waste coating that forms around rice grains throughout growth and is removed during rice refining, leaving the husk without any viable attention. Rice husk is a stringy substance that may be used to fill gaps in light-weight polymer composites. It contains natural silica, which has a positive impact on property value.

Calotropis Gigantea (CG) is a plant that grows to a height of 3-5 metres and has oval-shaped light green leaves and a milky stem that is loaded with fibres. Composites are made using fibres taken from the stems of Calotropis Gigantea plants. The TAPPI (Technical Association of the Pulp and Paper Industry) Standard is used to conduct chemical analysis on the extracted CG fibres. During the chemical test, the CG fibres had a cellulose content of 73.8 percent and hemicelluloses of 20.8 percent.

When used in composites, epoxy has excellent moisture barrier properties. When manufacturing fibre reinforced composites, it adheres effectively to fibres. The polymerization process is used to convert liquid resin into a solid phase, and it is carried out by adding a small amount of a reactive curing agent immediately before adding fibres to the liquid mix. One of the curing agents is an amine-based hardener (HY 951), which is used in a 9:1 mixing ratio to prepare the composites. M/S CovaiSeenu& Company, Coimbatore, Tamilnadu, India, provided the epoxy resin (LY 556) and the hardener.

For the alkaline treatment of CG fibres, M/S Spectrum Reagents and Chemicals Private Limited, Edayar, Cochin, India, provided sodium hydroxide pellets. In 800 mL of sodium hydroxide alkaline solution, 30 grams of CG fibre are soaked. The fibres are taken from the solution, washed several times with fresh water, and then rinsed with distilled water to eliminate any remaining NaOH. Chemical tests are carried out on CG fibre after it has been treated with sodium hydroxide solution at a concentration of 5%.

2.3 Compression moulding process

The CG fiber-epoxy composite plates are made using a 30 ton capacity ACE hydraulic compression moulding machine with dimensions of 30 x 30 x 0.3 cm. Mechanical stirring at 20 rpm for 10 minutes at room temperature was used to combine the required weight content of CG fibre, nano particles, and epoxy. According to literature research, the particle content of 20% and fibre content of 30% were chosen as reinforcing percentages. During the manufacturing of short CG fibre

reinforced epoxy composites, a fibre length of 30 mm was used. The manufactured composites were kept at a pressure of 2.6 MPa at a temperature of 80°C for 34 hours, which allowed for consistent curing of the composite sheets. During the composite production, ambient conditions of 280 C and 55 percent relative humidity were observed.

2.4 Testing Equipments

The Tinius Olsen H10KL Dual Column Digital Universal Testing Machine is equipped with a 5KN load cell, which makes it ideal for performing tensile tests in accordance with ASTM D 638 standard specifications. The tensile strength of composite samples was measured using five samples with dimensions of 165 x 13 x 3 mm3. The cross-head speed is adjusted to 1 mm/min, and the average result is recorded as the tensile strength of composite samples.

Flexural tests (Three point bending) are done with the Tinius Olsen H10KL (Column Digital Universal Testing Machine), which is armed with a load cell in the range of 5 KN, as per ASTM D 790 standards. 5 prismatic samples with a length of span of 48 mm are tested at a crosshead speed of 2.5 mm/min. A 3 point flexural test was carried out for the specimen dimensions of 125 × 12.5 × 3 mm3 and five samples of flexural specimen were tested to obtain statistically significant results for each condition.

ASTM D 256 specifies that the impact toughness (Izod) test be performed using a Tinius Olsen (Model 104) impact tester. In addition, the test equipment is equipped with a pendulum with a potential energy ranging from 2.57 J to 2.57 J. The impact strength is determined by testing five unnotched samples with dimensions of 64 x 12.7 x 3 mm3 for each instance, and the average result is recorded as the impact strength. The specimens for the impact test are cut from the manufactured composite and finished to an exact size using sand paper before being submitted for testing. The maximum pendulum capacity and maximum impact velocity of the impact tester are 25 J and 3.46 m/s, respectively. The specimen for testing is constructed as a cantilever beam with a vertical axis, which is then moved by the swing of a pendulum. As a result, the sample is no longer functional. The face of the sample is struck by the pendulum, and a total of 5 samples are examined in this manner.

Hardness test is as an indicator of the mechanical properties of the samples which not only elicits the importance of the surface properties but also friction and wears processes. It is also a simple and quick way to measure the hardness of the material and to obtain the mechanical property of the samples. The hardness test is based on the concept of piercing a sample surface with an indenter and measuring the size of the indentation that results (depth or actual surface area of the indentation).

The hardness of CG fiber-epoxy composites is determined using a Vickers hardness tester with a ball diameter of 2.5 mm and a force of 10 kgf, as described in the following section. The ASTM E10 standard is followed in this Vickers hardness test technique, which uses a specimen with dimensions of 76.2 x 76.2 x 3 mm3 and a prepared specimen with dimensions of 76.2 x 3 mm3. In each specimen, the hardness measurements are obtained at ten distinct locations, and the average value is recorded as the sample hardness, which is expressed in terms of the Vickers Pyramid Number (HV) (i.e. VPN (HV), which stands for Vickers Pyramid Number (HV). It is pushed against a material under pressure by a diamond indenter, which is in the shape of a right pyramid, with a square base and an angle of 136° between opposing sides.

The wear test is conducted as per ASTM G-99 standard and specimens are obtained from the samples of the dimensions 30 ×4 × 4 mm3 having contact with a hardened alloy steel disc with a surface roughness of 0.25–0.30 μm and the experiment is conducted at room temperature. The accurate sizes of the samples are obtained using emery sheet to ensure proper contact between pin and disc with the counter surface. The pin is initially weighed using electronic balance meter at an accuracy of 0.0001g. Sliding wear is measured using weight loss method, in which the difference between the initial and final weights of the specimen is calculated.

Specific wear rate $k_s = \frac{V}{L \times D}$ (mm3/Nm)

where, V is the loss of the volume(mm^3)

L is load (N)
D is the sliding distance (m)
5 samples are tested on each material, and the average of the results is used to determine the amount of wear. Specific wear is assessed by weight loss, which is translated into wear volume, and then the specific wear rate is computed using the equations above and the formulas below.

2.5 XRD set up

The organic materials contained in the boiled egg shell, groundnut shell, rice husk, red mud, and termite mound soil particles were identified by X-ray diffraction analysis. The organic materials included groundnut shell, rice husk, red mud, and termite mound soil particles. The XRD examination was performed using a Pan Analytical Expert Pro (Model: PW3040/60 X'pert PRO, CECRI-Karaikudi) equipment with Cu K (= 1.54) as the reference material. All of the samples were gently consolidated in an aluminium holder, and the scanner operated at 45 kV and 40 milliamps (mA), with diffraction intensities ranging from 10 to 90o at 2, an exposure duration of 120 seconds for each sample, and an exposure step size of 0.06o. The diffraction patterns were evaluated with the help of the X'Pert High Score programme. Figure 1 depicts a photographic picture of an XRD instrument, a hardness tester, and a wear set up for testing.

Figure 1Photographic image of XRD instrument, hardness tester and wear set up

3. Results and Discussion

The mechanical properties of raw, alkali treated CG fiber reinforced nano particles impregnated epoxy composites are given in Table 1. The better value of tensile, flexural and impact toughness of 75.8 MPa, 107.1 MPa and 81.2 kJ/m^2 were obtained in alkaline treated -CG –nano RH–Epoxy composites. The nano particles were prepared using high energy ball milling equipment and mixed with epoxy system which provided better value of mechanical properties to the alkaline treated CG fiber reinforced epoxy composites.

Sl. No	Properties	CG –Epoxy	Alkaline treated CG –Epoxy	Alkaline treated –CG –nano CT– Epoxy	Alkaline treated –CG –nano RM– Epoxy	Alkaline treated –CG – nano RH – Epoxy
1	Tensile strength(MPa)	62.7	64.3	67.9	69.3	78.2
2	Flexural strength(MPa)	60.5	80.3	87.4	89.6	107.1
3	Impact toughness(kJ/m^2)	43.5	56.2	63.8	66.1	81.2

3.1. Mechanical properties of chemically treated &nano particle added CG – EP composites

3.1.1. Tensile strength

Tensile values of CG – EP, alkali treated (NaOH) nano particle added CG – EP composites was shown in Figure 2. The tensile value of CG – EP composites shows low values (62.7 MPa), compared to other composites. Sodium hydroxide treated CG – EP composite increased 2.6 % of the tensile strength. The addition of nano particles (NaoH treated) like chitosan, red mud and rice husk increased the tensile strength of CG – EP composites as 8.3 %, 10.6 % &24.8 % respectively. Maximum hike of tensile strength (78.2 MPa) was found in 55 wt % of CG, % wt % of RH & 40 wt % of EP. Similarly, modulus of CG – EP composites was increased to 9.1 KPa with 5 wt % of rice husk. This is due to good agreement of RH with CG fiber, and higher amount of Si presence leads to hike the tensile behaviour of CG – EP composites (Madhuet al, 2018).

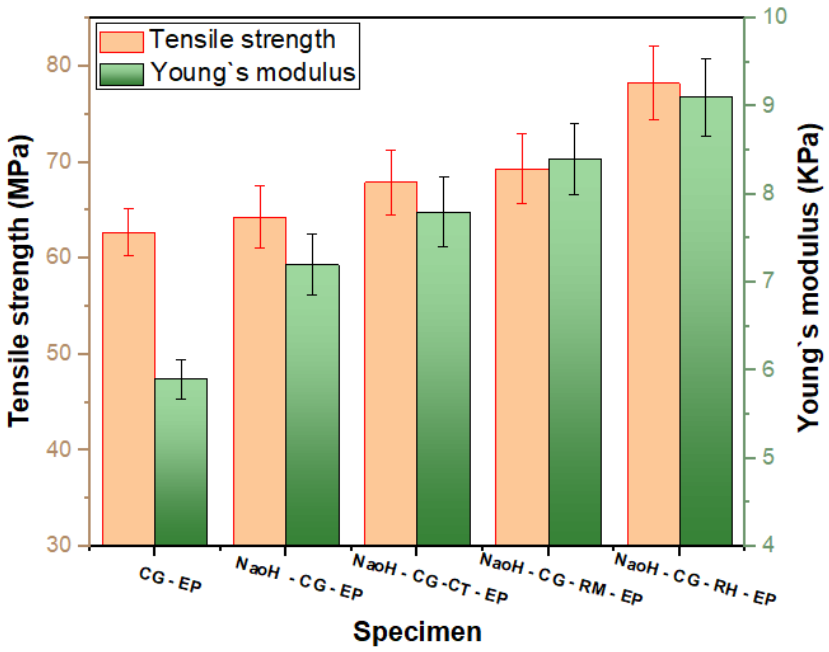

Figure 2 Effect of nanoparticle`s (NaoH treated) addition on tensile strength of CG – EP composites

The reason behind the increasing the tensile strength is, alkali treatment increasing the roughness of the CG fiber, that attributes better mechanical between CG fiber and epoxy matrix and enhances the physical adhesion. This because, basically agricultural waste RH is a high stiffness particle, therefore addition of rice husk increases the strength (Chen et al., 2020 &Prithivirajan et al., 2016). Similarly, chitosan added CG – EP composites, enriching the modulus and tensile behaviour, the same results was witnessed in graphene/chitosan composites (Hailong Fan et al., 2010)

3.1.2. Flexural strength & Impact toughness

The variations in flexural and impact strength of nano particle`s added CG – EP composites was presented in Figure 3. CG – EP composites shows a flexural strength value of 60.5 MPa, whereas, incorporation of nano particle`s (NaOH treated) moderately increasing the flexural strength of 87.4 MPa (CG – CT – EP), 89.6 MPa (CG– RM – EP), 107.1 MPa (CG – RH – EP) respectively, which is 44.5 %,48.1 % & 77.1 % higher than the CG – EP composites. Because, the addition of industrial waste red mud in the polymer its surges the flexural strength, owing to presence of Fe_2O_3& Al_2O_3 in red mud particle, which were used as fine aggregates to bung up the voids during the preparation of composites (Uthayakumar et al., 2014 &Chen et al., 2020) and other side RM deeds as an excellent rubber reinforcing filler,

that enhances the flexural properties of CG – EP composites (Qiu et al., 2020).

In contrast, alkaline treated RH filled CG – EP composites shown highest impact strength (81.2 kJ/m^2 with standard deviation of 4.06), compare to other composites and followed by other nano particles filled CG – EP composites. This was anticipated because RHparticle should be more resistant to crack propagation in the polymer (Nourbakhsh et al., 2014).

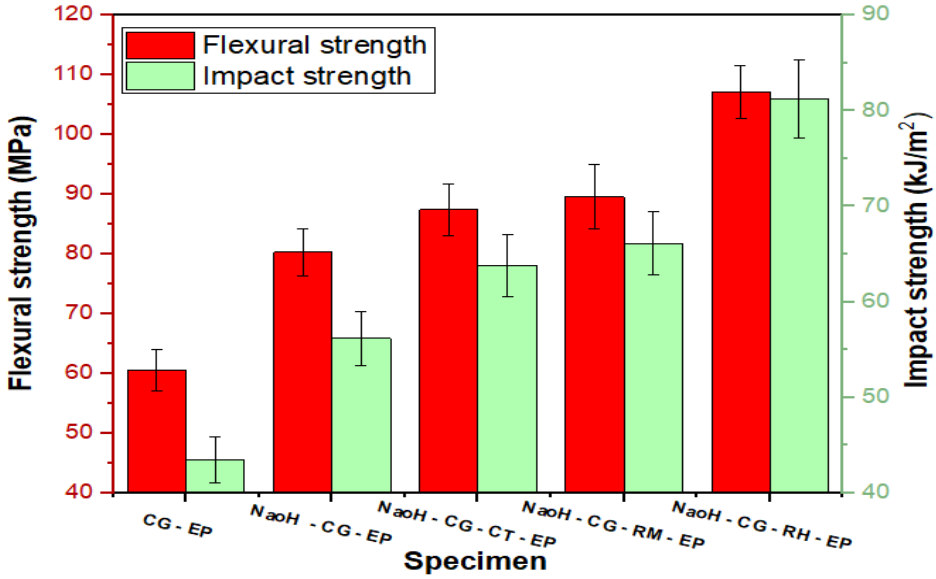

Figure 3 Effect of nanoparticle`s (NaoH treated) addition on flexural & impact strength of CG – EP composites

3.1.3.Hardness

The variations in hardness of particle`s added CG – EP composites was illustrated in Figure 4.The hardness of CG – EP composites are increased from 19 to 28 Hv with addition of chitosan particles. Due to uniform dispersion of chitosan particles in CG – EP composites increasing the hardness of the composites (Arumugam et al., 2020). Similarly, with addition of RH (19 – 24 Hv), RM (19 – 26 Hv), NaoH treated CG – EP (19 – 25 HV) was observed. Addition of red mud increasing the hardness is primarily owed to strong mineral oxides presence in red mud and increases the brittleness of the composites (Vigneshwaran et al., 2020&Samal et al ., 2020).

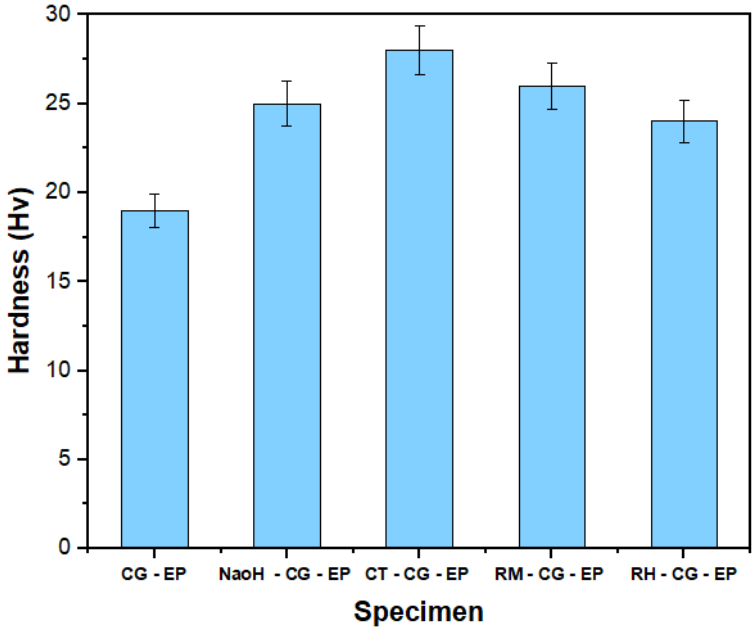

Figure 4 Effect of particle`s addition on hardness of CG – EP composites

3.2XRD analysis

The XRD pattern for chemically treated and particle added CG – EP was illustrated in Figure 5. The pattern clearly indicates the main crystalline peaks for composites occurred at 2θ = 22.8^0 (CG – EP), 2θ = 22.3^0(NaoH CG – EP), 2θ = 34.2^0 (CT – CG – EP), 2θ = 28.2^0 (RM – CG – EP), 2θ = 34.1^0 (RH – CG – EP) respectively, which belongs to the cellouse constitution.

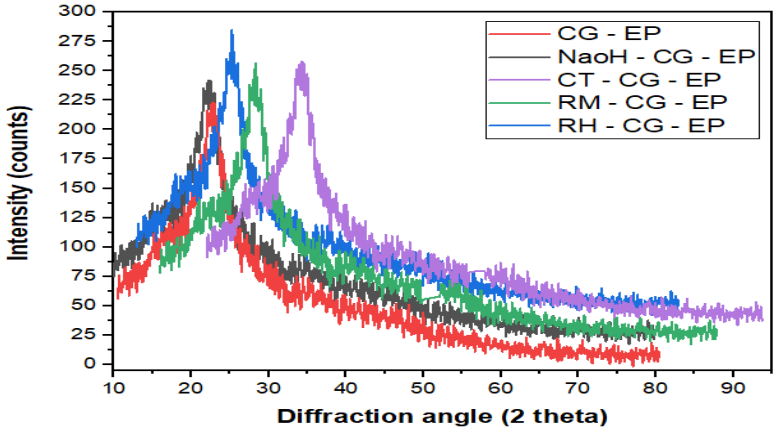

Figure 5 XRD pattern of particle`s added CG – EP composites

The crystalline line (CI) value of CG – EPcomposites was calculated using segal empiric method, values are 33.1 %, and followed by other composites 34.5 %, 48 %, 41.3 % & 46.6 % (Balasundar et al., 2019). It is noticed that, addition of CT & RH particle in CG – EP composites extended the crystalline peak into some greater extent.

3.3. Water absorption& Thickness swelling behaviour

Figure 6 indicates the effect of CG on water absorption of CT/RM/RH/EP composites at 24 ,48 ,72 ,96 ,120 ,144, 168 ,192 ,216 & 240 hrs. Ideally, the % of water absorption grew linearly with increasing the immersion time, after the 7 day`s gradual slowdown in water absorption rate and reached the saturated level finally, commonly this phenomenon is called as equilibrium state. Similar results were perceived with addition rice husk with high density polyethylene (Ruey Shan Chen et al.,2019) and Calotropis gigantea reinforced with Phenol-Formaldehyde composites (Sekar et al.,2020). It is noted that, composites soaked for 10 days, water absorption increased to 26.5% (CG – EP), 25.5% (CT - CG - EP,) 26.5% (RH - CG – EP), 27.5% (RM - CG – EP), 28.5% (NaOH - CG – EP) respectively.

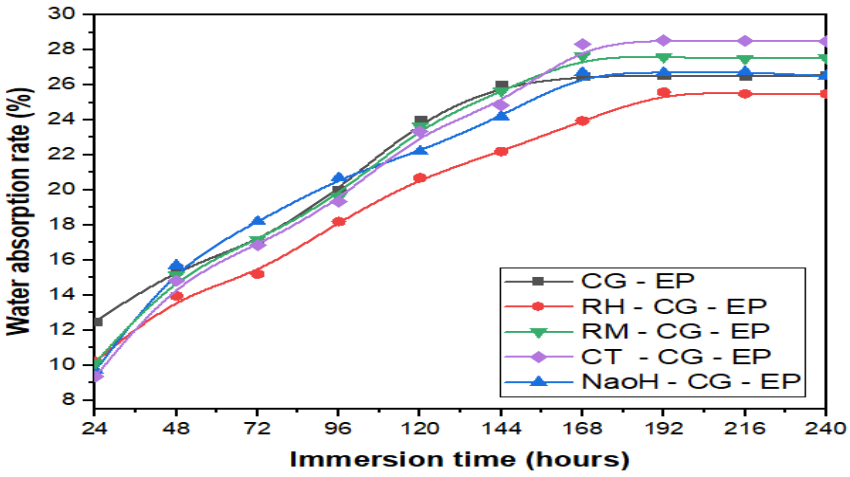

Figure 6 Water absorption of particle`s added CG – EP composites

Higher amount of water absorbed by NaOH - CG – EP, RM - CG – EP and followed by other composites. CG fibres are extracted basically from plant, plant fiber containing a large number of hydroxyl groups, that behind the strong capability of water absorption, leads to

higher water absorption of CG – EP composites (Chen Chen et al., 2020). That's the reason CG system & RM filled composites shown up with least mechanical strength compare to other composite system.

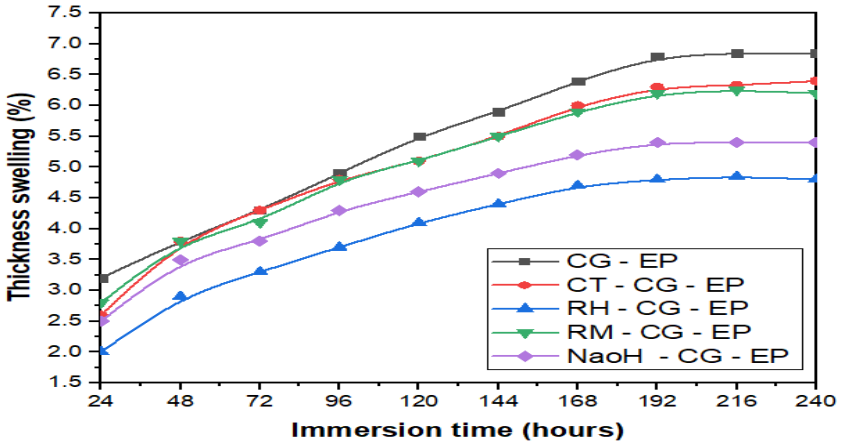

Figure 7 Swelling behaviour of particle`s added CG – EP composites

Figure 7 displays the swelling behaviour of particle`s added CG – EP composites. It is noticed that, similar results were observed in thickness swelling plot with water absorption trend. Particles used in this investigation are plant fiber, agricultural & industrial waste based particles, principally this are kind of cellulosic fiber and natural particle, in that way water or moisture simply built up in the fiber wall, leads to thickness swelling and instability of dimensions (Ruey Shan Chen. Et al., 2020 &Prithivirajan et a., 2016) It can be seen, maximum changes (thickness) in CG – EP (6.8 %), CT– CG – EP (6.3 %) and RM – CG – EP (6.2 %) composites. The particle added composite shown little reduce in swelling, that's reason particle added system shows betterment in mechanical properties.

3.4. Specific wear rate &Friction coefficient

The figure 8&9 illustrates the wear behaviour and friction coefficiency of different filler added CG – EP composites. It is noticed that, increasing the sliding distance (250 – 1250 m), leads to hikein specific wear rate (mm^3/N-m) for all composite system. The minimum wear rate was perceived in NaoH treated CG – EP composites (0.0392 mm^3/N-m) and maximum wear rate in CG – EP system (0.99 mm^3/N-m), which is 96.1 % higher than the treated composites. This is owing to removal of non-cellulosic constitutions from CG fiber.

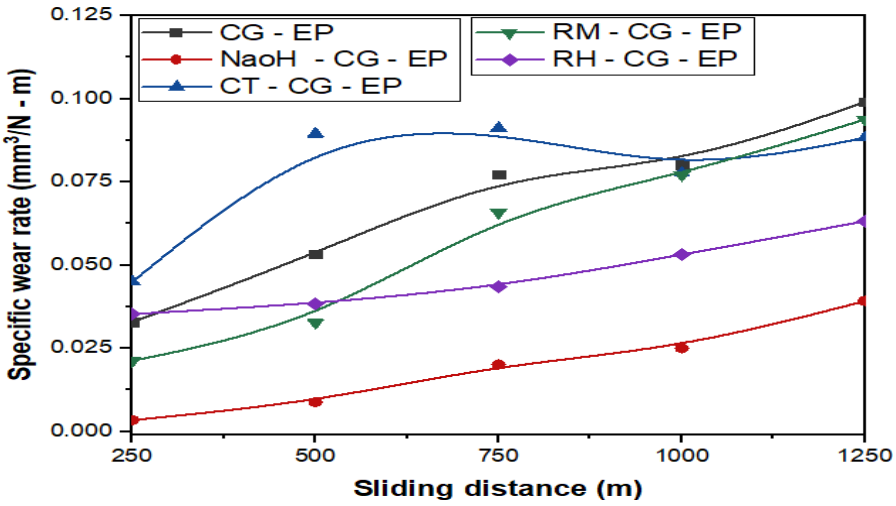

Figure 8 specific wear rate of particle`s added CG – EP composites

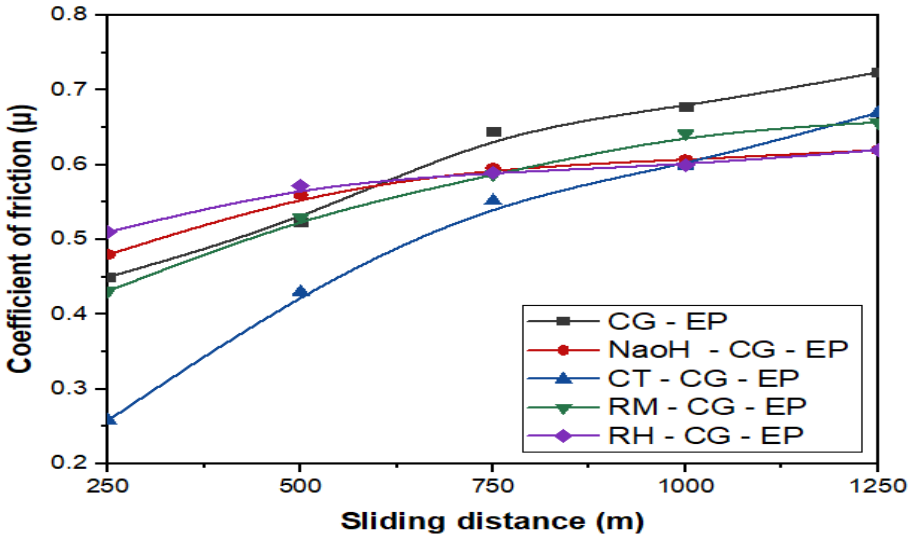

Figure 9 Friction coefficiency of particle`s added CG – EP composites

From the results, there is an appreciable reduction in wear rate with addition of particle, the particle added RH added CG – EP composites shown specific wear rate of 0.0632 mm^3/N-m, 0.0833 mm^3/N-m for CT – CG –EP, 0.0938 mm^3/N-m for RM – CG – EP at 1250 m sliding distance, from the plot it is clear particle added and NaoH composites shown less wear rate compare to neat composite system. This is due to higher load bearing capacity and good interfacial bonding between particle and matrix, leads to lower wear rate (Aigbodion, V. S et al., 2012).

Similar trend was noticed in coefficient of friction plot (Figure 8), increasing the sliding distance leads to increasing the friction coefficiency. The maximum friction was recorded for CT added (0.66 μ) & neat composites (0.722 μ); this is due to abrasion of fine CT particles pin with epoxy matrix, it will increase the interface temperature, due to which leads to high friction rate and more wear (Sharma et al., 2020).

4. Conclusion

The addition of rice husk particles in Calotropis Giganteafiber reinforced epoxy composites extended the crystalline peak into some greater extent which exhibited better value of properties. The better value of Tensile strength, Young's modulus and impact toughness were obtained in alkaline treated CG fiber reinforced rice husk impregnated epoxy composites The flexural strength is superior in alkaline treated CG fiber reinforced red mud impregnated epoxy composites due to the presence of natural silica and alumina in red mud particles. The water absorption and thickness swelling behaviours were lower in alkaline treated CG fiber reinforced rice husk impregnated epoxy composites, whereas the specific wear rate was lower in alkaline treated CG fiber reinforced epoxy composites. It is observed that the CG fiber – epoxy composites will be successfully used for engineering applications by the inclusion of micro particles.

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EXPERIMENTAL INVESTIGATION OF FAST CHARGING BATTERY USING MOLYBDENUM DISULFIDE AND GRAPHITE COMPOSITE

G. Manikandan[1], C. Uthirapathy[2], A. Mathivanan[3], S.D. Kumar[4] and S. Ganesh[5]
[1, 2,3,4,5]SRM Institute of Science and Technology, Ramapuram, Chennai

ABSTRACT

To meet the high performance of lithium-ion batteries, it is very important to improve the anode materials with high electrochemical capacitor use current carbon materials. Molybdenum disulphide is widely known as anode material and graphene is an effective supplement to achieve the electrochemical properties of MoS2. In this study, with the help of mechanical grinding, open graphite was made to extract from graphene by MoS2 which was formed to form a complex anode material, Gr / MoS2. This method worked to stop the Gros MoS2 mixtures to a great extent. The coupling anode samples were characterized by XRD, SEM, EDS, HRTEM, Raman spectra, and electrochemical experiments. The results showed that the magnitude graph disappeared and the carbon object was distributed evenly around the ball joint. With the increase in the MoS2 mass ratio of the open graffiti, the graphene content in the set of obtained results increased, but with more errors than structure. The optimized Gr-MoS2 blend produces a good charging / output character and storage capacity at 450 mAh / g after 55 cycles / out as the current density of 1 A / g.

1. Introduction

Carbon management has been a big concern among both businesses and individuals for several years. Many technologies for harvesting renewable energy sources such as solar panels, wind turbines, and earth energy are being created. The conversion of these resources into direct energy will not fulfil the output and usage criteria. Save fuel, including rechargeable batteries, it is a big alternative. An addition to battery work has been the advent of rechargeable batteries for conventional batteries and lithium-ion (libs).

Specific types of graphite, such as industrial type graphite and coke, is being used widely studied in recent decades as ways to store lithium-ion batteries (LIBs). Because of that huge volume, low value in price and low electromotive force compared to oxide of lithium, natural graphite is seen as the most promising nominee among the variety of carbon-based anodes. But LI batteries does not satisfy the efficiency standards (including price, density of energy, charging / discharging quality and safety) required for the goal of new sector such as all electrical motors sustainable wind and/or solar power storage markets.

Researchers have looked at rechargeable battery schemes with different charging carriers in this regard. The alternative charging carriers need being ideally plentiful and inexpensive to satisfy the rising energy demand. sodium and potassium ions of batteries provide desirable low-cost properties, reduced resistance, better protection and the potential to use low decomposition electrolytes. Due to the thermodynamic equilibrium of the graphite, the carbonaceous, graphite material will be negative for batteries based on sodium and potassium ions condition. Additionally, combined graphite distance (approximately 0.3401 nano meter) is tiny to separate the sodium and potassium ions. To solve this, it has been stated that graphite formulae are transformed by modulating their structure, analysing stiffness and using graphene oxide.

Recent years have seen the production of graphene and graphene oxide (GO) in a number of physical and chemical ways. Chemical vapor deposition (CVD) and graphite cleavage are among those processes most commonly used to detect stainless and high-grade graphene. These strategies are therefore rather time-consuming and result in low productivity Unlike CVD, Hummer's approach was generally accepted in GO formulation on the basis of its availability and fast runtime [But the surface of the GO sheets prepared by the Hummer approach contained too much oxygen, like hydroxy, epoxy, diol, ketone, and carboxyl groups formed oxygen-bonded sp3 carbon atoms, forming GO sheets without isolation devices. Toremoveoxygen, GO can be transformed to a semi-conductor.

In this research, based on this study, a systematic analysis has been carried out into the Hummer Adapted method for GO preparation with a drying temperature of 120° C, 200° C, 250° C, and 300 ° C on the use of

concentrated HCl as filtering solvent. There is no further cycle of chemical / thermal decrease. Electron and surface microscopy have supported the morphology of accordion and mesoporous RGO traits.

2. Literature Review

1. Habte et.al (2019), suggested a new kind of graphene preparation is by oxidizing carbon powder in an exceedingly mixture of H2SO4 / H3PO4 acid and Permanganate. The parameters admire latent period, temperature, and quantity of concentration varied to check the speed oxidisation of graffiti to graphene chemical compound. Currently, AN improved methodology for the preparation of graphene chemical compound is that the commonest one. The result showed that treating carbon powder with metal the salt (1: 9) and also the H2SO4 / H3PO4 acid mixture at fifty ° C for twelve hours resulted in an exceedingly higher oxidisation degree. The artificial strategy will be simply controlled and may be a inexperienced different to graphene chemical compound production likewise reduced graphene oxide.

2. Kunlei Zhu et.al (2018, It is based on the fact that conductive materials are necessary in the event of extremely economical electronic devices. Several current techniques are in the process of adopting modifications or chemical binders to stimulate interaction between variables, reduce cyclic lifetimes and increase production prices. Here we appear to mention a Sun-Gel, ascending Sun-Gel technique for synthesizing TiO2/Super-Solid Nanotube (hybrid films as alternatives to Li-ion batteries. They are also designed to shape completely transforming cells in all places where binders, activators and current cell collectors are not relevant.

3. Namhyung Kim et,al (2017), suggested varies methods are dedicated to the event of high-quality anodes. However, despite the diligent efforts, the low Coulombic potency and high compression capability with shy electrodes stay tough challenges to be self-addressed. As a result, the hybrid anode produces exceptional Coulombic performance (93.8%) and quick charging behaviour with industrial conductor conditions. As a result, the complete cell exhibits a high voltage worth (≥1060 Wh l - 1) while not sleuthing a Li plging charge at the present charge (10,2 mA cm - two) and one.5 times additional charge than traditional plumbago.

4. Muhammad Irfan Raza, Ehtsham Sarwar, et.al (2017), Numerous applications of gas fuel are thought to be the most desirable methods for obtaining renewable energy from direct fuel mixtures. Due to the fact that methanol is cheap, easily accessible and electrically transmitted over the last decade, significant consideration has been given to direct fuel cells (DCFs). During this period, we tend to report. However, the Hummer method modified the paper graphene (GO) compound and graphene, with a very simple chemical resolution, was backed by a metallic element and nickel nanoparticles. X-ray diffraction (XRD), microscopic screening (SEM) and EDX were listed in the materials. Electrocatalytic properties of the synthesized fuel oxidizing catalyst are investigated by cyclic voltammetry.

5. Minh N. Dang, Thi Dieu Thuy. et,al (2017), They justify here a unique approach for getting ready MoS2 / graphene composites mistreatment straightforward experimental conditions. the strategy is developed by combining chemical science exfoliation of graphene sheets from carbon electrodes and therefore the deposition of MoS2 from the [MoS4] a pair of negative. This technique provides a sexy different to the rumored ways like chemical induction of vapor, hydrothermal synthesis for the preparation of MoS2 / graphene composites.

6. Deepak P Dubal and Pedro Gomez - Romero (2016),It proposed that graphene electroactive nanofluid (ENF) should be used for primary time to synthesize the graphene electrodes and to provide proof of the principle of victims of such electrodes to store the power in the novel cells. Graphic nanofluids work alongside true laptop electrodes with a high-speed structure and value the use not only of graphene, but also of second, MoS2-similar materials for energy storage and on the other hand.

7. Choi, M., Koppala, S. K., Yoon, et.al (2016), Easy and efficient technique is being applied to the robust adhesion of the metallic element disulphide to the shallow supercritical-alcohol-minimal graphene compound. MoS2-SRGO compounds were developed, supported by one

pot of MoO2 in SRGO and synchronic reduction of the SRGO concentration in methyl alcohol critical followed by sulphur addition. This distinctive mechanism is synthesized with success and powerfully binds nans art nanoparticles to the SRGO person, leading to the SRGO. Improved structural rigidity, improved lepton transmission rate between the SRGO and the MoS2 sheets, and Lithium-ion infusion dynamics.

8. Guochuang Huang, Tao Chen, et.al (2013), referred as a single-pot solution is used to create a single-pot thermal reaction in the presence of the graph chemical component (GOS) sheets, defined as a mixture of atomic number 27 sulfide / graphhene nanosheets (GNS). The XRD, SEM and TEM signals indicate that the atomic number 27 components, i.e., CoS_2, CoS and CO9S8 complexes that are strongly distributed or siloxane graphs, have a median size of one hundred and fifty nm. The combined structure and catalytic effectiveness, the high battery quality, the wide expansion and the sensitive graphene versatility are responsible for the high chemical efficacy of the composite.

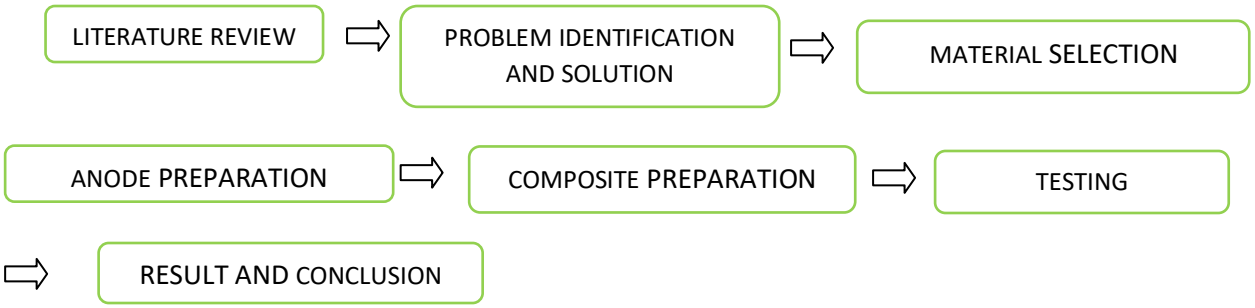
9. Feng, C et.al (2009), stated that the use of the MoS2 nanoflakes prepared physical science element reaction technique. The powder X-ray signal matter indicates the shape of the MoS2. Unconcealed observations of high-resolution microscopy showed that nanoflakes were prepared for MoS2 and partial MoS2 nanotubes were created. MoS2 embolism of metallic material / action of de-intercalation ready for additional investigation of the nanoflake conductor. This technique, which allows MoS2 to be used as promising anode tool, has been used to achieve excellent chemical characteristics of MoS2 nanoflakes.

10. Jin Hu et,al (2007)[10], proposed a well-dispersed nanosized solid carbon spherules (nano-HCS) with totally different element content were ready in a very changed hydrothermal manner. Their chemistry behaviour is being investigated. Results from Raman spectra and HRTEM pictures at totally different lithiation sites indicate that the formation of nano-HCS with high element content becomes less ordering when several removal / charging cycles. This change-order drawback wasn't discovered in nano-HCS with low element content. the way to interpret this example is projected. Additionally, the development of a durable interphase solution (SEI) film on the surface of nano-HCS is indicated and will be revealed while charging.

3. Problem Definition

The efficiency of the Li particle cells depends on the temperature and also on the operating voltage. If the charging voltage is elevated on the far side of the proposed higher cell voltage, normally four.2 volts, the excess current flows give rise to 2 problems. With excessive currents, the Li ions cannot be accommodated rapidly enough between the embolism layers of the carbon anode and the Li ions collect on the surface of the anode anywhere they are deposited as aluminous Li. It's also referred to as Li plating. The effect of this is always a discount within the free Li ions along with a degree of irreversible loss of energy, and because the plating is not inherently homogeneous, but nerve fibre in nature, it can eventually ends up in a short circuit between the electrodes. Another major reason for Li plating is vasoconstrictive surgery, which may be caused by non-uniformity within the cell component due to malfunction or abuse. Excessive current additionally induces excess Joule to heat the cell in the middle of a temperature increase.

4. Methodology



5. Experimentation

5.1 Synthesis of Graphene Compound (RGO)

An updated Hummer technique was used to synthesize the graphene compound. During a common place in the 1 L bottle (RB), H2SO4 (300 mL) and H3PO4 (40 mL) were used. The packet of metal elements was placed at 0-5 ° C in an ice bath. The entire collection was magnetic-driven unbroken, and then the black lead (2 g) powder was slowly added to the phosphate of metal part. Subsequently, under boiling conditions, KMnO4 (12 g) was added to mixture; this reaction mixture was extracted after three days at temperature. Then, the reaction mixture took place in a bathing bath in the snow; the H2O2 (20 mL) was added slowly for quenching the reactions, along with a laundry of HCl (10 percent), and then water was diluted several times to achieve neutral pH. By treating the liquid G O resolution of the hydrate, the graphene compound was reduced by stirring for 1 h so that the reaction mixture was continued at 180° C for 12 h under hydrothermal conditions. The resulting rgo has therefore been clean and dried.

Fig 5.1 Middle stage

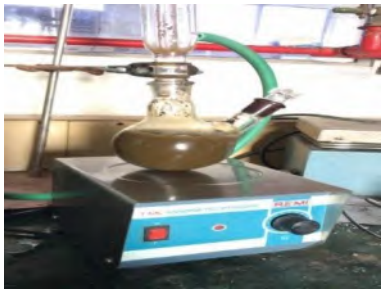


Fig 5.2 End Process

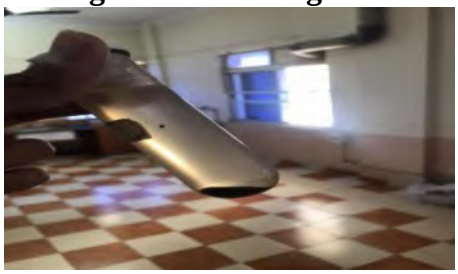


Fig 5.3 Washing of GO

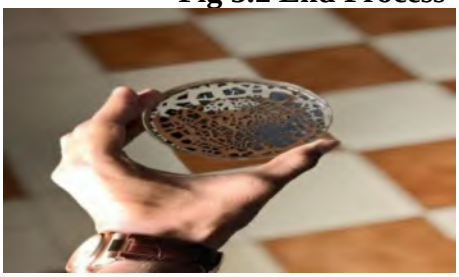


Fig 5.4 Dried GO

Fig 5.5 Graphene Oxide

5.2 Synthesis of Molybdenum Disulphide (MOS2)

It is highly hydro thermic that molybdenum disulphide is formed. The ammonium ion molybdates have been dissolved into 5 milliliters of fruit water, followed by hydrate reductions (N2H4.H2O, 86%, four ml), until the reductor is smart to wake you up. (NH4, 6MoO24.4H2O, 0.44 gm) The reaction blend was agitated in five ml of deionized water over 0.5 hours, the sodium metal (Na2S, 1.32 g) was dissolved; then the burning was left for 10 minutes; 5 ml of two MHCl was a drooping accessory. After that, the mixture of reactions stayed 10 minutes, but it did not add up. This mixture was later moved to fifty thousand liters of chrome steel filled with Teflon, which was heated to 180 ° C for 24 hours. The black commodity has always been washed with H2O and replaced by grain alcohol after 24 hours of temperature cooling. The collected product was dried in a kitchen appliance with intense

vacuum at a temperature of 60 ° C for 12 hours.

5.3 Synthesis of Mo-Graphene Composites

The mixture of molybdenum disulphide and GO was mud (at 1:4 ratios). The sampling mixture was then suspended by one mg for 24 hours in a grain alcohol-associated solution in nursing D (1:1 quantitative ratio). The suspension sounded for one hour, and after thirty minutes a 100-micro-liter nafion was incubated.

Following hearing, the glass conductor (GC), then dried under the IR lamp, was fed a huge mixture and five µl of high-strength ink. Chemical science process A hydro-genolutionary period of chemical change was subjected to the CH Instrument 920D model. A zero response was carried out in chemical science studies. The atomic number 78 is a resistive conductor, with a referential electrode, 5 M H2SO4 using the collection of three traditional conductors using a touch-sensitivity electrode.

In this effort the efficacy of HER was ensured by the linear sweep voltammetry (LSV) and cyclic voltammetry (CV). This glass conductor was polished before the mirror had been removed, along with the drying of the IR lamp, as a victimization associate in 0.05 micro meter of nursing aluminum oxide powder. Thirty minutes before chemical science experiments to remove dissolved oxygen, an electrolyte solution was mixed with N2 gas. The samples were cycled before operation to refresh the solid state with a speed of 10 mV-50 times. The conductor electrode (reversible hydrogen electrode) that is hostile to the electromagnetic dimension is the basis for all measurements. The silver / ag-cl reference conductor was able to be used as the working electromagnetic and the Pt wire as the reference electrode, using the atomic number of 78. The H2SO4 answer (0.5 M) was used for the refined victims of high-purity H2gas before and during service as an associate in nursing solutions. LSVs were measured at one mVs scanning rate −1, and the voltage was also measured at zero as −0.2246V was found in the reference voltage of the atomic conductor. All chemical science knowledge was used and RHE was returned with the following equation to calculated victimization electrodes of the silver / ag-cl reference. In addition to the potential modification of the reversible hydrogen electrode.

6. Results

6.1Developing Phenomenon of Molybdenum Disulphide Films

MO disulphide film is the enclosed degradation of thiourea as a source of molybdenum and hydroxy acid as a solvent to a central alkaline medium found in the ammonium ion molybdate. Mo particle ions inside the reaction vessel are regulated by hydroxic acid. Hydrate reactions are reduced as a chemical agent. Strong thiourea yielding to S2− decreases with a slight increase of temperature and reduction of Mo6 + to Mo4 +. Dissociation Mo-A (tartarate) complex releases Mo4 + particles to create Mo disulfide film in answer S2 – ion at hot temperatures. The growth mechanism is also demonstrated by the following reactions:

$Mo6+ + 3A2− \rightarrow [Mo(A)3]$

$[Mo(A)3] + 2NH2–NH2 + 2OH− \rightarrow Mo4+ + 3A + 2H2O + 2N2\uparrow$

$CH4N2S + OH− \rightarrow SH− + CH2N2 + H2O$

$SH− + OH− \rightarrow S2− + H2O$

$Mo4+ + 2S2− \rightarrow$ Molybdenum disulphide

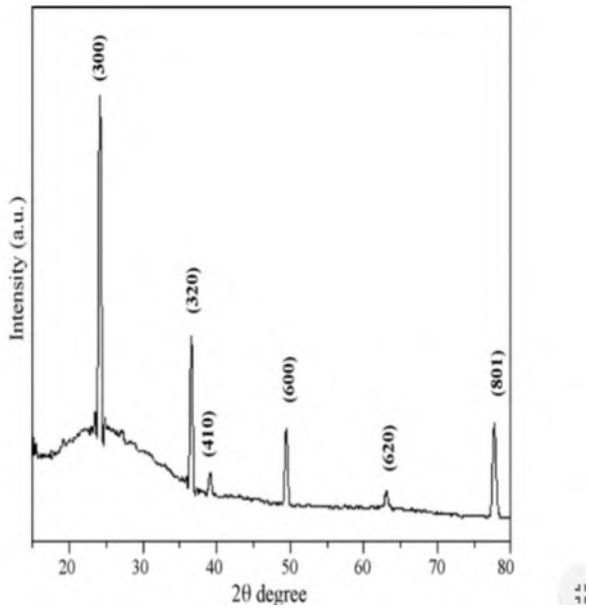
The ionic compound Mo4 + and S2− is higher than the solubility point when film exposure of Mo disulphide occurs. At 298 K, the temperature is low. In the first half hour, no movies occurred at maturity. That is also the time required to set up fractional nucleation centres. A cluster-by-cluster process is indicated by the existence of the induction number. For the use of Mo disulfide thin films, the speed limit 60-62 was selected. The films look the same, jutting and bright the pictures look close.

Molybdenum disulphide movie patterns are shown in the Fig.6.1 Diffraction (XRD). Seventy-one and seventy-seven. The appearance of sharp summits is a sign of the crystal film's life. A contrast of the word’d ‘measurable’d’ values ensures a polygonal shape structure (JCPDS 73-1508) in a chemically placed way. The XRD study shows a monophasis of the films collected (3 zero 0), (3 2 0), (4 1 0), (6 0), (6 2 0) and (8 zero 1). Figure 6.2 shows the SEM micrograph with a thousand magnifications of the thin film

Molybdenum Disulphide. A similar grain is exposed by the film and the glass boards cover well infused. Distributed, distributed circular grain diagram distribution. XRD Thin Film Disulfide Molybdenum Template. A similar size is given. Most breasts have an alternative connection. Table indicates the scale of the grain.

Table. No. 6.1: Morphological characterization of Molybdenum disulphide.

Film	'd' values (Å)		hkl planes	Grain size (Å)		Cell parameter (Å)
	Observed	Standard		XRD	SEM	
	3.5918	3.5507	300			
	2.4496	2.4437	320			a=12.30
MoS_2	2.3038	2.3244	410			
	1.8396	1.7753	600	189	193	
	1.4722	1.4771	620			
	1.2264	1.2264	801			c=3.45



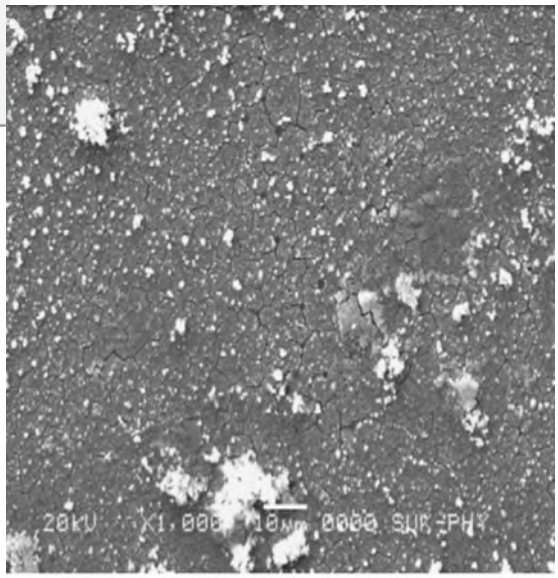


Fig.No.6.1 XRD pattern (2Q degree vs Intensity) **Fig.No.6.2 SEM micrographs**

Table. No:6.2 Visual and Molybdenum disulphide characterization

Optical and electrical characterization of MoS_2 thin film.

Sample	Band gap (eV)	Activation (eV) energy		Specific conductance $(\Omega cm)^{-1}$	
		HT	LT	303K	523K
MoS_2	1.8	0.882	0.092	1.3×10^{-5}	2.3×10^{-2}

6.2 Visual Properties

The UV v-NIR Double beam photometer was seen in the range 400-800 nm the basic edges of MOLYBDENIM disulphide were found to be extremely captivated by the energy of the tip, suggesting the presence of more than one mutant. Visual absorption Modulphene disulphide short-screen sample at temperature

Fig. 6.3 Indicates differences in wavelength optical absorption. Films are attractive, according to visual studies. The degree of rigidity depends on the radiation level and the film's composition. Usually a format from a 3-dimensional crystal model issued to translate the test results produced. By victimizing the connection, the 'Eg' range was determined.

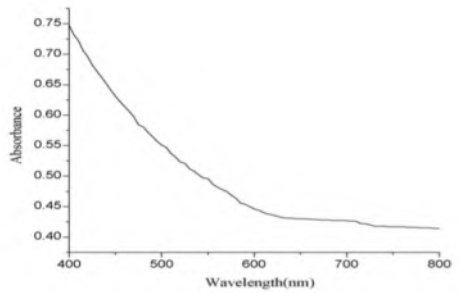


Fig.No.6.3 wavelength vs absorption

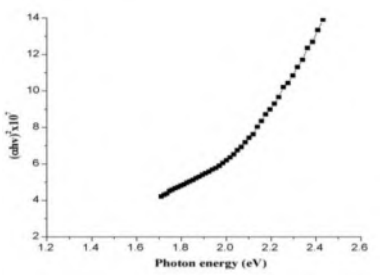


Fig.No.6.4 Photon Energy Vs Ohm2 *10*7

The 'Eg' distance from the band was h (fig. 6.4) from the two to two transformations. The layout line shape demonstrates that there is a clear transformation. By extrapolating the vertical dimension of the power axis to the value of the array = zero, the band gap is set. The band gap showed one.8 electron volt disulphide filmed with thin metallic elements that are remarkably close to the typical straight band gap (1.78 eV), that better suits the faster.

6.3 Analyzing Thermocouple Performance

Our mind- victimizing route 2 dc'-samples with temperatures ranged from 303-523 K were the overcast electric propagation of the Molybdenum disulphide short film on the immobilized slide. The transmission of 10–2(cm) −1 was found to be well related to the previous value [23]. Table 2 displays correct values of operation at 303 and 523 K.

Crystalline thin films have their electric properties depending on the structural and structural options [24,25]. The film production is observed to increase exponentially in the light. This means that a thin film is semi conductive. Differences in heat-and-rotation thermal transmission. This shows that, because of the suspension of uneven deformity in the primary sun, the films create a permanent nursing partner. In Fig6.5 you can see the log structure (conduction) and the total cooling curve temperature. The plot indicates that there are two straight states in the electric current. At the best temperatures, low temperatures show that two ways of development are available. The best temperature region is due to a grain limit that distributes a small operation, while the region with the lowest rock temperature is the product of the range variation.

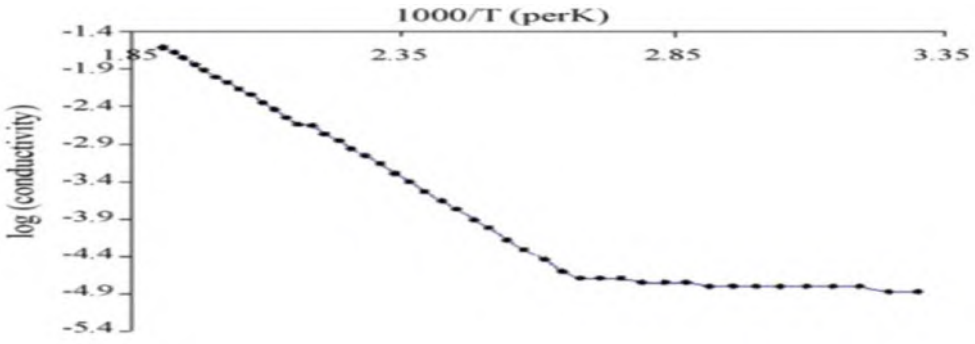


Fig.No.6.5 The variations of log (conductivity) with inverse temperature.

6.4 Analysis For Thermo gravimetric Properties (TGA)

TGA The thermal stability of MoS2 samples was visualized from 100 50 C to 600 C below N attitude as shown in the Fig.6.6 TGA was used to visualize. The pressure decreased slowly, but no obvious variance in the DTG curves could result in the water loss if it was heated from one hundred and fifty to two hundred C. In the samples MS-1, MS-2, MS-3 and MS-4, weight loss of 10.11%, 7.67%, 3.60% and 7.54%, respectively were observed with a thermal decomposition of MoS2 in the range 200-450 C. Moreover, the height temperature of the MS-3 sample is obviously greater than that of the MS-1, MS-2 and MS-4 samples as shown in the DTG curves. This means that in accordance with the XRD findings, the MS-3 test demonstrates higher thermal stability, i.e. the higher guidance of the extremely crystalline sample.

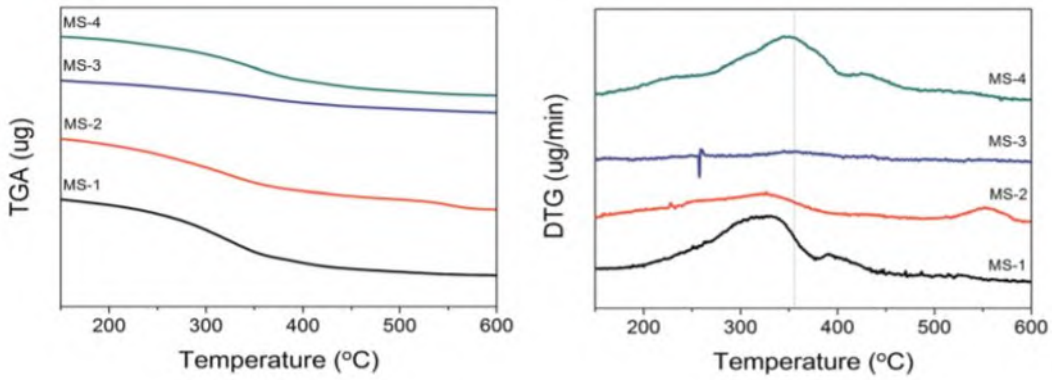


Fig.No.6.6 TGA performance chart

6.5 Surface Area (BET) Analysis

The basic region and accuracy of class-conscious MoS2 samples was examined for N2-adsorption. As the figure shows the N2 adsorption-desorption isarithm, which indicates a mesoporous structure, is known as an IV isotherm with a physical phenomenon loop of H3. Pores emerge from the areas between MoS2's crossbred nanosheets. The curves MS-1, MS-2 and MS-4 are shown in the figure. The findings show that the MS-3 sample has a largest area of 70,6,85 m2 g1, far larger than the recorded MoS2 (23,9 m2 g1) and also has an average pore diameter of the specimen MS-1, MS-2, MS-3.The existence of mesoporosity in ultra-thin nanosheets in a huge field. A relatively giant area can provide more active sites for dye molecules' surface assimilation which can be useful for fast surface assimilation and adsorbate transfers within a sample's hierarchically porous structure and MS-4 is illustrated in fig.6.7

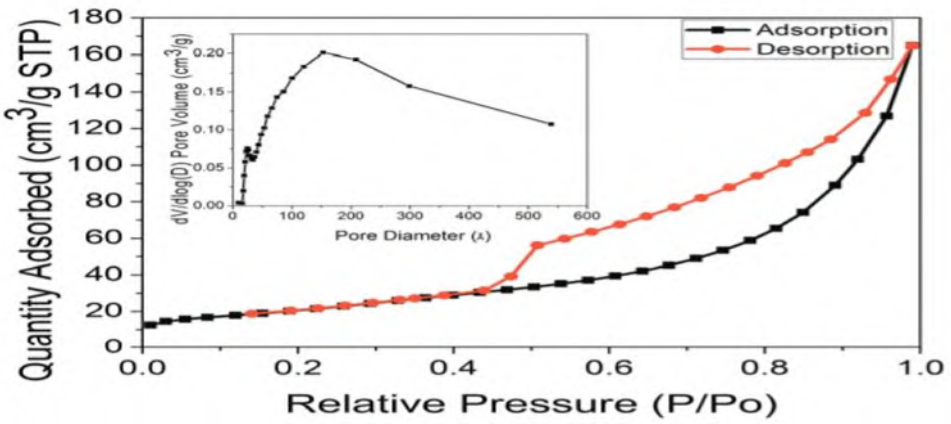


Fig.No.6.7 Size Distribution Chart

6.6 Adsorption Analysis

N ARRHB solution at different concentrations (20 mg L1, one hundred mg L1 and two hundred mg L1 were used to test the surface assimilation capacity of the as-prepared MoS2, 0.1000 grams of the MS-3 sample. Experiments on surface assimilation took place for a hundred and twenty minutes in dark conditions. Fig.7.8 indicates a surface assimilation capability of MoS2 for the RhB solution (200 mg L1) and Fig.6.8 for RhB in varying adsorption times and RhrB concentrations. The MoS2 tests demonstrate that RhB is removed effectively from the water. The full elimination of RhB occurred less than five minutes, as calculated by the resolution of the RhB, which weakens the chop to the colourless. In the case of a [RhB] of 21 mg L1 there were ninety-seven 96% and 19.6 mg g1 respectively of RhB extracted and even surface assimilation capacities for MoS2 samples. In comparison, 98, 65 and 98,6 mg g1 were available in a [RhB] of 100 mg L1. However, the surface assimilation capability was demonstrated to be reduced to 112.4 mg g1 up to 200 mg L1 of [RhB].Moreover, it was not able to assimilate its surfaces fast, but it

showed a pattern of sustainable development, meaning a higher surface assimilation capability for RhB with time beyond control would be given by the as prepared MS 3 sample. The MS-3 sample FT-IR spectrum before and after surface assimilation is displayed Fig.6.9 Specific variations within the spectrum, particularly between 1500 and 500 cm1, show the success of MoS2 adsorbing dye molecules. The surface assimilation experiments were concealed at zero to 420 min by victimization of two hundred mg of L1 RhB as waste material in order to test MS-3 's saturated surface assimilation capability for RhB.Meanwhile it is possible that the sample MS-3 for MB and MO solutions will jointly analyze the surface assimilation efficiency in higher conditions. The color removal percentage and MoS2 surface assimilation capability are shown in a couple (Figs. 9a and b). Table one pair shows the surface assimilation in the 200 mg L1 coloring resolution of the MS-3 sample at 5 min and 420 min. For all dyes, the dye removal percentage has risen rapidly within five minutes and is followed by various MB, RhB or MO sorptive (adsorption) values: 55.83% (111.7 mg g1), 32.16% (84.3 mg g1) and 21%. 34% (g1 42,7 mg). By comparison, with the surface assimilating time rising at 420 minutes, there were 99.9% (199.9 mg g1), 81.84% (163.0 mg g1) and 62.55% (125.1 mg g2). Higher than test results show that the superlated MoS2 surface assimilation capability is very high and much greater than the one recorded for other adsorbent materials such as bentonite Bi2O3, magnetic clay and Ag@AgBr / SBA-15.38–40 In different colours, MoS2 's surface assimilation capability varies from one color to the next, which can be related to the molecular structure of the dye and a significant amount of negative surface assimilation energy (DHads)20. It means that the MoS2 surface assimilation of different dyes has a particular degree of property that can be used for applications in water treatment. MS-3 for RhB and MO saturated surface assimilation efficiency were 163.0 mg g1 and 100 25.1 mg g1 under our experimental conditions at 420 min. MoS2 for MB is currently examined to determine the saturated surface assimilation capability. The surface assimilation experiment ranged indefinitely from 20 mg to 100 mg MoS2 in order to achieve MoS2's optimum surface assimilation capabilities for MB. Fig. 10a displays the UV-Vis spectra of MB (200 mg L1) which indicates that the absorbance at 664 nm slowly decreased over time after exposure to MS-3. Fig. Fig. 10b and c demonstrate the sorption and surface assimilation capability of the MS-3 porous sample for MB at varying adsorption times. Since the MoS2 indefinite rose from 20 to 1 hundred mg, the extinction rate was shown to range from 30 to 99.99 percent, however, for doses ranging between 20 to 1 hundredmg of the MS-3 specimen, the surface assimilation capacity ranged from 210.0 mg to 499.0 mgg-1 (Figure 10d). The highest MB surface assimilation of 499.0 mgg-1 is far above that for alternative adsorbent.cent materials previously reported.

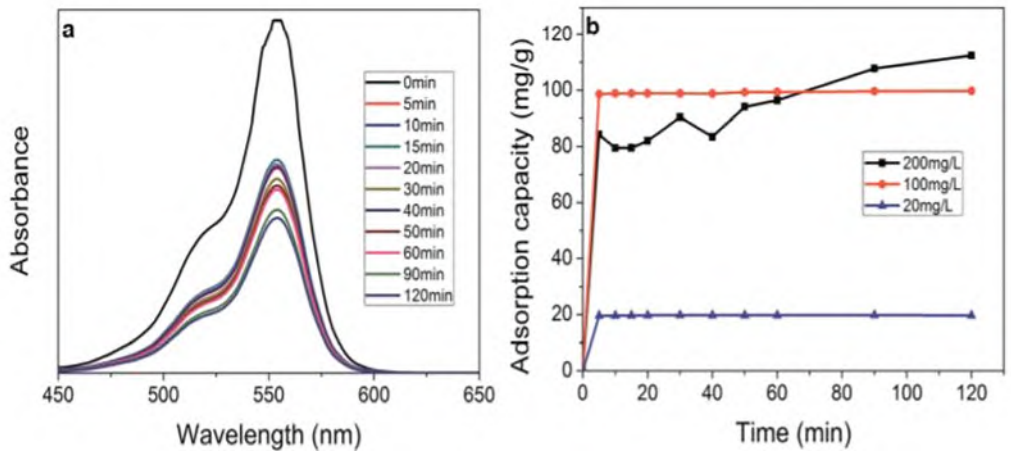


Fig.No.6.8 Pattern of MoS2 sample adsorption: (a) for RhB with the concentrationof 200 milligram L1; (b) for RhB with different concentrations.

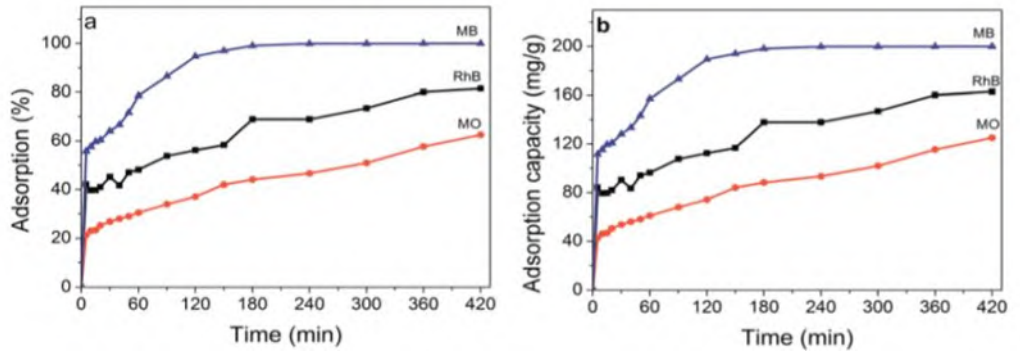


Fig.No.6.9 Adsorption performance of:(a) MoS2 synthesized for different dyes; (b)capacity MoS2 synthesized for different dyes.

7. Conclusion and Discussion

This system increases the charge density and the charge capacity with Gr / Molybdenum disulphide composite material as the anode layer of the lithium ion battery and thereby increasing the overall energy storage of the battery. With this, charging of the battery takes much less time compared with the ordinary batteries. All the things that we could achieve with this advancement on anode material are mentioned below:

- Maximum voltage (V) varies with lithium cell chemistry. Chemistries ranging from laptop batteries to power tools using lithium-cobalt blends and blends containing manganese, nickel, and aluminium have terminal voltages around 3.9 to 4.2V but by using Molybdenum Disulphide and graphene composite we can increase this range to 4.5V .
- Previously in lithium battery voltage must be prevented from exceeding the voltage limit of 4.2V because it degrades the electrode but now this problem can be overcome by the method that charges an LiB at an elevated temperature of 60 degrees Celsius to eliminate Li plating and limits the exposure time at 60°C to only 10 minutes per cycle to prevent serious materials degradation as the anode can withstand the heating. This method enables extra fast charging (EFC) of LiB with an excellent life cycle, while substantially reducing battery cooling needed during EFC.
- Our experimentation indicates that, similarly to previous electrodes, these new composite layer electrodes exhibit excellent electrochemical performance, including high capacitance and energy density. The experiment results gives the full electrochemical utilization of the RGO active material in the bulk and even at extremely fast charge rates, thus showing effective charge transfer percolation .
- The results we got after carrying out the analysis i.e. SEM.TEM,XRD and BET on our sample we can conclude that MoS2-Graphene composite increases the surface area of anode therefore during charging more and more Li ions can easy accumulate thus the energy capacity increases by 1.5%.
- For maximum battery cycle life and calendar life overcharging and overheating must be control. This parameter can be improve by Battery Management System and with this new development it works in hands with betterment ibn battery life.

This minimizes the over usage of the fuel gases in the vehicles and leads to the eco-friendly E MOTORS.

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DESIGN AND DEVELOPMENT OF HYBRID (WC&MOS_2) ALUMINIUM MATRIX COMPOSITE MATERIAL FOR CONNECTING ROD APPLICATION

G. Swaminathan[1], S. D. Kumar[2], P. Aravind[3] and A. Mathivanan[4]
Department of Mechanical Engineering, SRM Institute of Science and Technology, Ramapuram Campus, Bharathi salai, Chennai

ABSTRACT

Metal matrix composites are made by combining two or more materials with different properties. In this study, aluminum (A356) was used as the main base metal, and tungsten carbide particles and molybdenum disulfide (MoS2) were used as reinforcing elements. The addition ratio of tungsten carbide particles is 1%, 1.5%.Then, based on the mass fraction of the molten metal, 1%, 1.5% and 2% of 2% molybdenum disulfide were added respectively. Make various composition combinations. The mechanical properties of reinforced and non-reinforced materials, such as hardness and tensile strength, have been studied. A356 sample. In this work, the connecting rod was replaced by an aluminum-based composite material, which was reinforced with molybdenum disulfide and tungsten carbide. The connecting rod is the connecting rod between the piston and the crank, and is responsible for transmitting power and thrust from the piston pin to the crankshaft pin, thereby converting the reciprocating motion of the piston into the rotational motion of the crank. The connecting rod is usually made of carbon steel. In the past few days, aluminum alloy has entered the connecting rod. It also describes the modeling and analysis of connecting rods.Finite element analysis is performed using two materials: background stress, background strain, and displacement are obtained from ANSYS software. It has been found that the new material has better stiffness than the old material.

Keywords—*Molybdenum, Tungsten Carbide, A356, ANSYS, Connecting Rod, Stir-Casting*

I. Introduction

New aluminium alloy material manufacturing processes have been continuously produced for parts of car engines, wear strength and heavy applications. The combustion impact from the heat chamber to the connecting rod of automotive engine components requires good thermal resistance and a high structural strength to withstand excessively hot and strain. Aluminum manufacturing usually includes die casting of gravity, casting squeeze, heat forging, forging of powder, casting processes. Among them, the use of the liquid casting method is satisfy to more than 90% of the composites in the recent industry. Aluminium as a melting material of the casting action are nevertheless treated in a completely molten state.

The final product is in homogenously solidified, damaging the purity of the product. In addition, they have dendrites that decrease material strength. The challenged hot forging method has recently been suitable for high-speed goods because the workpiece has a considerable hardness of work. However, the need for high forming loads and low generosity with regard to product geometry cannot be ignored. The aim of this project is to select better material for the more rigid and temperature resistant process by producing AL A356 aluminium hybrid composite in different compositions as a matrix material and an active carbon fleece as a refinement. Various samples are provided by the methods of stir casting. Several experiments were performed to assess the various characteristics of aluminium composites and to equate them with industrial aluminium alloy.

Two or more material joint together form a single material as called Composite material. The components are in two categories: matrix and reinforcement. Any form requires at least one part. The matrix material encloses the reinforcement material and protects them by preserving its relative location. In order to increase matrix features, the reinforcements have their special mechanical and physical property. A synergy creates material properties that are not accessible from the various component materials. The design potential is enormous thanks to the large range of matrix and reinforcement materials available.

In general, composite materials have physical characteristics that are not isotropic. The stiffness of a composite panel, for example, also depends on the direction of the force or moments applied. In comparison, the same rigidity exists in isotropic material, independently of their directional orientation. Along the material parameter like elastic modulus, modulus of rigidity, poisons ration

and density the connection between forces/pressure and stress/strain of an isotropic material may be defined. Composite materials are composed of two or more substantially different physical or chemical materials. The precursors among various types of MMC. The last two century composites from the metal matrix (MMCs) have become material of broad technical and commercial significance from an issue of scientific and intellectual interest (Miracle,2005) Composite Metal Matrix consists of a material in combination with a strengthening substance. Aluminum, magnesium, titanium, etc. are the matrix components. The materials for strengthening may include Silicon Carbide, Fly Ash, Alumina and Graphite. MMCs have a special physical and mechanical balance. MMCs based on aluminium have in recent decades become increasingly important as engineering materials, the majority of which have the advantages of high strength, toughness and wear strength.

Composites consist of two phases: matrix phase and scattered phase Matrix is called the primary process with a continuous character. Usually, the matrix is ductile and less difficult. The scattered process is maintained and a load is shared.

Step two is discontinuously embedded within the matrix. R is called the Dispersed Phase, and protects the secondary phase h. The scattered phase is generally stronger than the matrix, so it often is referred to as the strengthening phase.

In the MMC enhancement category, continuous fibres, discontinuous fibres, whiskers, particulates and wires are dividing into five main groups. In general, reinforcement is metal or ceramic powder and fibre are used. Boron, graphite (carbon), alumina, and carbide are the most significant continuous fibres. This material is made of bore fibres on a tungsten core using a chemical vapour deposition (CVD). Often used were carbon cores. The monofilaments in 4.0, 5,6, and 8.0 miles of diameters are relatively thick. Strengthening of reinforcement by using such as SiC or B_4C are also used to retard reactions between boron and the metal at high temperature.

The monofilament of silicon carbide is often produced with a CVD process using a carbon core or tungsten cell. A Japanese multifilament yarn is also commercially available, known as silicone carbide by its maker. But the substance is from silicone and its characteristics vary considerably from those of SiC monofilament by pyrolizing organo-metallic precursor fibres.

Several suppliers have continuous aluminium fibres available. There are considerably different chemical compounds and properties for the various fibres. Graphite fibres consist of polyacrilonitrile (PAN) and pitch pitches, two precursor materials. Efforts are underway to produce carbon-based graphite fibres. A broad variety of strengths and modules are available in graphite fibres.

Aluminium oxide and Al-Si are better reinforcement fiber now. Both were originally produced as materials insulated. Silicon carbide is the biggest whisker stuff. Pyrolyses of rice hulls are the leading American commercial commodity. Silicone carbide is obtained from the industrial abrasives industry with boron carbide as the primary reinforcements for particulate matter. Silicon carbide particulate matter is also generated to make whiskers of this material as a by-product of the process.

A variety of metal wires have been used in strengthening the steel matrice, like titanium, copper, graphite, and Mg. The tungsten wires in superior functional graded material containing aluminium and magnesium are currently the most effective wire reinforcements. The above-mentioned strengthenings are currently the most significant. Over the past few decades a lot of others have been attempted, and in the future there will be surely still others. The material consists of a composite material which has two or three different phases, such as a matrix phase and a reinforcing phase and has substantially different bulk properties from each of the elements in the matrix. Composite materials have more positive characteristics than other metals and non-metals.

The advantageous characteristics include high rigidity and tensile strength, low density, high temperature stability, and even electric and thermal conductivity, characteristics such as thermal expansion coefficient, and corrodesity with reduced wear resistance are taken into account in some applications. The car bodies are made of a composite material to increase fuel efficiencies in automobiles so that the car

body weight can be kept low by improving fuel efficiency. Composites enhanced by nano carbon fibre aluminium are already in use. The light weight and abundance on Earth was largely due to aluminium composite materials. Due to all these options, associated studies are continuing with the aluminium composites and one of these is our research. In each sample, the properties of the basic material are altered by adding some strengthenings that evaluate the resulting properties and propose appropriate applications based on the properties. The three different reinforcement forms used are

- A356
- Tungsten Carbide
- Molybdenum Disulphide

Further the base metal used in the project is an alloy of **Aluminum** namely 7075**.**

1. This paper provides results of a study of the mechanical properties of samples made with stir casting of tungstene carbide and molybdenum sulphide and alumina reinforced aluminum alloy (7075). Three sets of Molybdenumdisulfide (3-100 μm) composites and Al2O3 (150 μm) were used with various weight percent (separticle scale 150 μm). Composite sampled tungsten carbide and molybdeum sulphide with 1, 1.5 and 2 percent Al2O3 varying percent wt of reinforcement weight fractions of constant 3%. Tensile strength, ductity and hardness were the major mechanical properties tested. The same properties have also checked with unreinforced 7075 samples. The quality and durability of the AA (7075) composites were found to increase up to a certain amount with the increase in percent wt of Aluminium based oxides. Additionally, the strength of Tensile decreases because of the weak wettability of the reinforced material with aluminum metal matrix. The sample microstructure analysis showed that the molybdenum disulfide and Al2O3 particles in the matrix have almost uniformly distributed. Alloy 7075 is primarily used when good mechanical properties are required to achieve the desired health quality in castings of a shape or dimensions that need an alloy with excellent castability. The alloy is also used when corrosion resistance is significant, especially if high resistance is also necessary.

ALUMINIUM Al 7075 chemical composition approximately occur,
Zn 5.2-6.08%
Mg 2.12-2.80%
Cu 1.30-2.00% And minimum 0.5% of iron, silicone and titanium are present.

Fig.1 Aluminium Metal Powder

In addition, an aluminium alloy called A356 is the base metal used in the plant.

Tungsten Carbide

Tungsten carbide is a compound (especially carbide) that contains equal proportions of tungsten and carbon atoms. Tungsten carbide is a fine gray powder, but it can be pressed into shapes through a process called sintering, making it into industrial equipment, cutting tools, abrasives, and armor. The elastic modulus of tungsten carbide is about 540-720 GPa (77010-102000). psi) is twice the stiffness of iron, and the density of tungsten is twice that of steel, approximately between the sleepers and gold. It can only be wiped off and has a hardness similar to that of corundum (α-Al2O3).

Fig.2 Tungsten Carbide

Molybdenum disulfide (or molybdenum) is an inorganic compound composed of molybdenum and sulfur. Its chemical formula is MoS2. This compound is classified as a transition metal dihalide. Silver molybdenite, the main mineral of molybdenum, is a molten black solid with a silver color. Compare. Does not affect dilute acid and oxygen. The appearance and appearance of molybdenum disulfide are similar to graphite. Because of its low friction and low strength, it is often used as a dry lubricant. 1.23Ev bandgap.

Fig.3 Molybdenum Sulphide

Table:1Aluminum A356(Al-Si7 Mg) means the composition (in%wt) of

Cu	Si	Mg	Fe	Mn	Ni	Zn	Pb	Sn	Ti	Al
0.20	7.50	0.6	0.50	0.30	0.10	0.10	0.10	0.05	0.2	Balance

In early August, a specific course of changes led to the stabilization of the reclaimed base with molybdenium disulfide, ensuring the correct mixing of the test cells. Mn/DOT has waited a month until the test cells were paved due to a different arrangement with the external supplier of the asphalt binder. During that time MnROAD dropped heavy rain into the exposed base layers. The HMA lorries fell into the base and made ruts above 4" while we tried to pave Cells 77 and 78 on September 11, and made paving impossible. The reinforced structure of molybdenum disulfide was not deformed and the paving continued on as planned. The work was continuing under a Force Account work order after several weeks of waiting for a halt to the rain to dry up its foundation & subgrade. The contractor excavated the wet base layer for 3 days, dried the subgrade and replaced the base before the pavement on October 25. For two years, field performance under traffic has demonstrated good performance in all three test cells.

Successes and Concerns

In order to dry out the unstabilized basic materials, Mn/DOT spent an additional $10,200 per cell on the force account work for these projects. Compared to the $8,970 for stabilisation of molybdenum disulfide, which saves 15%. One of the main advantages of using Molybdenum disulfide was that the building of a stable structure base instantly saves us six weeks. Although the work of the force account is unlikely to be needed on many jobs and while MnROAD charged a fee for the disulfide of Molybdenum due to the small amount, this project is a useful example of what might happen in the real world.

The disulfide of molybdenum construction consists of small quantities of mercury and other heavy metals. In order to collect and track the leachate generated by water flowing through the pavement, lysimeters were mounted in three cells. The leaching analysis continues to detect whether trace elements are leached from the layers of the floor. Several University of Minnesota laboratory studies also study the leaching features of stabilized content of molybdenum disulfide.

II. Literature Survey

A Study on Mechanical Properties of Tungsten carbide Reinforced Aluminium Alloy (A356) Composites

In 2012, the experiments on the mechanical behaviour of aluminium by mix Mg and TiC, Daljer, Harmenji were carried out in 2012. The purpose of this study was to study the change in aluminium behaviour by adding various composites 'Sic' and 'Al2O3' in the age of different percentages, and it was concluded that the weight of the strengthening improves durability parameter such as density output elastic stress and tensile ability. However, at the even the length reduces and the material behaviour vary from yield to breakable. In 2012, the thermal parameter of ash reinforced aluminium alloy (Al6063) Composites were performed by. Anilkanth, Hobbef and it was found that aluminium alloy composites had less tensile strength, compression resistance and hardening composites, as reinforced fly ash was increased. Increasing fly ash particle weight fractions increases tensile endurance, compression strength, stiffness and composite ductility. A comparative investigation into the mechanical characteristics of aluminum-based hybrid metal matrix composites was carried out in 2014 by Dinesh Kumar and Jasmeet Singh. The result showed that, compared to the newly formed SiC graphite reinforced composite SiC and B4C, which is improvement in ductile and yield properties. In 2010, the study of Al6062 SiC and Al7075 Metal Matrix Composites was performed by N. Selvaraj, M. S. Bhagyashekar, and aimed at presenting experimental results of study results concerning Al6062–SiC, Al6075–Al2O3 and Al7075–Mg composites ductile strength and tribology. The carbide and oxide have increased their respective composites' hardness and density. Asief, researched in 2011, production and smoothing dry wear of aluminium alloy composites depends on carbide reinforcement , in 2012, on the produced of Aluminum based Matrix Composites for automobile application (Sb2S3).

We may infer from the above experiment that aluminium combination materials can be easily processed by means of the cast method and the studies of microstructure show that the phases in the metal matrix are nearly evenly distributed. With an improvement in the% Wt addition of Al2O3, mechanical parameter as elastic and yield properties. Ductility and impact power are diminished at the other end. Because of this problem the strength decreases following such limits, the poor weightability of the matrix stages is the major issue with an increased weight fraction of the armour. With the addition of small quantities of magnesium and pre-heating of the composites, we can solve this problem.

III. Experimental Work

Experimental Procedure For Stir Casting:
The typical experimental set-up is made up of a mechanical stirrer and a furnace. The electric furnace is equipped with a 2 kg drain. At a maximum temperature of 1900oC, this oven works. The new oven is a single-phase, 50 Hz, 230V AC. Aluminum alloy (A356) is produced by means of a fine scrap forming system. It is 1150 gm. It is around. Metal waste is moved to the oven a little above its liquid temperature, making it half liquid (around 650 degrees C). For standardisation the matrix is mixed humanly. Then the preheated strengthening material is applied to the semi-fluid aluminium alloy in the casting machine at a temperature of 650°C. The heated reinforcing powder is then added to the semi-finished molten aluminium alloy of the machine. The composite aluminium is reheated completely molten. In the meantime, a few minutes of a supply argon gas will be put in the oven. A mechanical agitator is used to stir during this reheating phase at a velocity of 70 rpm. The Al matrixcompositel is fully molten at a heat of approximately 900 ° C, liquid molten point 700 ° C. This pumps into and subjects permanent moules of the completely molten metal aluminium matrix composite.

Fig.4-Stir Casting Setup

Fig. 5-Stir Casting Setup

Fig.6: Molten Metal

A. Moulded sample

MIXING RATIO

SAMPLE	AL ALLOY A356 (%)	Tungsten Carbide (%)	Molybdenum Disulphide (%)
A	98	1	1
B	97	1.5	1.5
C	96	2	2

Table.3 Mixing Ratio

B. CASTING

In this project, we used cast iron to die to the extent of the need. One is the casting of sand, also called sandcasting, a metal casting shape characterised by the use of sand as a moulding material.

The refractory is also relatively cheap and appropriate for use in steel foundry. A suitable binding agent is usually combined or linked to sand. To improve toughness, plasticity and mould of the clay the mixture is moistened with water. The word casting may also be employed to characterize a casting made of sand. Sand castings are produced in special factories called foundries.

The reinforcing particles are scattered through the liquid matrix with mechanical agitation. Mechanical stir in the molt is the key element of the operation. The total ceramic particle lava alloy is then used for permanently casting, casting or casting sand. The casting method is ideal for around 30 percent of volume. The surface or deposition of tungsten carbide is pre-heated at 1000oC in an electric preheater for 20 minutes. Aluminum (20 minutes 450°C). Aluminum. Aluminum. The pre-heated die is at 500oC for 20 minutes. Die is made of high quality stainless steel material. The slurry will be molten during this process. The slurry will be molten during this process. Die is pre-heated to ensure uniform solidification. If the die is not uniformly solidified, crystal structure and border are not formed according to the expectations.

Calculation

Length =240mm

Diameter =20mm

Volume of stir casting =

$=\pi \times 102 \times 240$

=75.398 cm3

Density = mass/ volume

Density of aluminium = 2.70 g/cm3

Density of Tungsten corbide = 2.1 g/cm3

Density of Molybdenum disulfide = 2.50 g/cm3

Mass = 204 gms

MATERIAL REQUIREMENT FINDING METHOD

FOR SAMPLE 1

98% AL + 1% TC + 1% MS

(Density of AL* % of AL*vol of AL) +(Density of TC* % of TC*vol of TC) + (Density of MS* % of MS*vol of MS) +

346.47 gms Al+ 1.37gms TC + 1.63gms MS

FOR SAMPLE 2

98% AL + 1% TC + 1% MS

342.92 gms Al+ 2.77gms TC + 3.306gms Fly ash

FOR SAMPLE 3

97% AL + 1.5%TC + 1.5% MS

339.47 gms Al+ 4.209 gms TC + 4.82 gms MS

CASTING

In this project we will use cast iron molds of the required size. Another process, sand casting, also called sand casting, is a metal casting process that is characterized by the use of sand as a molding material. Fire protection. Relatively cheap, it is also sufficient for molten steel. Suitable binders are usually mixed with clay or sand. Moisten the mixture with water to increase the strength and ductility of the clay and make the aggregate suitable for molding. Sand "can also refer to cast iron obtained from a sand casting process. Sand casting is done in specialized factories called foundries.

S.NO	ITEM	QUANTITY	COST
1.	AL 7075	1050 gms	RS.1800
2.	FLY ASH	250 gms	RS. 200
3.	CARBON	250 gms	RS.400
4.	FABRICATION	3 samples	RS. 7500
5.	TESTING		Rs. 2400
TOTAL	-	-	RS. 12300

Fig.7 Sample Pieces

TENSILE TEST

Tensile tests, also referred to as stress tests, are a basic strength of material test in which a material is involved before inability to monitor tensions. The test results are widely used to pick a material for an application and to monitor consistency, and to predict the reactions of a material under different forces. Properties measured directly via a traction test include elastic strength, extension and surface. The following properties are also calculated from these measurements: elastic and ductile properties.

Fig.8-Universal Testing Machine

TENSILE TEST TABULAR ANALYSIS

HARDNESS TEST

The hardness was measured by using variety of test like Rockwell, brinell and vicker etc.. In this work brinell hardness test was used. The brinell test force ranges, micro (0.5kg)

Table.3 Sample Identification

Fig.9 -Hardness Testing Machine

The indenter in both areas is the same, so the Vickers hardness value is continuous throughout the metal hardness range (usually HV100 to HV1000). Except for the test load below 200 g, the Vickers value is generally considered irrelevant to the test load. It is uniform, and the Vickers value is the same when tested with a force of 500 g or 50 kg. If the weight is less than 200 grams, be careful when comparing result.

5.1.3 HARDNESS TEST

Table 4-Result of Hardness Test

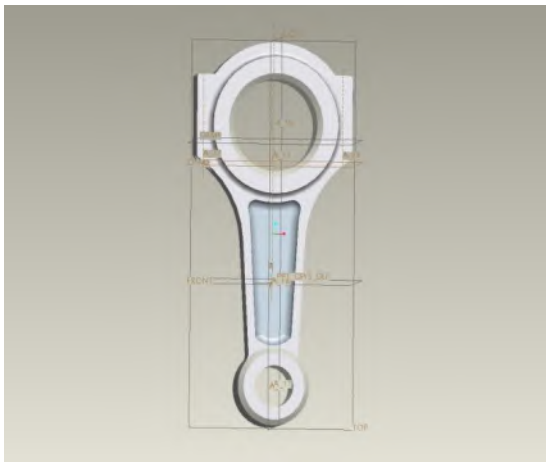
Type of Test	Sample ID	Observed Value
Hardness Test	Sample T1	77.8, 78.2, 80.2
	Sample T2	79.1, 76.3, 77.9
	Sample T3	73.9, 74.2, 74.7

Sample Identification	Observed Value		
	Ultimate Tensile Strength (Mpa)	Yield Strength (Mpa)	Elongation in 4D GL (%)
Sample T1	136	115	4.00
Sample T2	137	119	2.50
Sample T3	112	90	3.50

Hardness of Aluminium LM25= 58BHN

Table.5 Cost Estimation

6. Analysis Results



Modelling of connecting rod by using Pro-E W/F software

Table.7 Mechanical Properties of Materials Used

SI. No.	Parameters	Old material AL6061	New Material AL7075
	Ultimate Tensile Strength (MPa)	422	572
	Yield Strength (Mpa)	363	503
	Youngs Modulus (Gpa)	70	71.7
	Poission's Ratio	0.33	0.33
	Density (g /cm3)	2.61	2.81

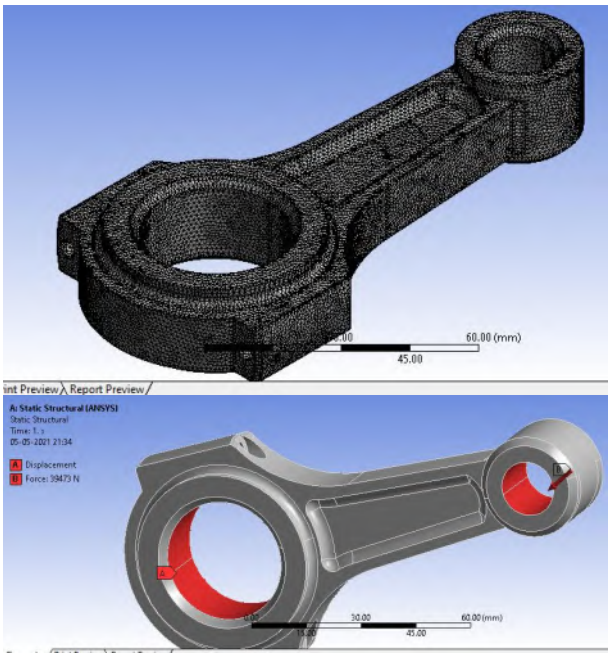
6.2 2D Detailed Drawings

6.2.1 Generating the mesh using ANSYS Software

Altair ANSYS is a powerful finite element pre-processor and post-processor, suitable for popular finite element solvers, enabling engineers to analyze the performance of product designs in an interactive and visual environment. Compatibility and efficiency. With the help of extended ANSYS functions, users can effectively combine high-fidelity models. This feature includes custom quality. Standards and control, deformation technology to update the existing network according to new design recommendations and automatically create intermediate surfaces with complex structures with different wall thicknesses. Minimal user input.

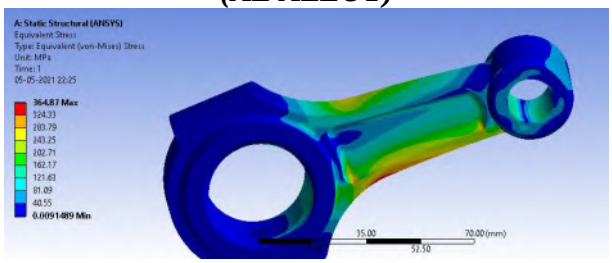
6.2.2 Meshing model

The complete connecting rod model (IGES file format) is imported into ANSYS, and the model is merged with the fixed four-element elements and save it in .hm file format to generate finite element model.

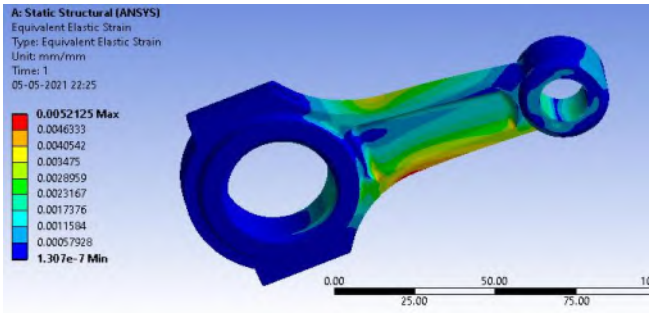


Compression load, displacement condition

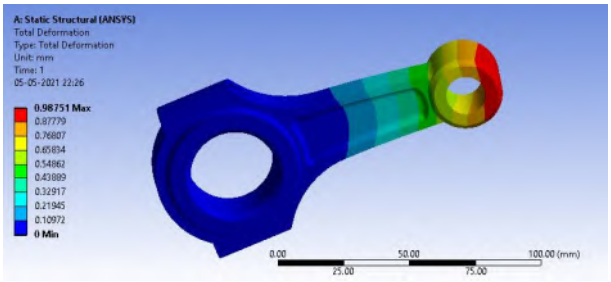
6.2.3 Static Structural analysis of old material (AL ALLOY)



EQUIVALENT VON MISSES STRSS ON COMPRESSION LOAD



EQUIVALENT ELASTIC STRAINON COMPRESSION LOAD



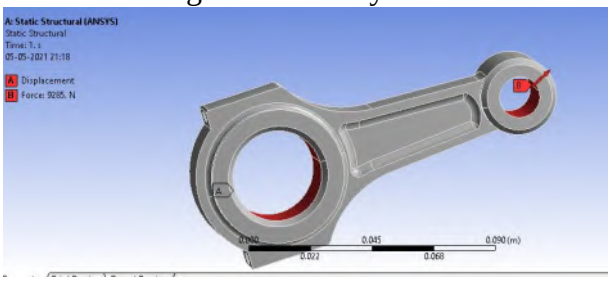
TOTAL DEFORMATION ON COMPRESSION LOAD

Results

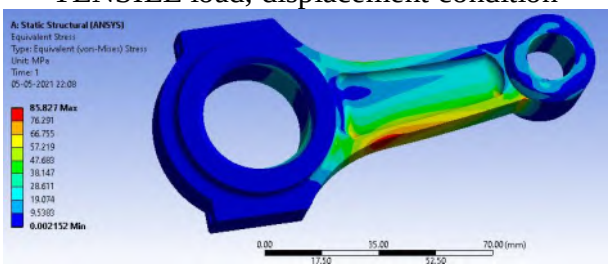
Object Name	*Equivalent Stress*	*Equivalent Elastic Strain*	*Total Deformation*
Definition			
Type	Equivalent (von-Mises) Stress	Equivalent (von-Mises) Elastic Strain	Total Deformation
Results			
Minimum	9.1489e-003 MPa	1.307e-007 mm/mm	0. mm
Maximum	364.87 MPa	5.2125e-003 mm/mm	0.98751 mm

TENSILE LOAD

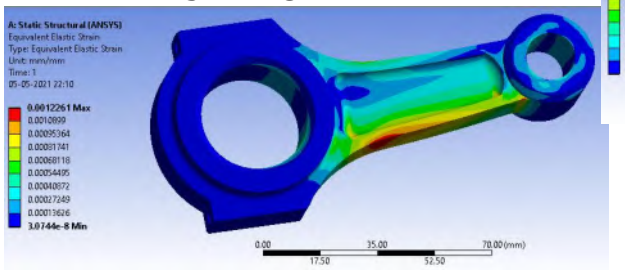
Loading and boundary condition



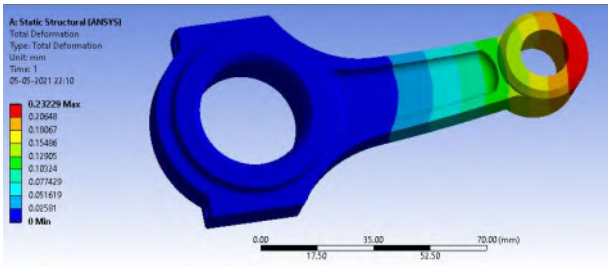
TENSILE load, displacement condition



EQUIVALENT VON MISSES STRESS ON TENSILE LOAD



EQUIVALENT ELASTIC STRAIN ON TENSILE LOAD



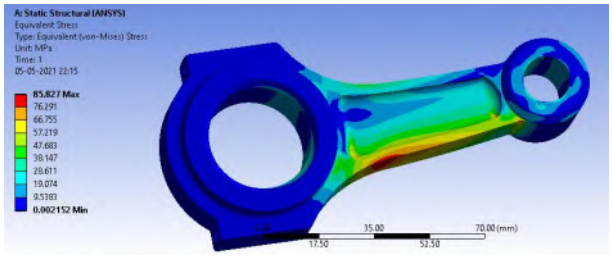
TOTAL DEFORMATION ON TENSILE LOAD

Results

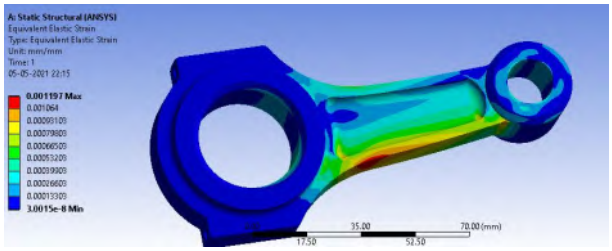
Object Name	*Equivalent Stress*	*Equivalent Elastic Strain*	*Total Deformation*
Results			
Minimum	2.1521e-003 MPa	3.0744e-008 mm/mm	0. mm
Maximum	85.827 MPa	1.2261e-003 mm/mm	0.23229 mm

Static Structural analysis of Al7075 Composites Material

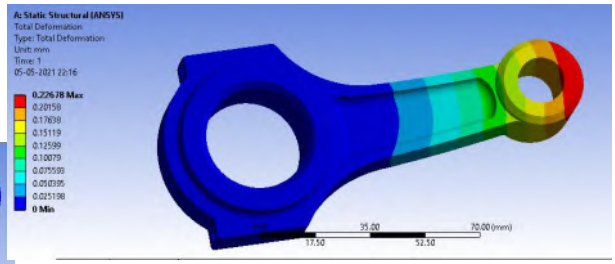
TENSILE LOAD



EQUIVALENT VON MISSES STRESS ON TENSILE LOAD



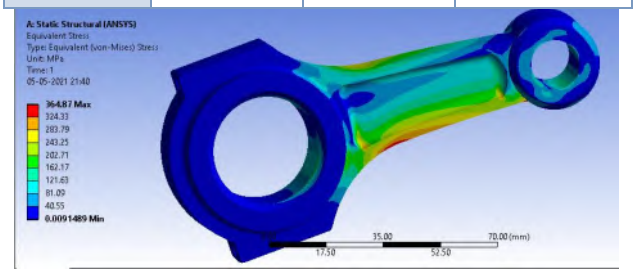
EQUIVALENT ELASTIC STRAIN ON TENSILE LOAD



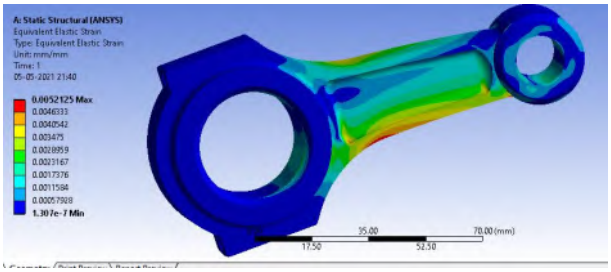
TOTAL DEFORMATION ON TENSILE LOAD

COMPRESSION LOAD

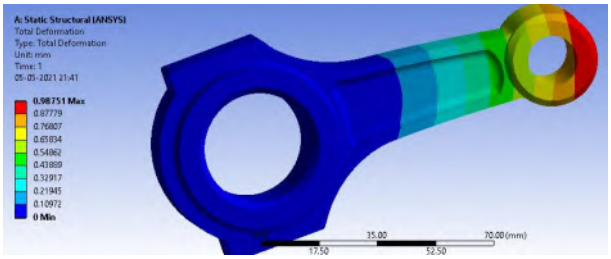
Object Name	*Equivalent Stress*	*Equivalent Elastic Strain*	*Total Deformation*
Results			
Minimum	2.152e-003 MPa	3.0015e-008 mm/mm	0. mm
Maximum	85.827 MPa	1.197e-003 mm/mm	0.22678 mm



EQUIVALENT VON MISSES STRESS ON COMPRESSION LOAD



EQUIVALENT ELASTIC STRAIN ON COMPRESSION LOAD



TOTAL DEFORMATION ON COMPRESSION

Results

Object Name	*Equivalent Stress*	*Equivalent Elastic Strain*	*Total Deformation*
Results			
Minimum	9.1489e-003 MPa	1.307e-007 mm/mm	0. mm
Maximum	364.87 MPa	5.2125e-003 mm/mm	0.98751 mm

7. Results And Discussion

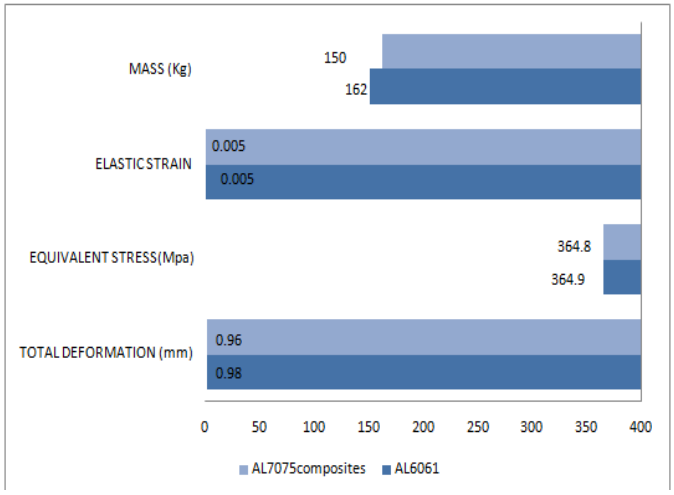
For the FEA analysis, the tensile load is 9280 N and the pressure load is 39453. The analysis was performed using ANSYS software. Force is applied to the small end of the crank to fix the fixed big end. The maximum and minimum fracture, elongation and displacement stresses are recorded in ANSYS.

7.2 COMPARISON OF SIMULATION RESULTS

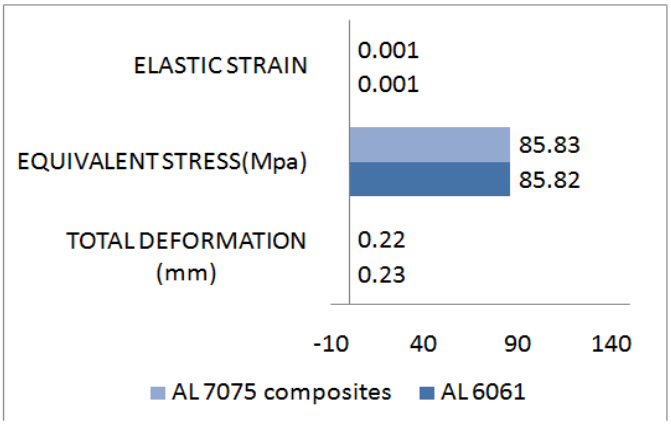
TABULAR ANALYSIS

PARAMETERS	AL6061		AL7075 composites	
	COMPRESSION LOAD	TENSILE LOAD	COMPRESSION LOAD	TENSILE LOAD
DEFORMATION (mm)	0.98	0.23	0.96	0.22
VON MISSES EQUIVALENT STRESS (Mpa)	364.87	85.8	364.9	85.83
VON MISSES EQUIVALENT STRAIN (mm/mm)	0.005	0.001	0.005	0.001
MASS (gram)	150		162	

GRAPH FOR COMPRESSION LOAD



GRAPH FOR TENSILE LOAD



Conclusion

- The elastic properties like stiffness of the connecting beam was increased than old material.
- AL 7075 Composites connecting rod suitable for manufacturing.
- In this composites Molybdenum disulfide is used traditionally in greases for bit lubrication.
- Tungsten Carbide is also added for High hardness High strength at high temperature and High resistance to corrosion.

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LEAN EXECUTION IN AUTOLEC DIVISION - PLANT IV (SUNDARAM FASTENERS)

Bhaskar. A[1] and Devaraju A.[2]
[1]Anna University, Chennai, Tamilnadu, India.
[2]Department of Mechanical Engineering, Adhi College of Engineering and Technology, Chennai, Tamil Nadu, India
tanvibhas@live.com

ABSTRACT

In the current scenario, the manufacturer's objective is to make quality components or products with multi-application by enhancing customer satisfaction regarding its performance or services and also to survive in this competitive world. Back in the 1900s, the manufacturers were in search of a method that could help in cost-cutting, reducing time and less manpower [1]. Various methods were discovered to enhance the quality output with high profit, leading to the lean manufacturing process. The persistence of our work is to implement a lean manufacturing process in Autolec division plant IV of Sundaram fasteners. Complete research was done to find places where lean manufacturing can be implemented. From this research, we nailed on the crucial ranges pointing the lean manufacturing where it can be introduced. We further proposed and endorsed the accessible ways of persisting the lean manufacturing system in the factory Autolec division plant IV, Sundaram Fasteners.

Keywords:*Lean Manufacturing, Waste, Just in Time, Throughout time, 5S*

1. Introduction

This article is well-prepared based on the experimental analysis by executing the lean manufacturing in Sundaram Fasteners, Autolec Division plant – IV, Chennai. In our research, we scrutinized the entire areas of the bay where various processes are undergoing for the different components and identified the key issues which affect the outcomes. Later we discussed and suggested with the management regarding the implementation of lean manufacturing, along with its long-term benefits if it is continuous monitoring and executing. The main idea behind this project is to increase the production of goods in a particular Enterprise by using less manpower, less wastage and also within the time given by the customer. With concern's permission and the Lean Manufacturing tool, we planned to reduce the wastes, time is taken for the product during the manufacturing process and without intermittent production process, we shorten the movement of materials in the bay itself for the fabrication, assembly, packaging and inventory zone.

1.1 Lean Manufacturing Transform

Lean Manufacturing is a refine or transform of getting an output / result of a product with minimum wastage or no wastage. Lean manufacturing uses several tools to produce a product more efficiently. Basically, the increase in demand leads to lean manufacturing. This process is taken up because it reduces waste, time and also. The only drawback in this process is if any one of the units goes wrong, every other unit goes wrong. Even that can be rectified by doing regular checking and maintenance should be done perfectly. The main elements for this process are Manpower, materials, machines, methods [12].

This process was first used in Toyota during the second world war. In simple words, lean manufacturing means creating more products for customers with less resources. Mainly, lean manufacturing works under five Principles [2].

1.1.1 Defining Value

Value can be defined as the demand according to the customer's need. For this, the cost estimation, people's expectation, manufacturing timeline and delivery are vital information for Defining Value.

1.1.2 Identifying the value stream

If the value is determined, then the Value Stream Mapping (VSM) is done. It is a process in which the needs of a product, from its raw material to delivering it to the customer, are tracked. In other words, the value of a product from its raw material until the delivery is mapped before the process is to be started. By

this process it would be easy to cut-down wastes and also reduce the cost of production.

1.1.3 Creating flow

After the wastes have been removed with the help of the VSM. It is to be made sure that the process goes in a smooth flow without any hurdles. So, it is necessary to create the flow in a continuous and tight path to the customer.

1.1.4 Using a pull process

If the above processes are done perfectly, it would be easy to produce the products as per customer's need, as in JUST IN TIME. By this, the products can be "pulled" from the producer, by the customer at any time. The stocks could be made ready when the customer demands and there won't be any need to pile up the stocks in advance or after delivery.

1.1.5 Perfect result

Once the product goes through the value map stream and comes out successfully and gains are seen continuously, it will be important to keenly watch the stream as lean manufacturing is sometimes a variable process.

1.2 The Lean Manufacturing System

The Lean manufacturing talks about one of the nastiest things that can ensue to any organization: waste. If you are not utilizing the advantages of all your resources, you have to drop the efficiencies and, in so responsibility, mass production. These ignored resources outlays everything in the project administration tools, production and the skills of the staff members [3].

Lean is a practice or procedure to diminish the wastes in a production system without losing throughput. The customer expresses what is worth in terms of what they would pay for the product or service. Through lean organization, what increases the value becomes clear by eliminating or falling everything that doesn't enhance value.

1.3 Wastes in Lean Manufacturing Systems

The negative impact of lean manufacturing is termed, in most cases, as waste. Adding the irrelevant parts, which does not add value to product, is deemed as waste. And also, when the customer is not ready or willing to pay for the part, which doesn't add worth is defined purely as waste.Wastes can be defined in many forms such as

1.3.1 Productivity

Production in exact number as per demand or in less numbers won't be a problem for the manufacturers, but overproduction is a problem because of the wastage. Manufacturing redundant products or components that are independent of the demands can be understood as overproduction. Overproduction is well-defined as production that surpasses needs from the customers. It clearly states that the manufacturing of goods before they are essential. The overproduction activities boost the possibility of making inaccurate products component obsolescence, as well as the necessity to bid products at a discount price. The outdated styles, in the view of higher production, as the expansion of resources, keys to an advanced prominence on machines linked to individuals. As such, overproduction not only peaks in the waste of material but also of worker resources.

1.3.2 Inventory Problems

If you are directing a lean manufacturing process as a manufacturer, you need to be free from the inventory wastes. Inventory is one of the perilous elements which act as a constraint to your industrial procedures of becoming slenderer and additional return on investment driven.

Because of overstocking the inventory every year, many industries, organizations drop a huge amount of money and are vanishing in the field due to the competitors. At further close of the field, losses correspondingly occur due to understocking and even the absence of raw materials (again, a consequence of meager inventory control of the raw materials).

Inventory management is one of the important techniques that supports you to save money by diminishing overheads. To enhance the growth of business strategy, inventory is the essential element. The systematic procedure of practicing the inventory method in the precise way will progress your cash flows, which can be parallelly capitalized in additional revenue generation carry-ons.Exploiting the probable of your inventory outcomes on improved business productivity -You can make better business

conclusions which significances enhance business results.

1.4 The Importance of Lean Manufacturing

Lean Manufacturing is a revolutionary process in the Flow-oriented production [4]. Generally, companies that can't designate the strife are compelled to cut down the charges and they lose turnout. In fact, losing of customers might be happened during this process. Consistently similar strategies will edge to catastrophe. As the organization needs/ demands to change its strategy, one of the proven and best strategies is lean manufacturing. The lean tool has the capability in many executive ways to shrinkage expenditures and raise percentages on a long term and this attitude is defined as "elimination of wastes". Lean's effectiveness is to produce the goods without wastes, by using the standard tools, calibrated machine tools, best suitable materials and workers. The rework and the scrap are diminished to a greater extent and continuous monitoring is one of the crucial factors in Lean. Regarding this excess production and holding the inventory above, the requirements are eliminated, which enhances directly the clients / customers satisfaction.

1.5 History of Lean Manufacturing

Lean Manufacturing is one of the best discoveries in the world. Lean Manufacturing finds its root back to the 19th century. In Fig 1.1,Lean Manufacturing is the root cause of the industrial revolution that exists till date. In the beginning, many processes such as Just in Time, Interchangeable Parts, Toyota Production Systems and the Ford Assembly line, influenced Lean Manufacturing. During the 1850s, where almost every manufacturing unit had problems with production because of less resources, man power and not much space for production and less time. Whereas, on the other hand, the customers demand was so high and not much time was given. [5] The father of this process introduced the Interchangeable Parts started the industrial revolution. Interchangeable parts lead to the Lean Manufacturing that helped a lot in increasing production.[5] The aim of the Interchangeable Parts was to produce every individual product identically, so that the final product will be identical for everyone.

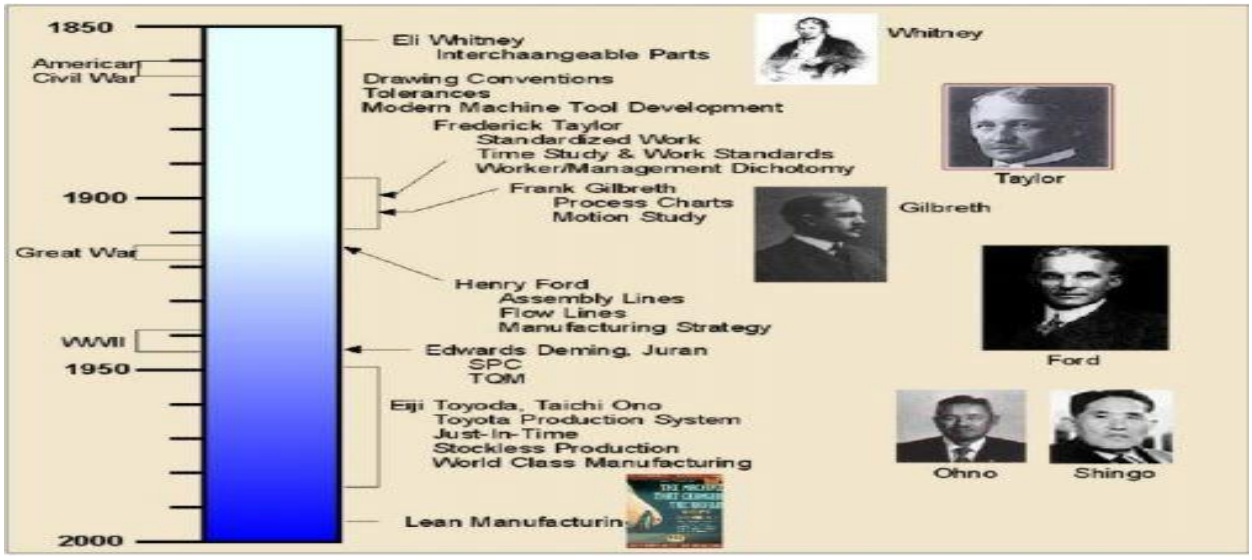

Fig 1.1 History of Lean Manufacturing

Later, Ford decided to convert from mass manufacturing system to Lean manufacturing system and hence HENRY FORD introduced the Ford Assembly Lin. The aim of the assembly line was to standardize the product which will bring in a standard process. The introduction of this assembling line made the workers to perform only a small part of the job, in other words, it reduced the manpower usually used in a process. Moving to the Assembly line made Ford to work in its own way as per customer's demand. After looking through the Ford Assembly System, Toyota discovered that the system could not fulfil the needs of every customer, then in the 1950s, the Toyota production company came ahead with a new process called the Toyota Production System (TPS) primarily used Just in Time

production to reduce costs [14]. Here the production is done with less resources, in less time and with less manpower, but produces more output as per customer's demand. The TPS is a management system which helps in organizing the manufacturing process and helps with the interaction between the suppliers and customers. All these processes were the main influencers for the Lean Manufacturing process. The word of Lean Manufacturing was first termed in the book "The Machine That Changed the World" [6]. states that Lean Production is not only the world's most efficient system for manufacturing, it is also one of the best ways of organizing industrial production.

1.6 Lean Tools

The industries which have implemented the Lean Manufacturing process use several tools and techniques according to the scope or opportunity available in the industry and the market to bring out the best from the process or cycle [2]. A few of the tools are:

1.6.1 The 5 S

The 5 S is the main principle of Lean Manufacturing introduced by Hiroyuki Hirano. It is nothing but 5 Japanese words starting with the word 'S' [7]. The words and meanings [8]are given in the above table.

Table 1.15 S and its meanings [8]

Japanese Term	Description	English Term
SEIRI	Removing all unwanted items from the workplace	Sort, separate
SEITON	Organize and identify storage place	Set in order, set in place
SEISO	Clean the work area	Sanitize, shine, clean
SEIKETSU	Standardize the best practice within the workplace	Standardize
SHITSUKE	Sustain and continue the cycle	Sustain

1.6.2 Six Sigma

Bill Smith, an American Engineer at Motorola introduced the technique or tool, Six Sigma (6σ) in 1986. The Six Sigma's strategy was to improve the manufacturing by removing the defects and minimizing the difference in the manufacturing process. Six Sigma has helped to improvement of manufacturing, in the 1980s, firms recorded a large number of savings after implementing the Six Sigma. After adapting the Six Sigma process in engineering and construction, it helped in reducing the construction time by 26.2% and construction waste by 67%.[7] The implementation of this process has helped in other sectors also such as Finance, Supply chain, Healthcare [13]. Later the process was also effective in Business performance improvement.

1.6.3 Visual Controls

From the word 'Visual Control", it is well understood that the process is about visually controlling a process. It is a business management technique, where the process is visually signaled and not in written texts. This process allows the quick recognition of communication to increase the efficiency. The signals can be of many forms such as different colors, signal boards or signage, Floor marking and other symbolically represented forms of communication.

1.6.4 Kaizen

The word KAIZEN is a Sino-Japanese word meaning "Change for Better" or "Improvement" [11]. It was first used in Toyota. It is basically an idea involving all the employees from the CEOs to the Assembly Line workers. This process is applied to healthcare, government, purchasing and logistics and other organizations that fall in the supply chain. It is applied to address the system level defects in an organization within a short period of time.

1.6.5 Value Stream Mapping

The process of Value Stream Mapping is almost a kind of flow chart in Fig 1.2 with the necessary steps to be taken to complete the process of manufacturing [9]. VSM is an essential tool to organize and plan a set of process or manufacturing as it includes all the

steps to be done in a cycle. This is mostly used in manufacturing streams. The aim of VSM is to reduce time, cost, unwanted transport and unwanted manpower. The process starts by preparing a flowchart of what is needed to be done in a cycle. It contains of the process from the first step of ordering to the last step of delivering and the manufacturing process in the middle. This gives a clear-cut idea of what is to be done, how much the process would cost, how long the process would take and how much manpower has to be used.

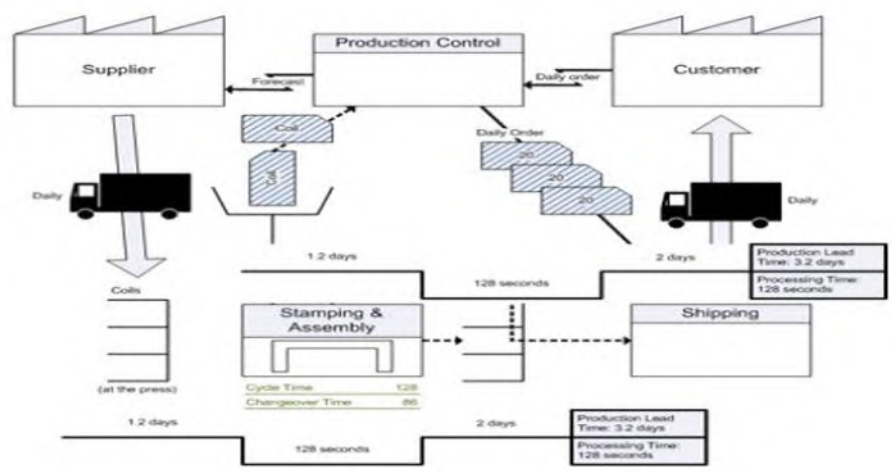

Fig.1.2 Example for Value Stream Mapping

1.7 Just-In-Time

1.7.1 History

In the middle of the 1970's, large numbers of Japanese assembly associations tested practically the Just in Time [a Japanese policy]. It was early emerged and idealized inside the Toyota fabricating organizations by Taiichi Ohno. The highlight of this method is gratifying the customer demands with bottom deferments [15].The specific advantage of satisfying the clients, purchasers, etc., enhances it popularization and directs Taiichi Ohno as the father of Just in Time.

Just in Time, contrive has a constraint that it has to be adjusted to the organization for reinforcing industry's depth in the profit-making center assuredly by curtailing misuses and improving the part aspect and productivities creation. intensification of Just in Time in Japan is due to the substantial communal mindsets and their hard-working attitude includes the accompanying ideas.

1.7.2 Just in Time (JIT)

Just in time is a typical technique utilized by creation and resale organizations to offset client support with lean operational destinations. With JIT, organizations just keep sufficient stock available to satisfy close term need. This stock administration procedure is powerful at controlling expenses; however, it additionally presents some inventory hazards.

- Workers are usually energetic and look to steady the improvement for which exists. Even though expectations are currently being met, there are also much better expectations to fulfill.
- Organizations revolve around the aggregate undertaking which incorporates the solidifying of capacities and sharing data, basic reasoning capacities, contemplations and the achievement of a common target.
- Work load always blackens recreation. It is not new to work for 14-hour days in Japan.
- Representatives will in general stay with one organization throughout their profession range. This permits the chance for them to sharpen their abilities and capacities at a consistent rate while offering various advantages to the organization.

1.7.3 Pros and Cons of Just in Time Inventory

Resource and space saving: The driver, which is mandated for the Just-in Time, is the equitable of setting aside investment, capitals and era. Maintaining the surplus reserves in a marketing supply or trade workplaces, the outlays will be large. To handle with the

reserves, you have to compensate the added entities and services and also it consumes further cradles and moving gears to grow, transfer and conveyance in the surplus reserves of volume section. If you constraint these expenditures, we can entreat the fair, satisfactory stock to finish the needs and expansion of potential advantages will be in peak.

Waste reduction:

The main elements of JIT are waste reduction [10]. The success of Just in Time depends on the diminishing rate of wastes and rework. This is the specific point where the customers slip in reserves / stocks / inventories nearby, the excess parts / products are inadequate and or mixed out. The exemptions in the prices decline, the net profits and direct in the dealing of products as calamities. Limiting the markdowns is the only possible way by avoiding the excess reserves.

2. Problem Identified

From our research, we found that there is a problem with the existing method used to manufacture products. That is the manufacturers take a lot of time in the production section. Generally, the main reasons for this problem may be due to the following points

- less labours,
- less time given to produce,
- more time taken in transport,
- unorganized production.

Butin this case, with the Autolec division plant IV, the problem is that the workers take a long time in transportation of materials within the production section and also to other sections. The only way is to reduce the time of production and give a boost in the production section is by changing the existing pattern or method to a new and a time saving method.

2.1 Existing Method

In Autolec Division plant IV, there is an existing method of production where the products are manufactured in a ZIG-ZAG method as in Fig 1.3 and Fig 1.4, in which the manufactured products are manufactured in a level and transported to another place for the next level, as in Fig 1.5. This method of transportation of materials will take at least a minimum time of the total production time. This kind of transport only results in wastage of time and less production within the given time. To overcome this problem, there should be a new process in which there is less or no wastage of time and gives a boost in the production section.

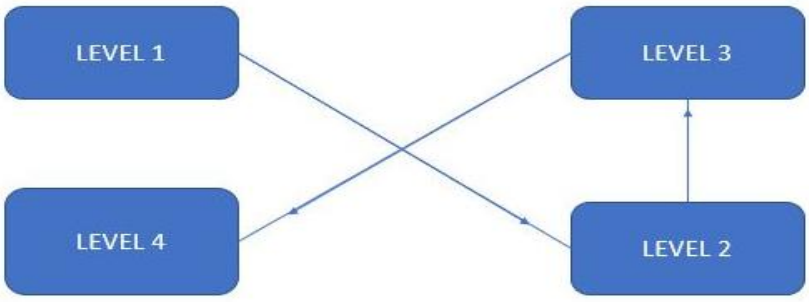

Fig.1.3 Current zig-zag method

Fig.1.4 Current ZIG-ZAG Process Washing (left) (level 1) and rotor performance test (level 5) (right in pic)


Fig. 1.5 Transportation of materials from Washing (level 1) to Pump Assembly (level 2)

2.2 Proposed Method

As seen in the previous chapters, the existing method of production in Autolec division IV, takes a long time in manufacturing due to the time wastage done in transportation of materials from one level to another level. To reduce the time wasted in production due to the transportation of materials, we have proposed a new method to the plant. According to the new method proposed, the transportation distance is reduced by placing every level of the production system next to each other, which results in reduction of time wastage, as the materials from one level to another are passed on easily within no time. This also helps manufacturers to produce more materials within the given time. The main expected outcome of the new method as shown in Fig 1.6is to reduce the time utilized in transportation of materials from one level to another level.

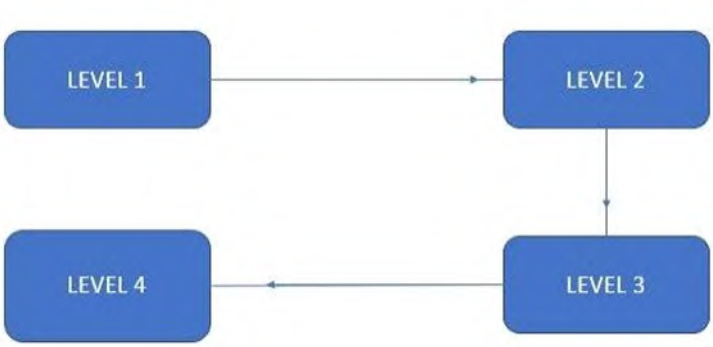

Fig. 1.6 Proposed method

3. Experimental Work

The TVS Sundaram fasteners is a company with worldwide clients, producing many products for different applications. In Autolec Division 4, They mainly produce the oil pump and water pump along with engine parts such as Engine Covers, Body etc. The clients to which they produce the products are Mahindra, Maruti, Mitsubishi. In the manufacturing process of those, we picked a few areas, where the concept of Lean Manufacturing can be used. The processes are as followed.

- Mahindra Bolero Engine Front Cover (IFC977)
- Oil Pump Body (OP475)
- Oil Pump Cover (OP475)

TVS Sundaram fasteners, a national brand, produces many products related to automobiles of different models and customer orders. We picked the above three models for our trials and noted the complete details of all processes with its time. And also, we interacted with the operators in different shifts regarding the wastes. From the information of the workers through visual identification and the recorded data's, we discussed as a team and framed the structure for the lean execution. Here, the customer demand is very high in a certain period of time and the time given for products by customers is less.The time taken for the

finished product is nearly 9-10 working days, but the customer demand is within 5-6 working days. So, they need more man power, which they can't afford within a certain period and work pressure is high.

Throughput Time

The time essential for manufacturing a product, which passes disparate process in that being transformed from raw products into perfect or completed goods. The same approach can be applicable to the transportation of raw products into a component. The time recommended for a material to pass through a production process envelope the unified time taken against when it enters production until it exits manufacturing, which adds the consecutive time intervals:

- Processing time. The time which is spent for the transformation of the raw products into Final products is called as processing time.
- Inspection time. The time which is spent for inspecting raw materials for quality and standards, work-in-process, perfect or completed goods, probably at numerous phases of the production process is called Inspection time.
- Moving time. The time taken to move items to and from the production bay as well as the workstations, is defined as Moving time.
- Queue time. This is the waiting time between the processing, moving action and inspection.

Table 1 Throughput Time for Mahindra Bolero Engine (IFC977)

IFC 977 Components In	Time Taken in Existing Method (Days)
Main raw material store	7
Machine shop	1
Dispatch	1
Total	9

3.1 Drawbacks with the Current State

1.The time taken in movement of material is high
2.More delay
3.Productivity is low
4.More man power is required
5.There is no proper layout (improper layout)

4. Manufacturing Processes

4.1 Mahindra Bolero Front Cover (IFC977)

Bolero Front Cover (IFC977) is produced after several process starting from washing through the final inspection. The process is explained in the below points:

Process 1: Washing

The washing process is so simple, the engine cover is placed in a washing machine to wash out the oil and grease over it, but the preprocess and post process takes more time than washing. From the Fig1.7the products are stored in some particular area.

Fig. 1.7 Washing Process in the Machine

Process 2: Oil Pump Assy

Oil pump assembly is where OIL pumpis fixed to the front cover. After finishing process 1 (washing), The worker carries the washed product to this segment in which oil pump as shown in Fig 1.8and water pump are fixed in the front cover. For this we come up with the line process where washing and oil pump and assembly can be fixed simultaneously.So, there is no need of man who carries the product from washing to oil pump and water pump assembly. By this we can reduce the work load, man power and the rime will be consumed for other assembly and testing.

Fig. 1.8 OIL Pump Which is to be Fixed in Mahindra Bolero Front Cover

Process 3: Leakage Testing

The leakage testing as shown in Fig 1.9test happens to check if the water pump gallery area is working properly without any leakage. After process 2 (OIL pump assembly), the worker carries the assembled products here for leakage testing, where the assembled product is checked properly. The product is placed in the leakage testing machine as shown in Fig 1.9. IN this level, the product is tested by giving a certain amount of pressure to the material and if the material clears the level, it is carried out to the next process, air pressure. There will be 15 second hold on the certain amount of pressure, if pressure decreases then the product will be rejected.

Fig. 1.9 Leakage Testing Machine

Process 4: Rotor Assembly

In rotor assembly as shown in Fig 1.10, a rotor in Fig 1.11is fixed to the cover of the engine, IFC 977 water pump joint assembly. The rotor is a moving part of an electromagnetic framework in the electric engine, electric generator, or alternator. Its rotation is because of the association between the windings and attractive fields which creates a force around the rotor's hub. The structure of a pump that joins inward stuff siphon rotors. The inward and external rotors are set whimsically inside a case. The external rotor has one more tooth than the inward rotor. The tooth tips of the external and internal rotor structure thechambers. After process 3 (leakage testing) the product is taken here for rotor assembly with the man power. It can be fixed by placing this equipment next to leakage testing machine

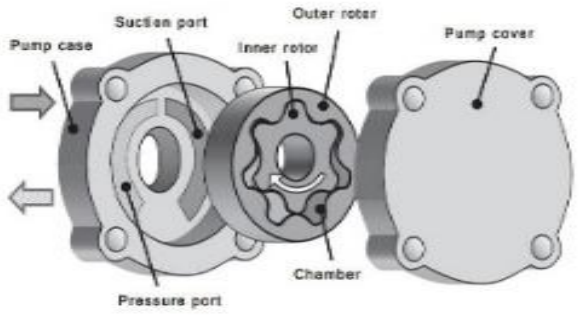

Fig. 1.10 Rotor **Fig. 1.11** Rotor Assembling M/c

Process 5: Performance Test

The rotor is made to rotate at a speed of 4000RPM to check its performance. The rotor after being fixed to the pumps and the engine cover is taken to the next level of production where its performance as shown in Fig 1.12is tested. The engine cover, placed in the machine, is made to rotate at a speed of 4000RPM to check its performance. Only if the performance of the rotor is successful, it will be taken to the next step or else the rotor is dismantled and the cycle will start from the first. After process 4 (Rotor assembly) the finished product is bought here for a performance test with manpower. By line method, this can be fixed quickly, and this performance test machine, can be placed next to the rotor assembly machine.

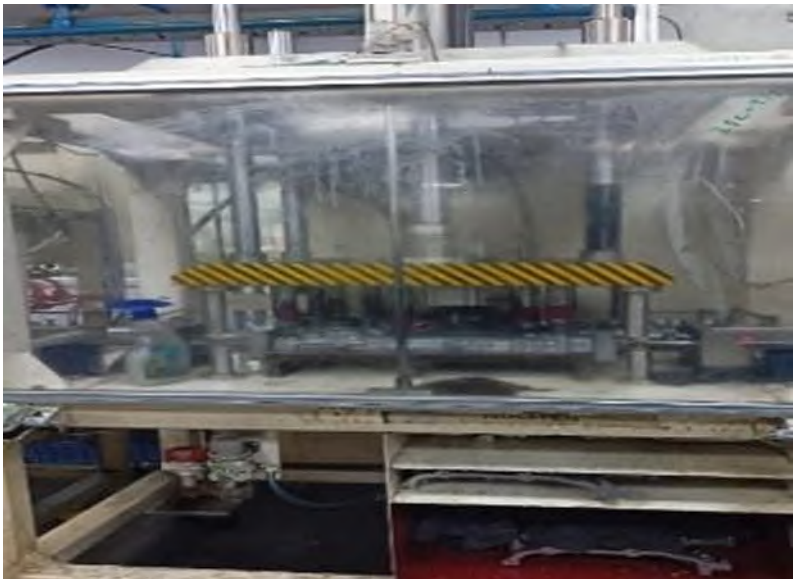

Fig. 1.12 Rotor Performance Testing Machine

Process 6: Final Inspection

The final test as shown in Fig 1.13such as leakage, performance etc. are done before packing. The Final test is done after the engine cover successfully passes all the levels such as washing, oil or water pumps assembly, leakage and performance test, before packing. If there is a problem with any part, the cycle of manufacturing is done again. After completion of process 5(performance test) the product is carried out for the next process.

Fig. 1.13 Final Inspection

Process 7: Packing

If the front cover passes all tests and is completely ready. If the engine cover in Fig 1.14is perfectly ready to be handed over to the customer, it will be packed as shown in Fig 1.15and transported to the end point of the customer.

Fig. 1.14 Packing **Fig. 1.15** Packing of Engine Cover

Current Method

The Existing method in Fig 1.16 shows the ZIG – ZAG movement of materials and the men during the process at different phases.

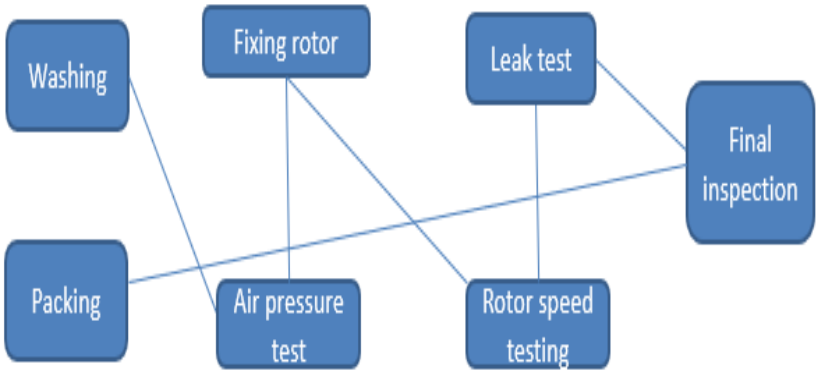

Fig. 1.16 Current ZIG-ZAG Method

Existing Prominence

Table 1.2 Time Taken for Current Method

Time Expenditure [Consumption]	289 seconds
Moving Displacement	189 meters
Workers (per shift)	15
Reserve (days)	7
Through Put (days)	9

The time consumption and the movements for the existing prominence are mentioned in the table 1.2.

Proposed Method

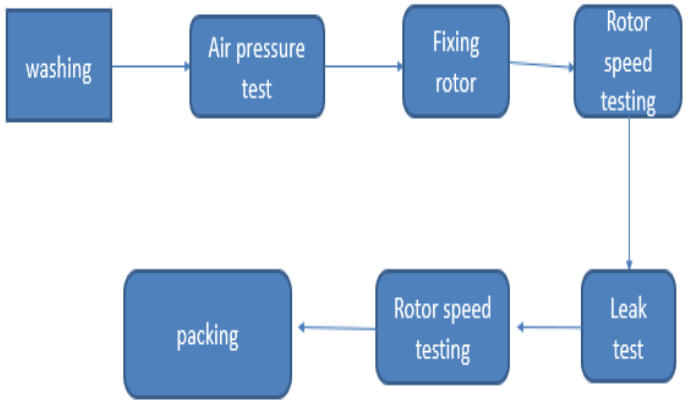

Fig. 1.17 Proposed Method of the process

we re-structured the framework of existing method and suggested the new method for the different process in Fig 1.17.

Proposed Status

Table 1.3 Time Taken for Proposed Method

Time Expenditure [Consumption]	29 seconds
Moving Displacement	14 meters
Workers	9 per shift
Reserve [Inventory]	3 days
Through Put Time	4 days

The time consumption and the movements for the proposed prominence are mentioned in the table 1.3.

Oil Pump Body (OP475). The Oil Pump Body in Fig 1.18 (OP475) is produced after undergoing several processes, starting from washing through the final inspection.

Fig. 1.18 Oil Pump body

The Current status Oil Pump Body (Op475) passing through different machines duringfabrications are mentioned table 1.4.

Current Status

Table 1.4 Current status of an Oil Pump Body (Op475)

Machine	Moving Time	Loading Time	Machining Time/ Part	Unloading Time	Distance (m)
	Main storeroom to Machine shop storeroom = 1min30sec	-	-	-	57
Machine -1 VMC	Machine shop storeroom to M/C-1 = 5sec	19 sec	320 sec	31 sec	1
Machine -2 CNC	Machine -1 to Machine -2 = 5sec	15sec	140 sec	10sec	2
	Machine -2 to T.S = 4sec	-	-	-	3
Machine -3 Labor-Intensive Drilling (2 Reaming process)	T.S to Machine -3 = 1min50sec	4sec	27sec	4sec	74
Machine -4 Labor-Intensive Drilling (Leak hole)	Machine -3 to Machine -4 = 5sec	4sec	25sec	3sec	3
Machine -5 (Deburring)	Machine -4 to Machine -5 = 26sec	1sec	8sec	1sec	17

Comparison of Current and Proposed Time (Sec)

The differentiation of Current and proposed time of an Oil Pump Body (OP475) passing through different machines during fabrications are mentioned table 1.5.

Table 1.5 Comparison of Time of an Oil Pump Body (OP475)

Machine	Moving	Existing - Sec	Proposed - Sec	Saving - Sec
Machine C -3 Labor-Intensive Drilling	Temporary storage to Machine -3	110	6	104
Machine -5 Deburring	M/C -4 to Machine -5	26	5	21

Comparison of Current and Proposed Distance (M)

Similarly, the differentiation of Current and proposed movement distance of an Oil Pump Body (OP475) passing through different machines during fabrications are mentioned table 1.6.

Table 1.6 Comparison of Distance of an Oil Pump Body (Op475)OIL PUMP COVER (OP475)

Machine	Moving	Existing - Sec	Proposed - Sec	Saving - Sec
Machine -3 Labor-Intensive Drilling	Temporary storage to Machine -3	74	3	71
Machine -5 Deburring	Machine -4 to Machine -5	17	2	15

Oil Pump Cover (Op475) as shown in Fig 1.19is produced after a process of seven steps starting from washing through the final inspection.

Fig. 1.19 Oil Pump Cover

The Current status of an oil pump cover (OP475) passing through different machines during fabrications are mentioned table 1.7.

Current Status

Table 1.7 Current status of an oil pump cover (OP475)

Machine	Moving time	Loading Time sec	Machining Time/Part sec	Time Unloading Sec	Distance (m)
	Main storeroom to Machine shop storeroom = 1min 45sec	-	--	-	63
Machine **-1** Labor-Intensive Drilling	Machine shop storeroom to Machine -4 = 3sec	5	10	6	-
Machine **-4 VMC**	Machine -1 to Machine -4 = 10sec	29	355	28	8
Machine **-3 VMC**	Machine -4 to Machine -3 = 3sec	11	315	17	3
Machine **-2VMC**	Machine -3 to Machine -2 = 3sec	15	365	11	3
	Machine -2 to T.S = 6sec	-	-	-	3
Machine **-5** Labor-Intensive Drilling	T.S TO Machine -5 =1min50sec	11	30	11	75
Machine -6 (Deburring)	Machine -5 TO Machine -6 = 28sec	1	30	1	15
Machine -7 (Washing & Cleaning)	Machine -6 to Machine -7 = 4sec	3	140 (W+C)	4	1
Machine -8 (Leak hole testing)	Machine -7 to Machine -8 = 6sec	11	1	13	4
Machine -9 (cleaning)	Machine -8 to Machine -9 = 6sec	1	15	1	4

The differentiation of Current and proposed time of an oil pump cover *(OP475)* passing through different machines during fabrications are mentioned table 1.8.

Comparison of Current and Proposed Time (Sec)

Table 1.8 Comparison of Time of an Oil Pump Cover (OP475)

Machine	Moving	Existing	Proposed	Savings
Machine -4 VMC	Machine -1 to Machine -4	10 sec	6 sec	4 sec per shift
Machine -5 Manual Drilling	T.S to Machine -5	110 sec	6	104 sec per shift
Machine -6 Deburring	M/C to M/C -6	28 sec	6	22 sec per shift

Similarly, the differentiation of Current and proposed movement distance of an Oil Pump Cover (Op475) passing through different machines during fabrications are mentioned table 1.9.

Comparison of Current and Proposed Distance (M)

Table 1.9 Comparison of Distance of an Oil Pump Cover (OP475)

Machine	Moving	Existing sec	Proposed sec	Savings sec
M/C -4 VMC	M/C-1 to M/C-4	480	180	300 sec per shift
M/C -5Manual Drilling	T.S to M/C -5	4500	180	4320 sec per shift
M/C -6 Deburring	M/C to M/C -6	900	180	720 sec per shift

5. Results and Discussion

From the above tables of the existing method, the proposed method and comparison of the old and new methods, we find that the newly proposed method is more time efficient than the old method. In the old method, transportation of materials was high because the machines were kept in a long distance away from each level, but in the proposed method, excess transportation is reduced by placing each process next to each other, so that, transporting of materials does not happen for a long time and helps to reduce the time and speed up the process in a large way. The time & Distance comparison for each product is given in the below table.

Time & Distance comparison of IFC977 Engine front cover.

From the below table 1.10of comparison, it is evident that the newly proposed method helps to save the time as 260 seconds per shift and the moving distance as 175m per shift.

Table 1.10 Time & Distance comparison of IFC977 Engine front cover

Description	Existing sec	Proposed sec	Saved sec
TIME CONSUMED	289sec	29sec	260 sec per shift
MOVING DISTANCE	11340 sec	840 sec	10500 sec per shift

Time & Distance comparison of OP475 body

From the below table 1.11, it is proven that the newly proposed method helps to reduce a lot of time waste by excess transportation.

Table 1.11 Time & Distance comparison of OP475 body

Description	Existing sec	Proposed sec	Saved sec
TIME CONSUMED	136sec	11sec	125 sec per shift
MOVING DISTANCE	5460 sec	300 sec	5160 sec per shift

From the below table 1.12, it is proven that the newly proposed method helps to reduce the time and distance for the OP475 cover of an oil pump as 130 seconds per shift and the distance as 89 m per shift.

Time & Distance comparison of OP475 cover

Table 1.12 Time & Distance comparison of OP475 cover

Description	Existing sec	Proposed sec	Saved sec
TIME CONSUMED	148sec	18sec	130sec per shift
MOVING DISTANCE	5880 sec	540 sec	5340 sec per shift

Conclusion

In the TVS Sundaram Fasteners Autolec Plant IV, we executed the lean manufacturing in the three models of manufacturing process, where the traditional way of practicing methods consumes more wastes in time, i.e., movement of materials and workers during the processes. The implemented outcomes clearly highlight the time wastage in the specific process [earlier practicing the traditional methods] and reduces the time taken for the movement of materials with in the bay for different process through the continuous monitoring. The new method proved to be more Time-saving than the previous method followed. From the above tables of comparison and design of the proposed methods, it is evident that the new method is a Cost-cutting process with reduced Manpower and also helps in reducing the time taken to manufacture and increases the production.

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DESIGN AND FABRICATION OF SEMI-AUTOMATED WELDING FIXTURE

Vinothkumar K.[1] and G. Swaminathan[2]
[1,2]Department of Mechanical Engineering, SRM Institute of science and Technology, Ramapuram campus, Chennai
[1]vinothkk@srmist.edu.in, [2]swaminag@srmist.edu.in

ABSTRACT

The objective of the project is to build a Semi-Automated Welding Machine to overcome the difficulty facing by Small Scale Industries such as accuracy of welding in a large number of jobs, the safety of labor, skilled labor, and welding quality by using a stepper motor, Lead screw with ball screw, guide ways and work fixture. The stepper motor is controlled by using Arduino Drive. This project will eventually reduce human work. This machine can be used for welding in small-scale industries to reduce the skilled labor cost, to increase the accuracy of welding, to completely reduce hazardous accidents such as burns, eye damage, electrical shock, cuts, and injury to toes and fingers. This semi-automated welding fixture is affordable compare to a fully automated welding machine so it is economical for Small Scale Industries.

Keywords- *Arduino Drive, stepper motor, economical, Small Scale Industries, reduce*

1. Introduction

Automation, often known as automated control, is a technology that allows a process to be completed with little or no human intervention. The use of various control systems to run computers, manufacturing processes, and home appliances is automation often referred to as automatic controls. Processes are automated using mechanical, hydraulic, pneumatic, electrical, electronic, and computational devices. Many of these techniques are often used in diverse settings such as manufacturing plants, aeroplanes, and ships, typically use all these combined techniques. The rate at which automation is being brought into the welding process is astounding, and it is possible that by the end of this century, welding production facilities may have more automated machines than persons. Furthermore, computers play an important part in automating welding processes, and the commands issued by the computer are derived from programmes, which, in turn, are derived from the equations.

Shendage Yogesh, et al., [1] According to the article, the Doptimal approach is a comparatively recent technique similar to response surface methodology that is used for carrying out design of tests, study of variance, and analytical modelling. The Doptimal criterion was created to choose design points in such a way that the variance associated with the estimates of defined mode coefficients is minimized. In certain ways, this approach is more useful than central composite design (a traditional response surface method) since it requires less trials and can address categorical variables used in experiment design. Mohd Khairulamzari Bin Hamjah,et al., [2] The article communicated The collection of parameters is an important element in achieving the best surface roughness of the weld bead. In the mould industry, surface roughness is a crucial factor. Increased surface roughness can minimise extra work or polishing, as well as time and manpower constraints in mould manufacture. Nonetheless, correct parameter specification is important to performance. When it comes to getting the optimum welding surface, ampere, movement speed, and filler rod feed rate are all crucial.When setting up a device based on its form and dime, parameters such as current, CFH, arc gap, and others must be treated as constants. Sanidh Sanchala etal., [3] The paper conveyed in the welding process the number of parameters affected the quality of weld. In case of linear and angular welding, angular welding is much more difficult than linear welding. In order to get the desire quality of weld one has to give accurate feed, which is one of the most important parameter. Due to the automation using VFD the weld accuracy and quality is increase with controllable linear motion of Welding torch with precise feed of work with less time utilization. By means of 6

degree of freedom the flexibility offers Ease of operation for moving the welding torch smoothly with appropriate adjustment of height, surface finished worked with less welding defects is achieved. Vaishnav Karan et al., [4] The paper conveyedthe study suggests that the number of parameters affected the worth of weld. In case of linear and angular welding, angular welding is much more problematic than linear welding. In order to get the get quality of weld one has to give precise feed, which is one of the most significant factor. This can be delivered by semi automation which provides the benefit of precise feed, decrease the time of work, fewer skilled labor requisite for the work. The investigates will look to accept the semi automation for angular corner joint Mig welding by given that five degree of freedom for linear and angular motion of welding torch for feeding, and with appropriate controllable method for weld accuracy. Akshay M, etal., [5] According to the article, they created "A SEMI-AUTOMATED ARC WELDING MACHINE," This is very valuable and offers workplace safety in small factories. The workpiece diameter of the unit is lower than 6 mm (mild steel). The machine will weld a maximum length of 150mm and the metal part that you can weld a maximum width of 50mm. In the mass manufacturers of conveyors, MIG and TIG and other applications that would be highly helpful. Commercially viable is the economic production of this enterprise. Semi-automated welders need less time to solder in contrast to unqualified jobs. Ashwane Kumar Srivastava et al.,[6] The paper conveyedthey have developed a fully automated welding which is using in medium and large scale industries. It consists of Drive, Controller, Multi axis robot which is programmed using Teach Pendant after the installation. It is a very high cost automation which the micro and small scale industries could not afford it. Seayon S. Dmello et al.,[7] The paper conveyedas we seen in the above Literature [6].They have developed a fully automated 2-axis welding chine which is using in medium and large scale industries. It consists of Drive, Controller, Multi axis robot which is programmed using Teach Pendant after the installation. It is a very high cost automation which the micro and small scale industries could not afford it. Faiz F. Mustafa et al.,[8] The Angle, length etc. From this we obtained a quality welding technique by means of accurate

conveyor, which holds and transports the MIG's soldering gun on the revolving rail fixed near the groov, increases its soldering finish in contrast to the manual method, maintaining welding parameters such as the gap from the gun to the soldering joint groove, the constant travel speed of the soldering gun, and the time and money saving. There are several benefits, such as maintaining worker wellbeing and reducing mistakes and problems that arise during the welding process. Three DC motors operate the system: one to go around the shaft, another to control the distance, and a third to oscillate the solder weapon

Welding defects (such as undercut, lack of fusion, inadequate penetration, cracks, insufficient surface finishing, not having fair feed, which causes the other surface defects), improper usage of filler materials, time taking, high concentration needed for welding, well trained and qualified workers required, and so on are some of the issues that arise during manual welding. Because of automation, the above welding defects can be minimized while maintaining high precision and efficiency of the welding board. Wastage can be reduced by consuming less time and employing less people.

As a result, integrating properly engineered machinery with automation will increase Welding efficiency. Owing to a scarcity of economic opportunities and facilities, small scale businesses are now reliant on manual welding and machining processes. Furthermore, the uniformity and consistency of the weld cannot be guaranteed, not to mention the working hours put in and the money expended on labor. There is still a constant chance of endangering the user due to smoke, flames, and spatter coming off such devices

2. Component and fabrication

Mechanical cutting

Mechanical cutting is a process in which tooling and machining takes place, and it is a method that uses powerful tools to machine and shape the materials to form in to present design.

Welding

Welding is a joining procedure that uses high-temperature electrodes to fuse two metals together. There are two types of welding processes: arc welding and TIG welding. Arc welding uses an electrical source to supply heat to the electrode, while TIG welding uses an electric current to flow through the electrode to create even stronger connections..

Bending

Bending is a manufacturing technique that creates a V-shape, U-shape, or channel form in ductile materials, most frequently sheet metal, along a straight axis. Box and pan brakes, brake presses, and other specialist machine presses are commonly utilised.

Drilling

Drilling is a cutting technique that involves using a drill bit to create a circular cross-section hole in solid materials. The drill bit is generally a multi-point rotary cutting tool. The bit is pushed against the work piece and spun at speeds ranging from hundreds to thousands per minute.

Tapping

Tapping is the process of cutting a thread within a hole in order to insert a cap screw or bolt into it. It's also used to create nut threads. A tool called a "tap" is used to tap.

Assembly

In assembling process all the mechanical component is arranged and is placed in a specific area according to the calculation. Each component is positioned with care to ensure that the material is of higher quality. Every component is thoroughly tested before being installed and then thoroughly checked again after assembly. This will minimise the likelihood of the machine making an error, and if one does arise, we will be able to correct it before the final run.

3. Design Calculation

The following components are to be designed.

1. Motor Torque Calculation

$T=1/2\ \pi\ P\ (F+\mu Wg)$

T=1(2x3.1415) x (1(7.848+(0.3x4x9.81)

T=3.123N-m.

Where:

T= Torque (N-m), F= External Force (N), W=Mass of Load (kg), μ= Friction Co-efficient on sliding Force (Approx: 0.05 to0.2), g=Gravity Acceleration (m/s²), P=Ball screws lead (m), F= 20% of the load N, W= 4Kg, μ=0.3,g=9.81m/s², P=1m, 20% of the load =0.8 x 9.81=7.848N-m

2 Motor RPM Calculation

Welding Speed = 5mm/sec, 1 Revolution = 5mm/sec, Speed= 60 RPM

3 Screw rod calculations

Major Diameter (D) = 16 mm, Pitch = 1/Number of threads per inch = 1/14 = 0.0714” = 1.813mm

Single thread height = 0.75 x Pitch x Cos (30) = 0.75 x 1.813 x Cos30 = 1.1779 mm

Pitch diameter (d) = Major diameter – single thread height = 16-1.779 = 14.221mm~14mm (say)

Area of threaded screw rod (A) = 3.14xlength of screw rod x d x 1.65 = 3.14x500x16x1.65 41448mm^2

2D Drafting

The following 2D diagrams are the components to be used in the project. Using AutoCAD software.

1. Base Plate

The Base Plate is designed for the compactness of the machine. The material is used in the base plate is mild steel. The main purpose of the base plate is, it makes the whole assembly portable easy to carry.

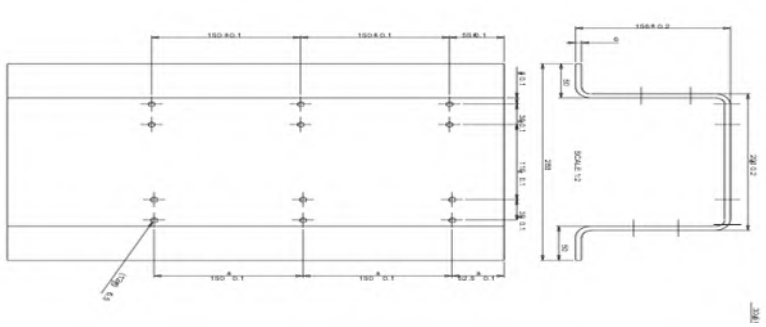

Fig: No: 1 Base Plate

2. Bearing Block

The Bearing Block is designed to hold the two sides of the bearings which are attached to the lead screw. It is made up of mild steel.

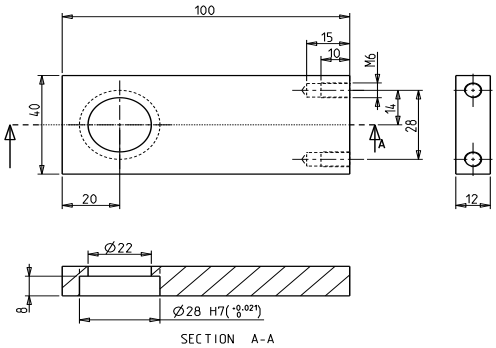

Fig: No: 2 Bearing Block

3. Connecting Plate

The connecting plate is designed to connect the lead screw and job holding plate. One end of the connecting plate is fixed with a nut in the lead screw and another end is connected with the job holding plate. It is made up of mild steel.

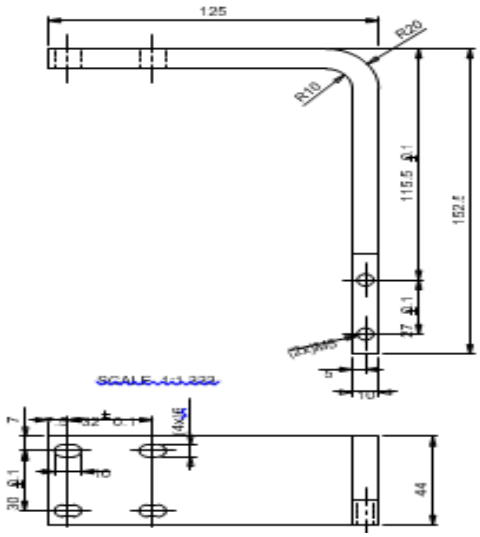

Fig. No: 3 Connecting Plate

4. Holder

The holder is designed to hold the welding torch. It is made up of mild steel. The torch will be held by the four bolts which is mounted in the holder.

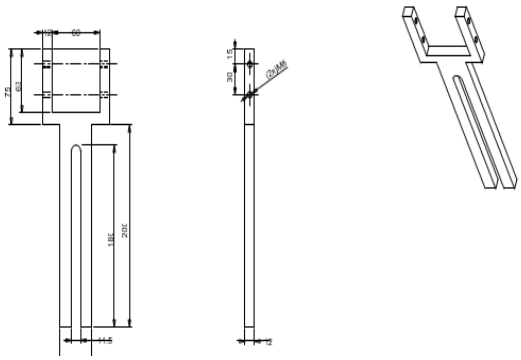

Fig: No:4 Holder

5. Job Holding Plate

The job holding plate is designed to hold the work piece. It is made up of mild steel. It will be fixed on the top of the guide ways using bearing blocks.

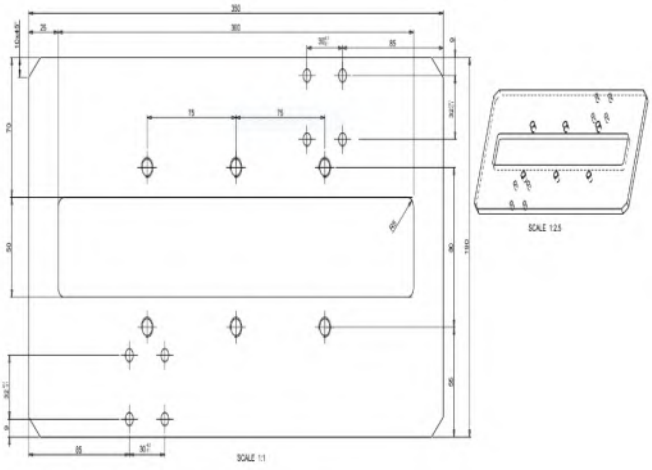

Fig.No:6 Job Holding Plate

3D-Modeling:

This 3D view represents the whole assembly of the project.

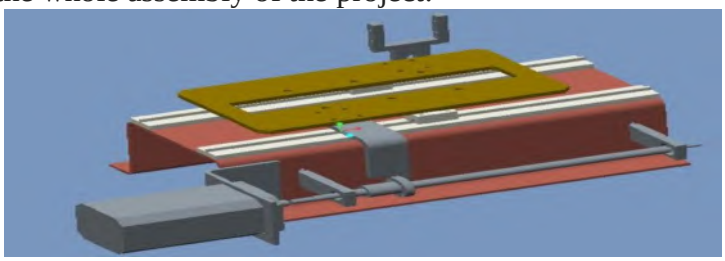

Fig.No:7.1 Orthogonal View

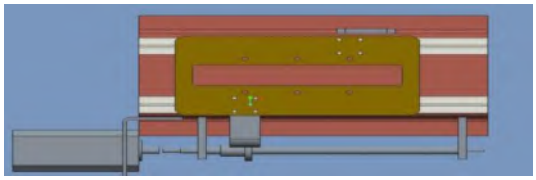

Fig.No:7.2Top view

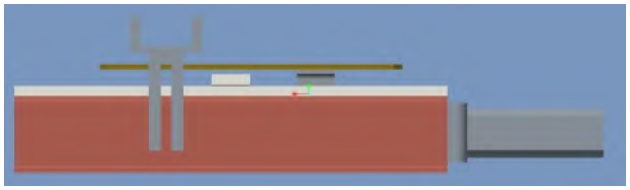

Fig.No:7.3 Sideview

Circuit

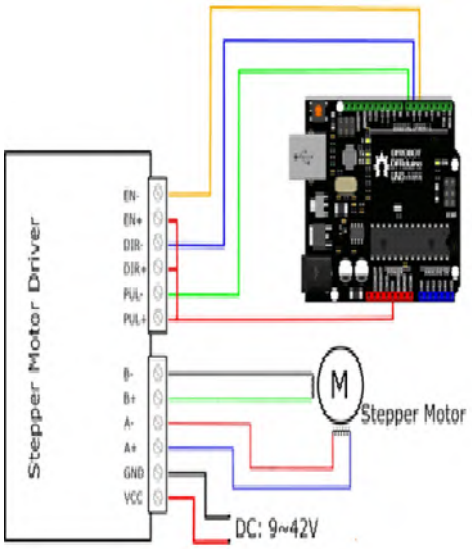

Fig.no:8 Circuit Diagram

5. Working Condition

The project contributed to the welding industry and also in the area where the machines can be simplified and made cost-efficient. The project did work in making the work easy, the main purpose of the machine is risk-free, safety, the accuracy of the welding, to make the semi-automated welding machine affordable to all the Micro and Small Scale Industries and to give slightly equal output as powerful as the other higher-end machines. Mechanical, electrical, and electronic components are all working on this. It uses a semi-automatic machine to execute precise tasks, and it is also portable and simple to move.. It contains a stepper motor, driver, these components are controlled by ARDUINO UNO. This machine can be easily operated by an unskilled worker. Hence, no skilled laborers are required. The cycle time of the machine also can maintain consistently. So, the production output will be consistent.

6. Conclusion

The manual welding method has a number of restrictions and drawbacks, including lower production, inconsistent welding quality and dimensional inaccuracy, and a high reliance on humans. Semi Automatic Welding Machine overcomes all of these drawbacks. When compared to unskilled labour, welding with semi-automated welding equipment takes less time. It is preferable to use a semi-automatic welding equipment for welding than to use unskilled personnel.

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SCREW-TYPE PICO HYDRO TURBINE

R. Nirmal Raja[1], J. Renuraman[2], G. Nivruth[3] and S.M. Sambavi[4]
Department of Mechanical Engineering, SRM Institute of Science and Technology, Ramapuram Campus, Chennai
[1]nirmalrr@srmist.edu.in

ABSTRACT

One of the major problems India is facing is power shortage. Hydropower is the most reliable renewable asset for power generation and does not release any greenhouse gases or toxins into the environment. Small hydro power systems require the use of small turbines which can efficiently and economically meet the electricity requirements of impoverished and rural societies. In this paper, screw (Archimedes) type pico hydro turbines are studied. Archimedes screw is one of the oldest marvels of engineering and it is in use even today. Recently, by modifying it as a turbine, it has become a huge rejuvenation in engineering. Pico-hydro turbine systems are a flourishing option that aims to generate electricity in a clean manner by using small waterfalls and/or streams. Installing pico hydro turbines (screw type) in households can help generate power. These small steps must be taken to eradicate the electricity deficit in our country. This study depicts the results of a CFD analysis of a pico-hydro turbine designed for generating electricity in rural townhouses. The data, which was collected, provides potential backing for additional research in the field as well as the possible production of prototypes. The data was collected using simulations developed for a model created and simulated in Fusion 360. It also promotes the creation of experiments and lab testing in which geometric or operating factors can be changed.

***Keywords**: Pico-hydro turbine, Archimedes, CFD, Fusion 360*

Introduction

Energy

India, in terms of power consumption, it ranks 5th in the world. About 90% of India's electricity generation is from fossil fuels. Amidst the growth of the world population, the continued exhaustion of conventional fossil fuels sources such as oil, gas and coal and the threat of worsening of the environment, appropriate exploitation and utilisation of energy from renewable sources has now become a primary priority around the world in recent decades. (Kumar et al., 2020). The consumption of various energy sources in India is oil (32.3%), coal (54.4%), natural gas (7.7%), hydro (4.5%) and nuclear (1.2%). The fossil fuels release carbon dioxide and other greenhouse gases and cause problems like global warming, air pollution, ozone depletion and deforestation (Kumar et al., 2020). To reduce carbon emissions the energy demands can be met through sources of renewable energy. Moreover, it is also impossible to reverse the trend and reduce power consumption significantly. A huge role in the decision making process is to encourage the use and expansion of renewable energy sources (Askarzadeh, 2017). To nullify this pattern, studies and deployment of renewable devices and sources has increased (Askarzadeh, 2017).

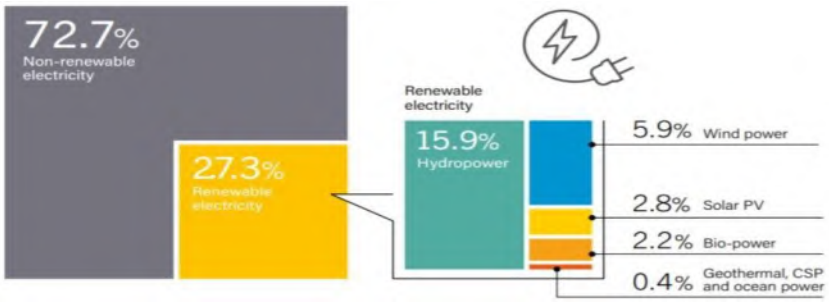


Figure 1.1 Estimated renewable energy share of Global Electricity production 2019

Hydropower

One of the most cost effective and dependable renewable energy is hydropower, with significant value for a sustainable future. Because of many countries continued reliance on renewable energy generation, hydropower development is regarded as one of the world's fastest growing economies and emerging markets. The use of renewable hydropower energy is critical to economic growth and the improvement of local living standards. When compared to fossil and nuclear fuel, hydro power directly supplies one-fifth of absolute power and represents an internationally significant source of electrical energy. Hydropower is the cleanest source of electricity, transmitting the fewest greenhouse gases when compared to alternative sources.

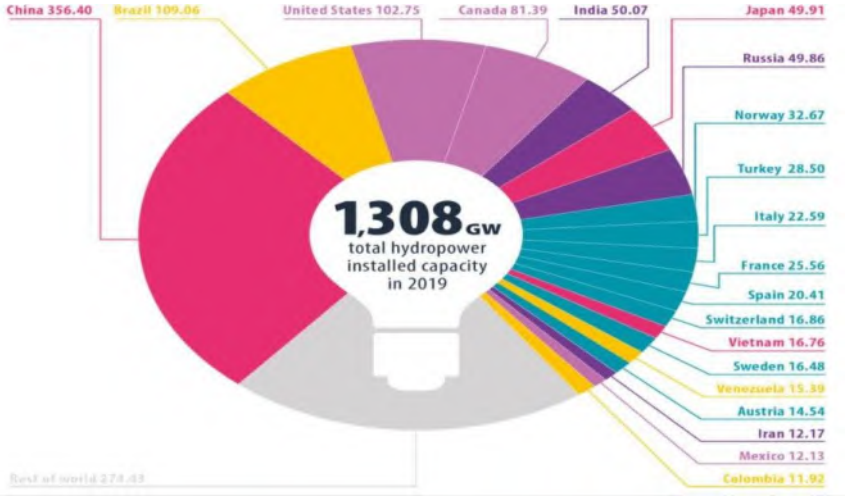


Figure 1.2 1308 GW total hydropower plants installed in 2019.

These plants are categorized based on their energy producing capability, which is measured in megawatts. While large plants generate above 100 MW, small systems typically generate less than 10 MW. Small-scale hydropower system is divided into four size categories based on energy production capacity, pico- , micro, mini, and small (Prasanna et al., 2012). Because of its environmentally friendly operation, water energy in mini/micro systems have gotten the most attention (Abhijit and Aliakbar, 2009; Laghari et al., 2013). They have the capacity to replace fossil fuels more quickly than any other renewable energy source. Water energy is critical for a better economy because it is a tidy, low- cost, and environmentally friendly source of energy.

Hydro Turbines

The classification of the hydro turbine based on their head (in meters) and flow (discharge in m3/s) is given in Table 1. Particularly in lower head, it could be the excellent low-cost alternative for electrification in growing countries. Around the world, there are many sources of hydro power in the form micro or pico hydro power from low head river or irrigation have not been exploited yet (Yulianto et al., 2017).

Table 1. Types of Hydro Turbines

HYDROPOWER TURBINE TYPE	TYPICAL SITE CHARACTERISTICS
Archimedean Screw	Low heads (1.5 – 5 m) Medium to high flows (1 to 20 m^3/s)
Crossflow turbine	Low to medium heads (2 – 40 m), Low to medium flows (0.1 – 5 m3/s)
Kaplan turbine	Low to medium heads (1.5 – 20 m) Medium to high flows (3 m3/s – 30 m3/s)
Pelton/Turgo turbine	High heads (> 25 m), Lower flows (0.01 m3/s – 0.5 m3/s)
Waterwheels	Low heads (1 – 5m) – though turbines often more appropriate for higher heads, Medium flows (0.3 – 1.5 m3/s)
Francis turbines	No longer typically used besides in very massive garage hydropower systems, although masses of older, smaller mills are in life and may be restored.For older turbines : Low to medium heads (1.5 – 20 m) Medium flows (0.5 – 4 m3/s)

Classification of hydro turbines based on direction of flow

1) Tangential or peripheral flow
2) Radial inward or outward flow
3) Mixed or diagonal flow
4) Axial flow types

Classification of hydro turbines based on specific speed

i) **Low specific speed:** This employs a high head in the range of 200m upto 1700m. These machines require lowdischarge. Example: Pelton wheel. Ns = 10 to 30 single jet.

ii) **Medium specific speed:** This employs moderate heads in the range of 50m to 200m. Example: Francis turbine, Ns = 60 to 400.

iii) **High specific speed:** This employs very low head in the range of 2.5 m to 50m. These require high discharge.Example: Kaplan and propeller etc., Ns = 300 to 1000.

Classification of hydraulic turbines based on pressure change

1) **Impulse Turbine**: The pressure of liquid does not change while flowing through the rotor of the machine. In impulse pressure of the turbine change occurs only in the nozzle of the machine. One such example of an impulse turbine is the pelton wheel.

2) **Reaction Turbine**: The pressure of liquid changes while it flows through the rotor of the machine. The change in fluid velocity and reduction in its pressure causes a reaction on the turbine blades and Francis and Kaplan turbines fall under the category of reaction turbines.

Archimedes Screw Turbines

Screw turbines use Archimedean screws to generate power by utilizing the potential energy. They are preferred when the potential head is low and the rate of flow of water is high. The screw turbines work at lower speeds and are easy to install and remove when necessary. Screw turbines are divided into two types: open and closed trough. The trough in open trough turbines is made of concrete, whereas the trough in closed trough turbines is manufactured of steel or aluminum pipe. This work mainly focused on the design, analytical solution for a closed turbine and CFD analysis. Changing heads and capacity have little effect on efficiency. The Screw Turbine does not require a grease pump to keep the bottom bearing lubricated. This increases efficiency while decreasing operational costs. When compared to other types of small turbines, the Screw Turbine has a very high efficiency. Screw turbines could be used to extract potential energy from fluid flow. Because of the advantages of ultra-low head, this turbine looks promising.

Literature Survey

Ranjan et al. (2019) analyzed the nozzle entry's arc angle and the effect of blade on the output of hydro cross flow turbines. In their work, they investigated the cross flow of a hydro turbine that was carried out with the help of ANSYS FLUENT in a finite volume solver that can handle multiphysics. The unsteady three dimensional simulation. The last configuration of design was found to be 20% more efficient compared to the existing model. The impact of temperature of the flowing water on overall performance of the turbine also has been studied. The maximum performance at inlet blade angle, 10° has been discovered to be 93.8% at 600 rpm. By incorporating the nozzle entry arc angle, maximum performance has been found to be 97.8% at nozzle entry arc angle, 65° with rotational speed 600 rpm and inlet blade angle, 10°. The performance of the modern design configuration has been discovered 20% better as compared to the existing model.

Hidayat et al., (2020) designed and analyzed the portable hydro turbine with spiral vortex for a pico hydro power station. Due to this sloping angle, it is vital to regulate the turbine consumption to supply an extra speedy water go with the drift in order that the turbine can rotate quicker. The amendment is made by designing and creating a spiral vortex hydro turbine, in which the consumption is designed to resemble a snail house or a whistle to supply a spiral vortex to force a turbine. Their results showed that the hydro turbine with spiral vortex produced better rotation in the turbine than a traditional intake of water. To produce electricity, the turbine was then paired through a pulley system with a generator. The

maximum output of voltage for the generator was found to be 27.5 Vdc with the speed, 293 rpm.

Shashikumar et al., (2021) studied the application of vertical axis hydro turbines for sustainable energy technology in irrigation channels with special bed slopes. The present work is performed to have a look at the overall performance of a Savonius rotor for small-scale hydropower generation. It has been observed that a number of the irrigation channels to be had in the rural regions are having sufficient bed slope to generate kinetic energy, which may be harnessed through a Savonius rotor. An in-house fabricated scale-down model of the Savonius rotor is examined at an inclination of the recirculating indoor multipurpose tilting flume at 0, 0.5, 1.0, 1.5 and 2.0 to decide overall performance under managed conditions. It is observed that on the tip velocity ratio of 0.92 and channel inclination of 0.5 as compared to 0 inclination, the coefficient of energy and coefficient of torque improved to 40% and 10%, respectively. Furthermore, it is found that the torque and energy developed by the turbine are maximum at a bed slope of 2.0° because of the maximum available energy.

Malhan and Mittal (2021) evaluated the various mathematical techniques for generating micro hydropower system's cost correlations. In this study, they have meticulously analyzed three methods in total. The first two methods used approaches that existed already to assess cost components each separately in order to find the cost respectively. The last method analyses the results of having a model of multivariate regression in polynomial for the cost correlations improvement. The proposed method yielded a MAPE (mean absolute percentage error), lower than 5% with the MHPs' cost of the total project.

Paulo et al., (2018) approached the design of hydro turbines with diffuser-augment utilizing the momentum of blade element. They have used a novel approach considering the diffuser efficiency, to design the hydro diffuser-augmented turbine. Expressions that are new for the thrust and factor of axial induction were obtained based on the momentum of the blade element. To evaluate the model proposed, a comparison between the two distinct diffusers were carried out. Theoretical and mathematical results were compared. The power increased by 53% for the flanged conical diffuser.

Najafi et al., (2018) analysed the using of the Lattice Boltzmann Approach, mathematical simulation of flow in a hydro turbine channel to enhance efficiency. In this work, they studied the channel geometry's influence and its assembly gap of a hydro turbine for the improvement of efficiency. The velocity of flow increasing and the inlet fluid's pressure drop control were studied. As a result, the perfect channel configuration in hydro turbine constructions for improved efficiency was with an airfoil-like channel in a one-meter assemble gap.

Elbatran et al., (2015) reviewed the installation, efficiency, and economic assessment of the turbines of micro-hydropower with low head for remote and rural areas. This paper examines the turbines of micro-hydropower with low head, with an emphasis on efficiency and operating costs. Micro-hydropower plants are used to generate electricity in remote and rural areas in both developing and developed countries. Researchers aspire to accomplish good results with simple turbines that need little initial and operating costs in order to increase efficiency in poor countries.

Williamson et al., (2014) analyzed the selection of a pico hydro turbine with low head using a multi-criteria. In this work, a method for deciding which architecture's turbine is best suitable for a pico hydro turbine with low-head as requirement was described. The end user's specific requirements decide the quantitative and qualitative selection criteria. Individual sample scores are weighted according to the presumed perceived value of each parameter in comparison with the original specification and the overall weighted score is used to choose a turbine variant. For a remote location with low head as well as variable flow specifications, this technique is used to identify whether to use a propeller turbine or a single-jet turgo turbine.

Lashofer et al., (2012) investigated the guidelines of design and state of technology for Archimedes screw turbine. The presented work includes a site inquiry, an operator

survey, comprehensive field measurements, and extensive laboratory tests. It assesses the prevalence of the turbine, its application, operational experiences as well as design alternatives and design guidelines. Because of the large screen spacing and the overall stable layout, running costs are relatively low and specific investments range from 0.5 to 2 €/kwh. Peak efficiencies above 75% were achieved by the six top-performing plants and mean plant efficiencies were 69% .The rotary screw turbine design was examined. Efficiencies of up to 94 percent were recorded for seven separate screw designs that were tested in key experimental trials.

Irwansyah et al., (2019) investigated the archimedes screw turbine's configuration and output as a micro hydroelectric plant with flow rate debit variants. The aim of this research was to design, construct, and according to the impact of flow of water discharged on torque, rotation, optimum performance and pressure, Archimedes Screw Turbine was tested in order to determine the best turbine design and output. In results it is found that the highest rotation, turbine speed, and test results occur at a 116.10 watts as power, and a peak turbine performance of 57 percent, the turbine's flow rate of 0.02 m3/s and 236.40 rpm. With the flow rate as 0.02 m3 /s, the turbine with the most power and efficiency is obtained.

Rohmer et al., (2016) modeled and investigated the archimedes screw turbine's working results. Here, the optimal sizing of Archimedes screws is discussed. The mechanical efficiency is calculated using a numerical model based on design parameters, speed of rotation, and filling degree. The experimental data with a diameter of 0.84-m archimedes screw producing 250-N-m torque are analyzed and discussed to data from an authentic installation: This paper documents the effects of an archimedes screw with a diameter of 0.84 m and a torque of 250 N-m.

Chris Rorres (2000) investigated design of an optimal archimedes screw for the screw's turn. Here, the pitch and inner radius of the screw that increase the water's volume that is lifted in a turn are discovered in this paper. The best parameter values are compared to those that are in the screw mentioned by engineer Vitruvius and Roman architect of the first century B.C., as well as those in the modern Archimedes screw's design.

Kozyn and Lubitz (2017) investigated the Archimedes screw generator's power loss model. This includes a full loss of power concept for an Archimedes screw used for electricity production (ASG), as well as a non-dimensional method for analyzing losses of power by flooding the outlet submersion. The proposed model for power loss outperforms the previous power model with no friction and can predict the output power for a real-world ASG in most cases.

Deshmukh et al. (2017) investigated the performance of sustainable screw turbine using computational fluid dynamics for micro and pico-hydro applications. In this study, the performance of a uniformly pitched double start closed trough screw turbine is analyzed for the fluid flow characteristics through variation of its operating conditions using the sliding mesh method in computational fluid dynamics (CFD). This proposed screw turbine would be beneficial and can be considered as a sustainable candidate for the power generation from micro and pico-hydro resources.

Adhikari and Wood (2018) did numerical analysis of cross flow hydro- turbines for part-load flow control. In this paper, well-designed cross flow turbines without a guide vane have been shown to achieve over 90% of full-load efficiencies. This raises the question of how to maintain maximum efficiency at a part-load, which is characterized as low flow with constant head. Operation of part-load cannot be accomplished exclusively by using electronics' power to minimize shaft speed as flow decreases, as it can be done with other hydro-turbine models. The slider outperforms a vane guide as the main means of cross flow turbine's control at part-load, according to the findings.

Pérez et al., (2020) did a CFD simulation of a pico-hydro turbine and collected its data. This paper presents the results of a pico-hydraulic turbine built for electricity production in housing units is simulated using CFD with the aid of the ANSYS CFX programme, data was collected using simulations designed to a model built in SolidWorks. The boundary conditions have an impact on the turbine's operation, which is why three runs were

performed, one for each of the device's operating pressure, turbine collapse, and hydro - power requirements at the 3 points of function. It also encourages the improvement of simulations and lab tests of this sort of system for which geometric parameters and working conditions can be modified.

Scott Simmons (2018) analysed the Archimedes Screw Generators using Computational Fluid Dynamics. These two computational fluid dynamic models were developed and validated throughout this paper. The first model used a single screw bucket to collect data from a geometrically perfect screw with no blade-trough distance. The second model was geometrically similar, but it had a four-bucket domain to account for and investigate the effects of gap leakage between the blades and the screw trough. The impact of the gap on torque and rotational speed, kinetic energy inside a bucket, pressure along the screw's trough, bucket fill height, and wall shear stress along the screw's blades was studied.

The paper focuses upon the pollution caused by fossil fuels can be counteracted by the use of micro/pico hydro turbines. This way the water is used as a renewable energy and ultimately we can produce electricity with less pollution in rural parts of India. The objective is to install small pico hydro power turbine systems into pipelines in rural households which can produce enough energy to light a few LED bulbs.

Problem Statement

Problem Definition

Many impoverished areas still do not have electricity access, are deprived of proper food, have limited access to schooling and studies. They have low living standards. Despite attempts to electrify these regions, improvement and chances of success remain low. Even a small amount of electricity can impact rural areas in India. The utilization of such energy supplies is critical for economic growth and the enhancement of local standard of living (Date et al., 2012). Fortunately, rural areas in India where water is abundant, electricity can be generated using a micro-hydro turbine. The use of pico-hydro turbines can counteract this pollution caused by fossil fuels. This way the water is used as renewable energy and ultimately we can try to produce electricity with less pollution in rural parts of India.

Computational Model And Procedure

Screw Type Pico-hydro turbine

Screw Type turbine, also referred to as Archimedes screw works as follows, water flows into the top of the screw, making it turn at the same time as water continues moving down as the length of the screw. The hydrostatic pressure from water on the screw surface causes it to turn. Rotation of the screw shaft can generate electricity by connecting to a generator. Hydro turbine has a role which is to convert hydroelectricity (potential energy, pressure and kinetic energy) into mechanical energy in the form of shaft rotation. The rotation of the turbine shaft can be modified with the aid of using the generator into electric power. The turbine will be a screw turbine.

Based on the output, the hydroelectric power plants with output power 100 W - 5kW can be classified as pico- hydro power plants.

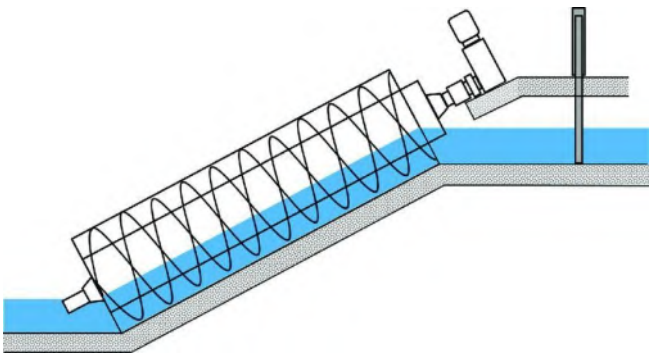


Figure 4.1 Schematic Representation of a Screw Turbine

Hydro turbine is to convert hydro energy (potential energy, pressure and kinetic energy) into mechanical energy in the form of rotation in the shaft. The rotation of the turbine shaft can be changed by the generator into electric power. The turbine will be a screw turbine as shown in the above figure 3.1.

Screw type turbine works as follows, water flows into the top of the screw, making it turn while water keeps moving down as the length of the screw. The hydrostatic pressure on the screw surface causes it to turn from the water. Rotation of the screw shaft can generate electricity by connecting it to a generator. This research aims to design and make a portable spiral pico hydro turbine. The design of this equipment utilizes a modified flow of water in the blades to drive the turbine. Furthermore, the hydro turbine is coupled with a generator to produce electricity.

Water runs across the screw, causing the screw to rotate, whereas water continues to flow along the length of the screw. Fluid across the screw exerts pressure, allowing it to spin. When connected to a generator, the motion of the screw has the potential to create electric power.

The goal of this study is to design and build a portable spiral pico hydro turbine. This equipment's design drives the turbine by directing a different flow of liquid across the blades. In addition, the turbine is to be linked to a generator to generate power.

The flow of water causes the turbine to rotate at a rate proportional to the power generated by the generator connected to the turbine. As a result, the turbine's RPM determines the output power, which can be calculated using

$P=\rho.Q.h.g$

Where,

P = Theoretical output power (watts)

ρ = Fluid density (kg / m^3)

$$\nu = \frac{V_T}{\pi R_o^2 \Lambda}. \qquad L = \frac{H}{\sin\theta}$$

Q = Water discharge (m^3/s)

h = Effective height (m)

g = gravitational force (m/s^2)

Design

Design Parameters

Internal Parameters: Internal parameters can be set, changed and edited by the designer.

External Parameters: Site-specific criteria that are determined by the destination where thedevice will be installed.

Runner diameter

The runner's diameter is determined by the water flow. If it is high, choose a larger diameter if low, choose a smaller diameter.

Number of blades

The optimal no. of blades is critical when designing a Turbine runner; lesser blades may lead to insufficient utilisation of available water across turbine, while an increase in number of blades may result in thumping power andreduced efficiency.

Radius of blade

The curvature of the blade has a lot for the efficient working of the turbine. It varies directly with the size of the turbine.

Thickness of blade

To withstand the stresses caused by water, the blade thickness should be kept as thin as possible. Under the given load conditions, the blade mustn't be very thin to wear down. Alternatively, excessive blade thinness may cause water admission to be obstructed.

When a parameter of design is modified, it frequently has an unintended consequence. Recognizing such connections between different parameters

Calculations

Angle of inclination for the turbine in this study is set as **22°** so as to get more flow through the blades which is said to provide more efficiency.

The available head for the turbine is assumed to be **5m** which is ideal for an archimedes screw. **(H=5)**

Hence, **Length**

However, the efficiency increase due to length will reach a point where losses will overcome the benefitsVolume Ratio **'ν'**,

Where **VT =** $\frac{Q}{RPM}$ **×60**

V_T, to the total volume of one cycle of the screw **"$\pi R^2 \Lambda$"**

Speed is taken as 20 RPM, above which higher speeds can cause frictional losses in the volume of fluid flowing.

Because of low rpm, a complicated gearbox is needed to transfer the turbine's mechanical energy into electrical energy. Nevertheless, there's many ideas that turbulence liabilities within the turbine are reduced at low rotational speeds. Besides that, friction losses decrease as rotational speed decreases to an extent, the increment in diameter of the turbine must result in an increase in output power. The space between hollow pipe and the screw must be kept small. The less flow that crosses around the turbine blades, the smaller the gap, which will never contribute to energy production and reduce efficiency.

There are fewer leakage losses as pitch is reduced. A larger pitch, on the other hand, generates higher pressure (torque) along the flight of the screws.

To fulfill the standard statement of the problem, the following criteria (in SI Units) have been computed.

Software used for design

Based on the above calculations, the optimum values were decided and the design process was carried out using Fusion 360.

Table 4.1 Design Specifications

Length	**305mm**
Inner diameter	12mm
Outer diameter	56mm
No. of blades	5mm
Blade Thickness	0.5mm

Once the desired design was generated from the CAD in FUSION, the geometry was exported to AUTODESK CFD.

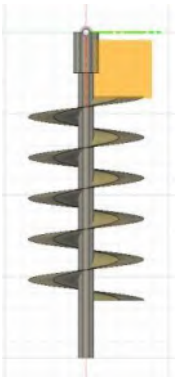


Figure 4.1 Screw Turbine design Top View view

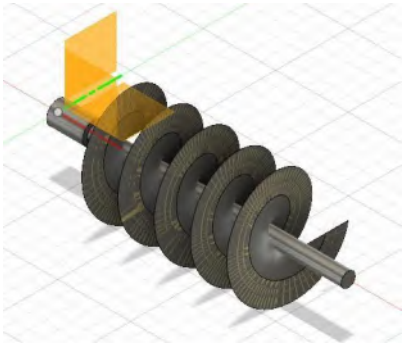


Figure 4.2 Screw Turbine design 3D

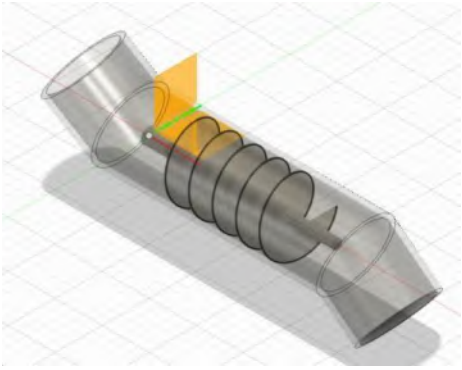


Figure 4.3 Hollow Pipe enclosing the turbine

A hollow pipe with dimensions 70mm outer diameter and 62mm inner diameter was made to make the screw turbine closed assuming the path through which the water will flow. The design is done taking into account that the turbine would be coupled to the pipe of a house.

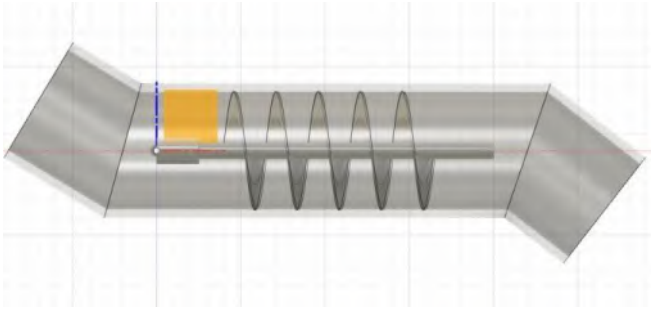


Figure 4.4 Closed turbine

It includes both the internal and external properties that affect the outputs of the turbine.

CFD Model & Analysis

Materials

A closed pipe was defined by filling voids on both the inlet and outlet with the volume of fluid flowing inside it set as water. The hollow pipe with thickness 8mm and the Screw turbine were both assigned as solids (ABS). The materials assigned for water and ABS are shown in the figure 3.5.

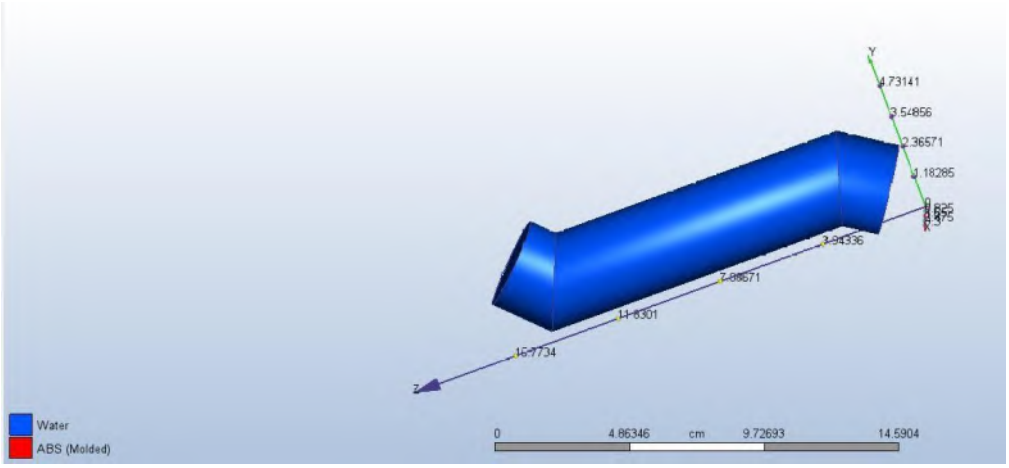


Figure 4.5 Materials assigned (Water and ABS)

Boundary Conditions

In CFD, a valid configuration used to obtain a robust simulation is to set pressure at the outlet and mass flow at the control volume inlet. The turbine is defined as the rotating region and it is assigned a RPM, this will actuate the turbine to rotate when the water flows through it. Given the inlet flow rate further analysis can be performed. The outlet boundary condition is zero pressure. Assuming that water at the outlet will be in contact with the atmosphere, the outlet pressure is considered as zero. Figure 3.6 shows the boundary condition for the analysis.

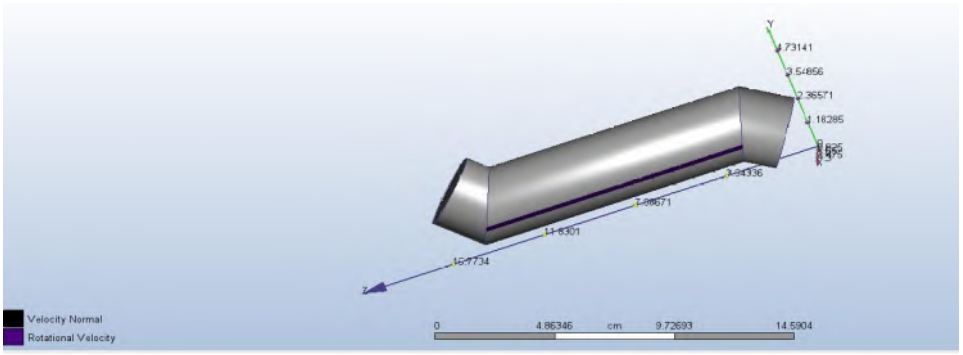


Figure 4.6 Boundary Condition for the analysis

CFD Mesh

The outer wall of the mesh is kept stationary whereas the complete volume is rotated. The speed of the rotating part and volume flow rate at inlet are varied to get the required power output. Figure 3.7 shows the meshing of screw turbine.

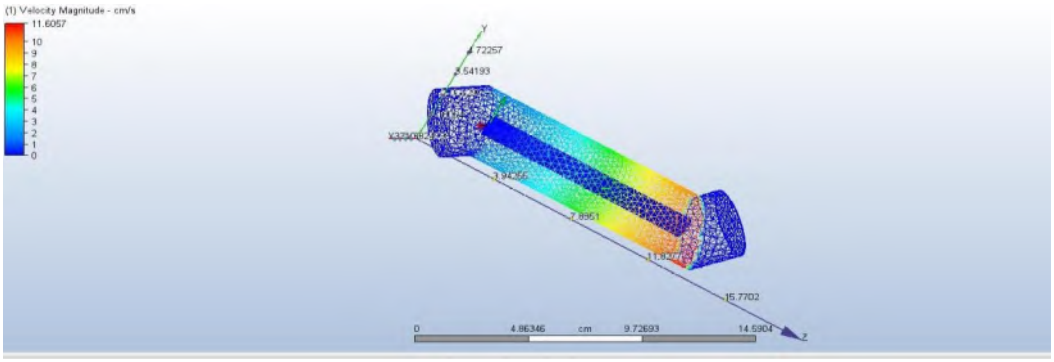


Figure 4.7 Meshing

Motion

The turbine is to be installed at an angle of 22° around a hollow pipe through which the water flows and the directionof flow is defined. Figure 3.8 shows the direction of motion for screw turbine.

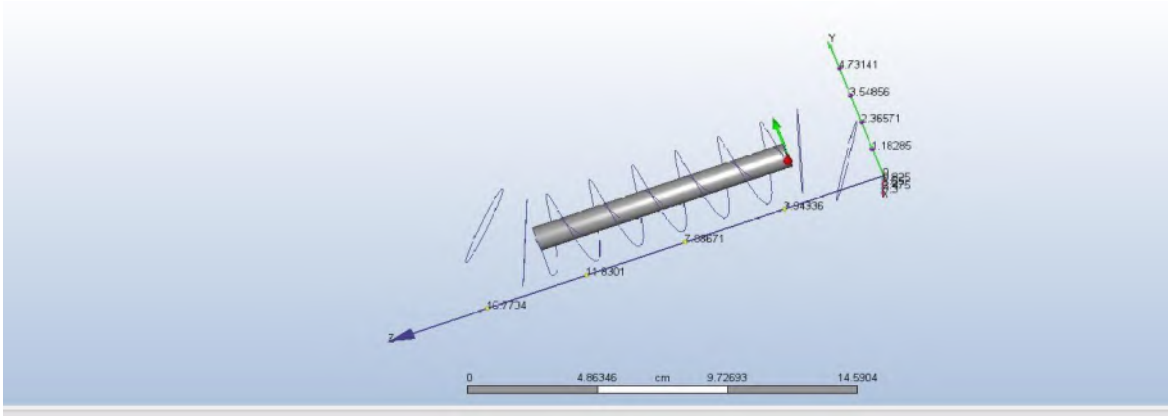


Figure 4.8 Direction of motion

To extend this study, a comprehensive analysis has been carried out using Autodesk CFD.

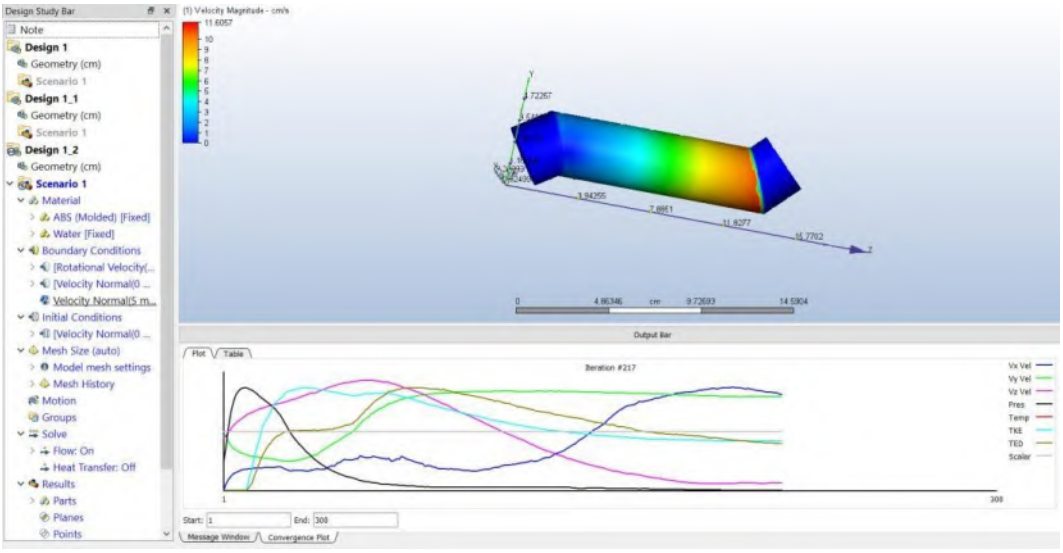


Figure 4.9 Velocity Magnitude through the turbine

The numerical discretization of the model was carried out through the generation of the mesh. The geometrical quality of the mesh is essential in a simulation independently of the shape functions used. The analysis was carried out subject to the boundary conditions as described below.

Table 5.1 RPM vs Power (W)

RPM	20	21	22	23
POWER (W)	3320	3892	4486	6804

Table 5.2 FR vs Power Graph Table

FLOW RATE	0.416	0.182	0.219	0.291
POWER (W)	3319	3315	2788	2626

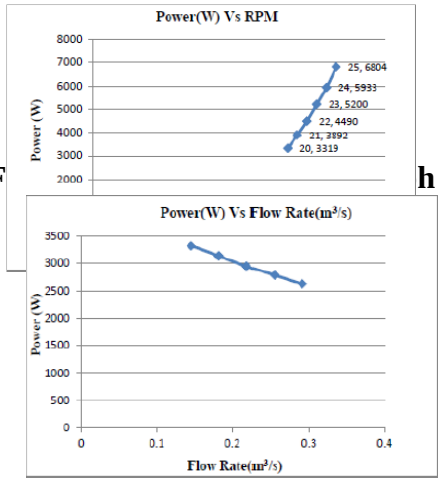
The overall performance score for parameters (RPM Vs Power and Flow Rate Vs Power) was shown in Table 4.1 and Table 4.2. Consequently, the graphical representation of parameters (RPM Vs Power and Flow Rate Vs Power) at various loads can be seen in above figures. Figure 4.1 shows that there is decrease in power due to flow rate increase Figure 4.2 clearly indicates that the increase in RPM increases the power.

Conclusion

It can be concluded that the increase in the

Results and Discussions

For different inputs for inlet volume flow rate given, the power generated (theoretically changes with respect to flowrate at inlet, Q). We have chosen a combination of different flow rates (Q) and speeds to arrive at the specified power rating of theturbine.



flow rate will decrease the value of power obtained. The required value of 5 kW (for a pico hydro turbine theoretically) can be obtained for 0.1457 m3 /s flow rate and a speed of 23 RPM. Succeeding turbine designs for simple hydropower plants aim for increased efficiency and low production costs. The size of the screw turbine is an important factor in reducing production costs. However, no reliable guidance based on numerical research data is publicly available. This study serves as a guideline for selecting, designing, modelling, and analysing the performance of a

pico hydro screw turbine, as well as an example of how the dimensions of a turbine can affect its efficiency. The restricted head and pico-hydropower are the best possible options for countering the shortage of energy and poverty in remote regions, making sure a brighter future for the community. Between clean energy hydropower energy and protracted advancement, a sensitive balance needs to be struck. Also it is important to improve research studies of this magnitude.

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LOAD SENSING SELF ADJUSTER TO COMPENSATE WEAR IN BRAKES

S.D Kumar[1], A. Mathivanan[2], C. Uthirapathi[3] and G. Manikandan[4]
Department of Mechanical Engineering, SRM Institute of Science and Technology, Ramapuram, Chennai, India
[1]sdkumar1973@gmail.com

ABSTRACT

Nowadays Brakes in automobiles play a vital role as far as safety is concerned. It is also necessary that to reduce the wear and tear of the brake linings to improve the life of them. Moreover brake liners have to be released as soon as brake is released. Self- adjusting arrangement taking a vital role in safety and improvement in life of the brake. This project is about design and development of an Auto adjuster mechanism with load sensing feature. Auto adjusters are used as wear compensators in mechanical devices. One potential problem of many currently available auto adjusters is they do over adjustment due to deflection of parts, thermal expansion of parts etc.,. In this project, various concepts are evolved, evaluated and one concept is selected, designed, developed and verified to come up with an auto adjuster which does not over adjust. This will help to maintain a desired constant working clearance throughout the life of the product.

***Keywords**:* Self adjuster, load sensing, auto adjuster

1. Introduction

Auto adjusting mechanism is commonly used in many mechanical systems. Systems that have wearable parts, commonly uses auto adjuster mechanisms to compensate the wear and to maintain desired clearances. Auto adjusters are used in brakes, clutches or wherever compensation for wear is required. The primary requirement of an auto adjuster is it should maintain a constant working clearance whenever there is wear in system. The secondary requirements of auto adjuster are it should not over adjust, thus reducing the working clearance or deteriorate over a period thus producing higher clearance. Currently used auto adjusters have a potential problem of over adjustment. If over adjustment happens, the working clearance reduces in steps and after certain applications, the static part will come close to the dynamic part thereby causing accelerated wear of parts or high temperature exposure of parts sometimes leading to seizure. Hence, over adjustment is considered to be highly dangerous to the system. This project will focus on a design of auto adjusting mechanism, which is load sensitive to avoid over adjustment. Mechanical auto adjusters generally use screw & nut mechanism or wedge mechanism for length compensation.

2. Working of a Typical Auto Adjuster

2.1 Construction

Parts of a typical auto adjuster are shown in Figure.1. It consists of a housing, tappet, drive ring, adjuster sleeve, piston, Belleville spring, circlip, rollers & spring (that functions as one way clutch), wearable static object & a wearable dynamic object (between which clearance is to be maintained). Piston and adjuster sleeve are connected by threads which will function as length compensator in case of wear. Tappet has male helix and drive ring has female helix and they are coupled helically to convert linear travel of tappet to rotary motion. Rotary motion is required to cause unscrewing of thread. A typical auto adjuster used in brakes is considered for illustration purpose.

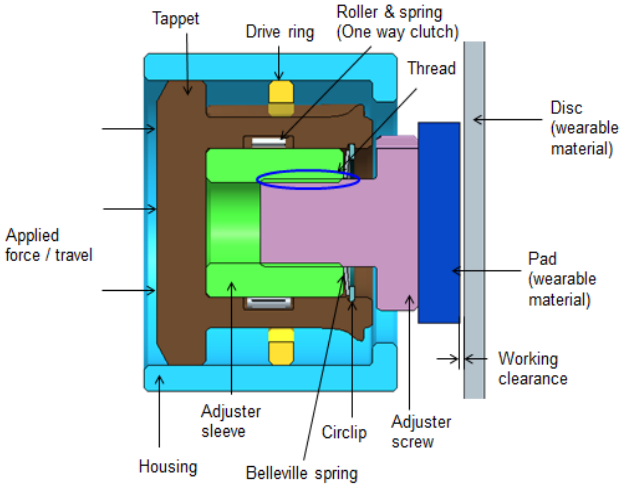

Figure.1

2.2 Working - Normal Condition:

Force/travel is applied to the tappet which moves the adjuster assembly to close the working clearance. This happens continuously during normal conditions as long as the clearance remains the same. Adjustment does not take place because a backlash is provided between tappet and drive ring helical grooves as shown in Figure.2. This backlash defines the nominal working clearance of the adjuster.

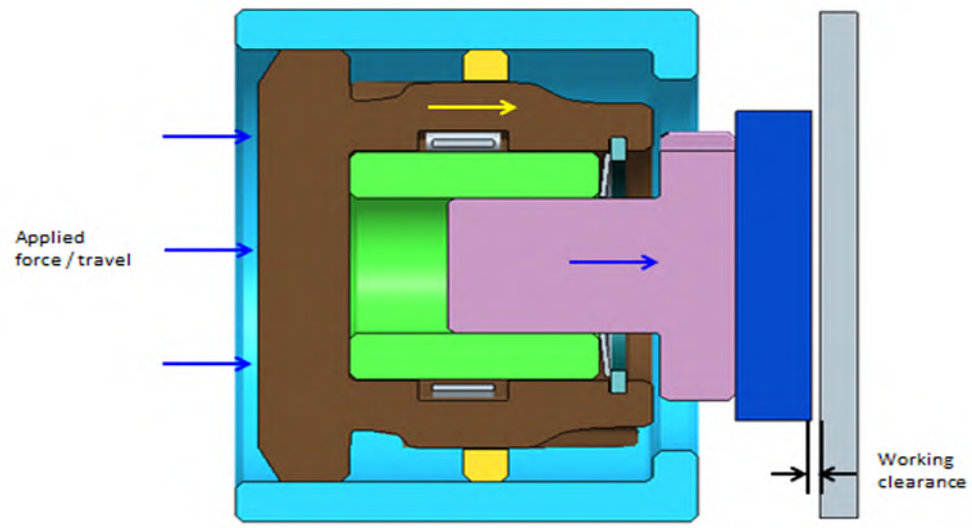

Figure.1.a.

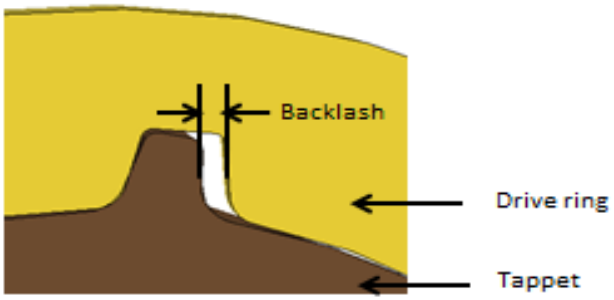

Figure.2

2.3 Working - Adjustment

When wear occurs in pad / rotor, the clearance increases. Application of force at that time closes the backlash between the helical parts. Once backlash is closed, further application of force causes the tappet to rotate due to helix and as drive ring is fixed rigidly to housing. Tappet travels linearly and is rotated to take up the excess clearance caused due to wear. Thus, tappet takes up new position due to rotation in forward stroke. During forward stroke rotation of tappet, does not rotate adjuster sleeve, due to roller & spring arrangement which acts as one way clutch as shown in Figure.3. While return, adjuster sleeve rotates along with tappet until tappet takes up its original position, which causes advancement of piston in proportion to the rotation caused (piston cannot rotate as it is fixed to housing, hence it advances linearly due to unwind of thread). This maintains the working clearance after some applications. This type of adjuster is called as exponential auto adjuster. A typical exponential auto adjuster adjustment pattern is shown in Figure.3. Normal working clearance is defined as working range in the Figure. It exponentially reduces the excess clearance until working range or set clearance defined by backlash is achieved.

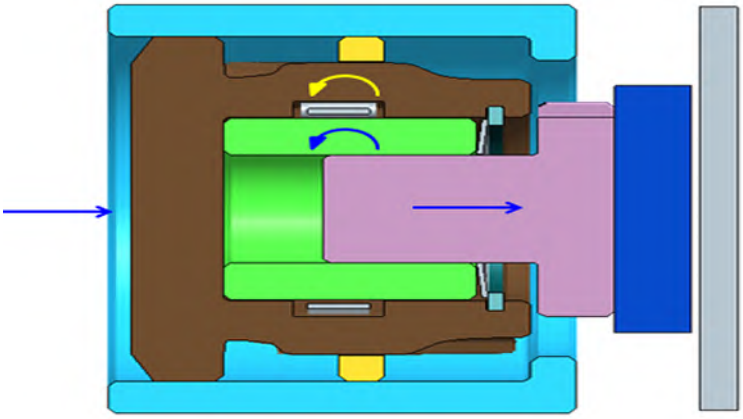

Figure.2.a

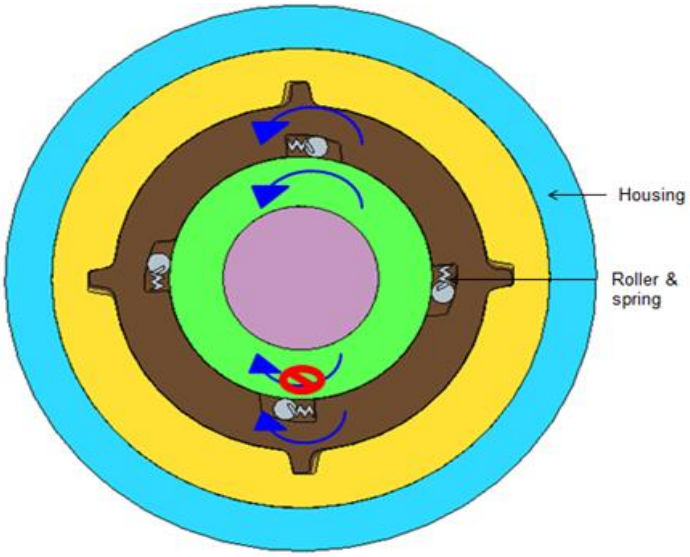

Figure.3

2.4 Adjustment pattern of an exponential auto adjuster:

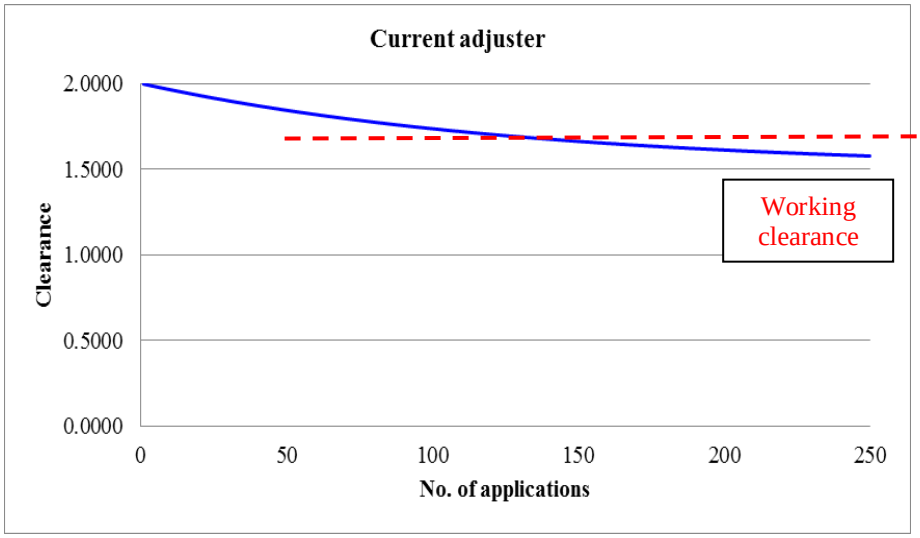

Figure.4

Figure.4 shows adjustment pattern for a typical auto adjuster which maintains a constant working clearance if there is no deflection of parts, compression or expansion of parts.

2.5 Potential Issue With A Typical Auto Adjuster:

- This adjuster adjusts for the deflection of the parts or thermal expansion of the parts or compressibility of the parts.
- This in turn reduces the working clearance step by step which causes contact of parts in all conditions which is not desired.
- For example, if working clearance is 1mm, wear has happened to 0.2mm and if the part's deflection or compressibility is 0.5mm, this adjuster adjusts for 0.7mm step wise to maintain 1mm clearance.
- But in actual 0.5mm of deflection should not be adjusted because it will return to its original state once the application of force is removed.
- The adjuster should adjust only to wear of 0.2mm.wear occurs in pad / rotor, the clearance increases.

3.Literature Review

Denis John Mccann[1]*,(2007)* Patented Air disc brake adjuster and invented that A one-way clutch is used in a disc brake adjuster to individually adjust first and second brake pads in reaction to brake pad wear. A brake caliper supports the first and second brake pads in relation to a revolving brake disc in the disc brake assembly. The first brake pad is on one side of the rotating brake disc, while the second brake pad is on the opposite side. In response to a brake demand, a brake actuator engages the first brake pad with the revolving brake disc. A force from the first brake pad causes the rotating brake disc to be forced against the second brake pad, causing it to slide or have compliance.

Hans Baumgartner[2]*,et.al.,(1996)* Patented Self adjusting Pneumatically operated disk brake and concluded that The current invention includes a brake saddle that encloses a braking disc and a clamping actuation mechanism with a pivoting lever that is rotatably supported on one side of said brake saddle. The lever is designed to be abutted at a longitudinal center by an eccentric wheel around a transverse member extending parallel to the axis of rotation, the transverse member being shiftably guided with respect to the braking disc. And at least one adjustable adjusting spindle is screwed into the transverse member, and the adjusting spindle is equipped with a brake saddle via a pressure piece attached to the brake disc's end. On the inner side of the tightening operation, it is configured to work on a brake shoe that is shiftably supported on a braking disc, as well as the brake lining of the brake shoe.

Walter J. Rozmus[4],(1987) Patented Drum brake adjuster and summarized that To adjust the brake shoes, the adjuster uses a standard star wheel and screw thread adjusting strut. An precise, wire-like push rod, ideally fastened to the anchor pin, operates the adjustment strut, which extends parallel to the inside surface of the primary brake shoe table and terminates with a hook-shaped pawl finger anchored to the brake shoe web by a tension link.

Hajime Niki[8], et.al., (2000) Patented Automotive stroke adjustment device for a brake actuator and invented an automatic stroke adjustment device for a brake actuator as well as A brake actuator with an automatic stroke adjustment device at a cylinder bore opening.

Rudolf Fischer[8],(2003), Auto adjusting mechanism for Pneumatically operated disc brake and invented that The present invention relates to a pneumatically or electromotively operable disc brake, having a brake caliper, which reaches around a brake disc, at least one brake application device for applying the disc brake by way of a displaceably guided element, in particular a crossmember. The displaceably guided element has at least one threaded hole, into which an adjusting spindle is screwed which bears a pressure piece, with which it is possible to press a brake lining against the brake disc. An adjusting device, which is operatively connected to the adjusting spindle for adjusting the clearance play, and a securing element, which acts on the adjusting spindle so as to impede rotation up to a defined torque, are also provided

Torney[21], Patented A wheel-brake cylinder for a vehicle brake system having a cylinder housing provided with a cylinder bore, a piston axially shift-able in the bore for displacing a brake shoe and a self-adjusting mechanism re-

establishing a rest position of the piston upon displacement thereof beyond a predetermined stroke, the self-adjusting mechanism comprises an adjustment member received in said bore co-axially with said piston member, and a split resilient adjusting ring in I form-fitting and wedging inter engagement between the members upon movement of the piston member in one direction relative to the adjustment member and to the housing and released by said members upon movement of the piston in the opposite axial direction.

Thirion Rene[5] patented Automatic brake adjuster for disc brake - In the conventional disc brakes with hydraulic and mechanical actuation use is made of adjusting means arranged between the piston of the brake motor and the stirrup to provide to the piston a constant stroke whatever be the state of the linings. The space required for the unit formed by the friction pad, the piston and the motor is thus substantial.

Anthony J. Lamela, et.al[7], patented a fail safe self-adjusting brake is disclosed in which a service piston selectively actuates brake discs to contact shaft discs and apply braking to the shaft. The service piston is hydraulically actuated. Should there be a system failure an emergency piston forces the service piston to brake shaft rotation. The service and emergency pistons are uniquely mounted such that they are properly guided within the brake housing.

Rudolf Fischer, et.al[9], Patented a pneumatically or electromotively operable disc brake, including a brake caliper that straddles a brake disc, at least one brake application device for tensioning the brake disc by way of a displace-ably guided element, particularly a cross member. The displace-ably guided element has at least one threaded borehole into which an adjusting spindle is screwed. This adjusting spindle Supports a pressing piece by which a brake pad can be pressed against the brake disc. A wear adjusting device is provided for resetting the clearance and is actively connected to the adjusting spindle.

Juan Belart[3], in the first of these applications, it has been pointed out that dual-network brake systems have gained in interest of late and, in fact, may be required in many jurisdictions. The term Dual-Network Brake System, as used herein, is intended to designate a vehicular brake system in which the master cylinder is subdivided into a pair of compartments, each of which may communicate with a respective portion of a subdivided brake-fluid reservoir and receives a respective master-cylinder piston operated by the brake pedals of the vehicle.

Tirovic,et.al (1991), Thermal effects and pressure distributions in brakes and summarized that This paper
describes how the thermal effects of interface pressure distribution may be divided into bulk temperature effects, such as brake drum expansion and brake disc coning, and its macroscopic thermal effects, such as heat spotting, and suggests how the two are related through the process of thermoelastic instability. The results of analyses, using finite element methods, indicate that uniform friction interface pressure is very important in minimizing brake thermal problems.

M.Tirovic, et.al,(2007), Structural analysis of a commercial vehicle disc brake caliper The application of digital image correlation (DIC) to a commercial vehicle disc brake caliper provided valuable strain results. In comparison with strain gauges, DIC proved to be exceptionally easy to use and enables straightforward comparison of measured strains with FE predicted values. Initial work dealt with the static actuating forces, and excellent correlation between the predicted and the measured strain values was achieved throughout the operating range of clamp forces. The present authors are confident that the addition of the dynamic frictional forces will give even more interesting results, providing insight into the interaction of different components within the brake assembly.

4. Methodology And Proposed Solution

The solution to problem has been arrived based on the systematic approach as shown in the flowchart shown in Figure.5.

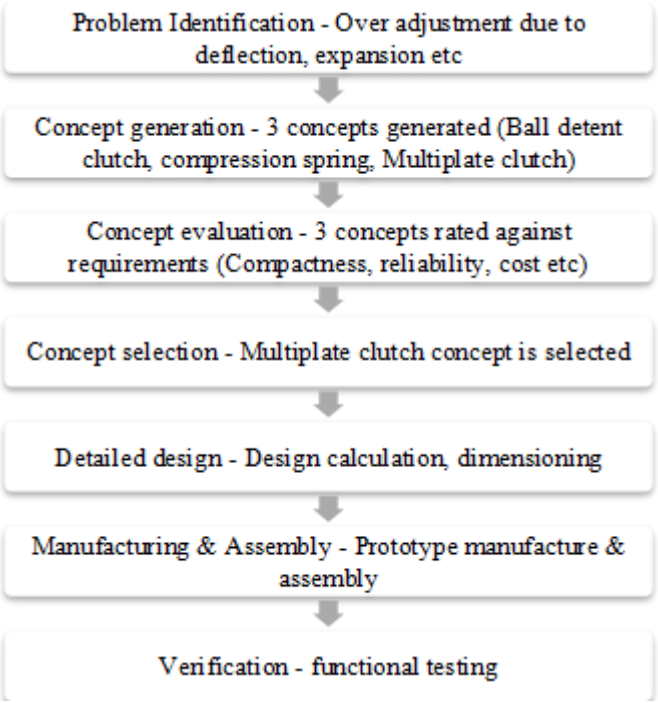

Figure.5

3.1 Concept Generation

Three different concepts were generated in this phase and they are rated against various parameters.

3.1.1 Concept 1 – overload slip by ball detent clutch

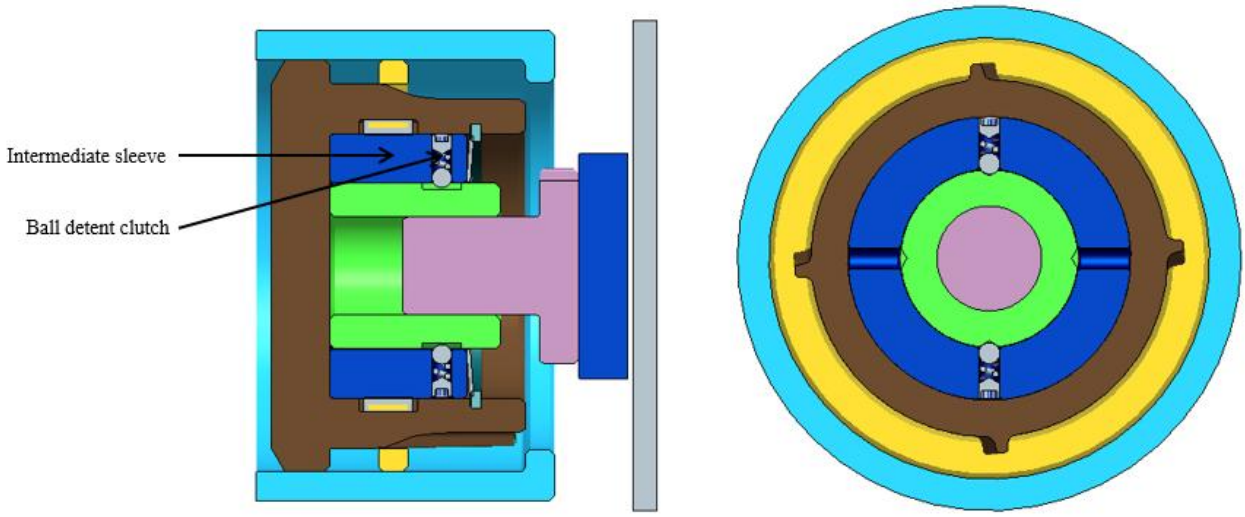

Figure. 6

- A ball detent clutch and an intermediate sleeve is added to slip after transmitting particular torque.
- If the piston touches the object, resistance occurs for further rotation which causes the ball to slide up the ramp by compressing its spring.
- Hence, torque is not transmitted to shaft after slipping. Only the intermediate sleeve rotates.
- Thus adjustment during deflection, compression etc., is avoided.
- Diameter increased by 20mm compared to existing design.

3.1.2 Concept 2 – overload slip by compression spring

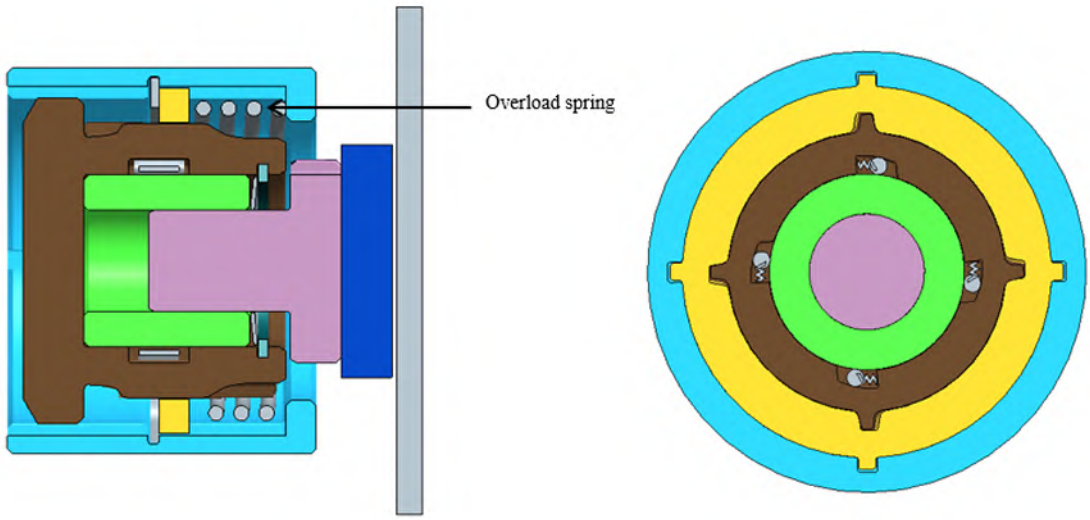

Figure. 7

- A compression spring is added to the existing adjuster and sliding motion is allowed for the drive ring.
- If the piston touches the object, resistance occurs for further rotation which causes the helical drive ring to slide by compressing the spring.
- Thus adjustment during deflection, compression etc., is avoided.
- Envelope dimensions remains the same compared to existing design.

3.1.3 Concept 3 – multi plate clutch

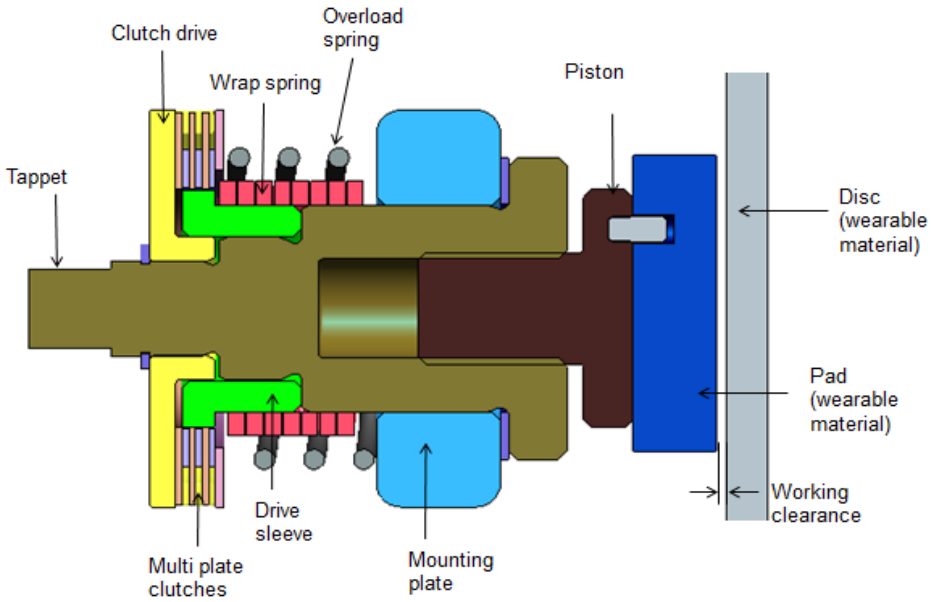

Figure.8

- Multi plate clutch with overload spring is allowed to slip in case of overload.
- In this concept, wrap spring is used as one way clutch.
- In forward, wrap spring couples tappet & drive sleeve and transmits torque.
- In return, it disengages tappet from drive sleeve.
- Length reduced by 5mm & height by 27mm from existing design.

3.2 Concept Evaluation

The concepts generated, were rated against the arrived product requirements, ranked and then selected based on the concept selection matrix as shown in Table.1.

Table.1 – Concept rating matrix

Requirements	Concepts		
	Concept1	Concept2	Concept3
Overload mechanism	Ball detent clutch	Compression spring	Multi plate clutch
Compactness (Compared to existing)	-	0	+
No. parts addition (Compared to existing)	-	+	+
Reliability rating	0	0	0
Cost rating	-	+	+
Design complexity rating (Manufacturaility)	-	-	+
Ease of assemly	-	0	0
Sum of +'s	0	2	4
Sum of 0's	2	3	2
Sum of -'s	4	1	0
Total score	-4	1	4
Rating	3	2	1
Decision	No	No	Yes

3.3 Concept Selection

Based on the above matrix, concept 3 is selected. It is considered for further phases like detailed design, manufacture & verification.

3.4 Detailed Design

3.4.1 Construction :

In this design the complex helical gear design is eliminated and rotary motion is achieved by a pin and slot arrangement. Parts include Tappet, Piston, Clutch drive, Drive sleeve, Multi plate clutches, wrap spring, mounting plate as shown in figure.9. This mechanism is made compact in terms of length and diameter when compared to existing.

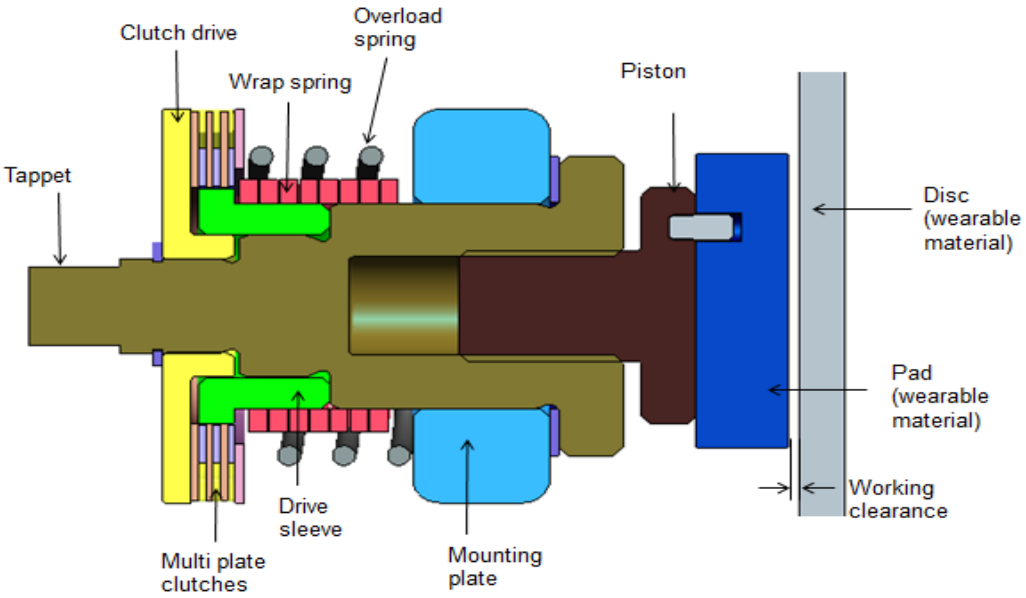

Figure.9

3.4.2 Working – normal condition:

Force is applied to the mounting plate through an operating lever and it is transferred to the tappet, then to the piston through threaded joint as shown in figure.10. From piston it is transferred to pad and then to disc. Backlash is maintained between clutch drive and operating lever pin. No adjustment takes place until backlash is closed.

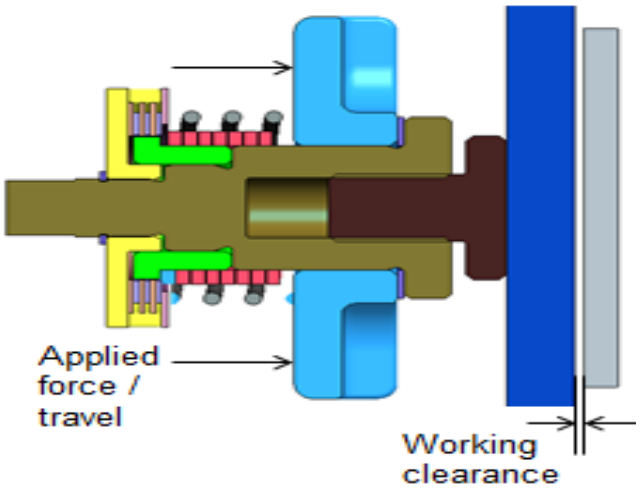

Figure.10

3.4.3 Working – adjustment:

Stroking of operating lever causes the pin to rotate and close the backlash. Once, backlash is closed, further stroking of operating lever causes the pin to rotate the clutch drive as shown in figure.11

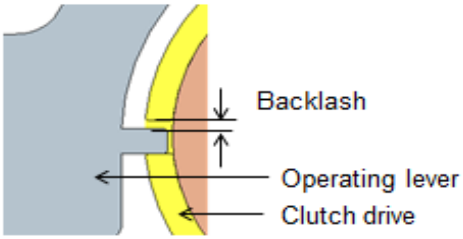

Figure.10.a

Rotation of clutch drive in forward (anti-clockwise) direction, causes the wrap spring to couple drive sleeve with tappet. Tappet is rotated in anti-clockwise direction which causes advancement of piston because rotation of piston is arrested. In reverse (clock-wise) direction, wrap spring functions as one way clutch and does not rotate the tappet.

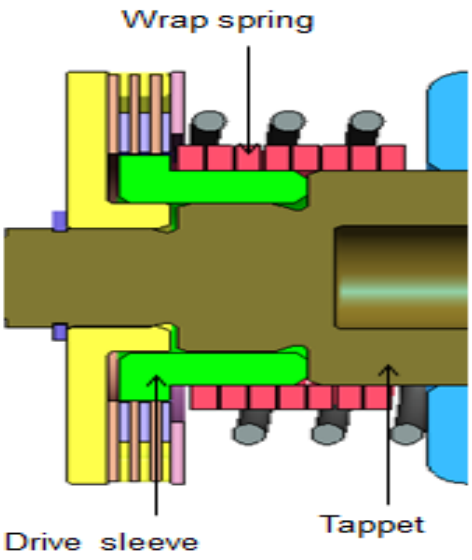

Figure.11

3.4.4 Working – overload:

Multi plate clutch with a pre-tensed spring provides the slip that acts as overload protector as shown in Figure.12. Once, the pad touches the disc, huge reaction will be experienced by tappet through threads in piston & tappet. This requires high torque to rotate the tappet. Overload spring is designed such that it holds friction between inner and outer clutch plates to transfer certain torque required for adjustment and to create slip in clutch plates after the torque has exceeded.

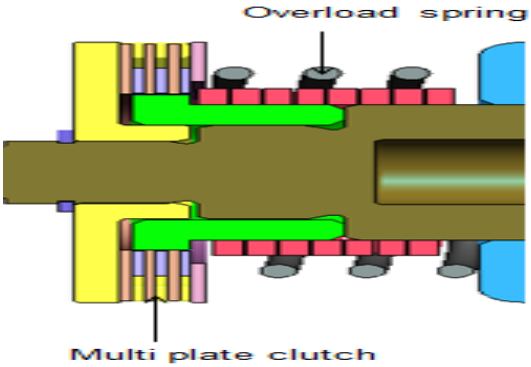

Figure.12

3.4.5 Calculation:

The following factors are considered for mechanism design.

a) Adjusting torque
b) Backlash & adjustment
c) Multi-plate clutch design
d) Wrap spring design
e) Overload spring design

3.4.5.1. Adjusting torque:

Adjusting torque is the sum of following components which are individually calculated.

- Torque required raising the load by thread joint. Here load is the sliding resistance of parts and pad retaining spring load.
- Mounting plate and tappet collar friction due to overload spring load and sliding resistance.
- Tappet and mounting plate guide diameter friction
- Wrap spring friction

Maximum adjusting torque considered & calculated for this prototype adjuster is 1.2 Nm after which slip will occur to avoid over adjustment.

3.4.5.2 Backlash & adjustment:

Backlash is defined by the clearance between operating lever pin and clutch drive slot which is designed to have 1.5 to 2mm clearance that defines the nominal working clearance. Backlash also includes position of pin in operating lever, position of slot in clutch drive, clearance between clutch drive and outer clutch plates. Adjustment is controlled by radius of clutch drive where pin drives the slot with respect to tappet rotational axis, radius of pin position with respect to pivot axis, full operating lever travel and thread lead. This prototype adjuster is designed to have an adjustment rate of 0.02mm for 1 operating lever full stroke of 4mm.

3.4.5.3 Multi-plate clutch design:

Torque transmitted by multi plate clutch is given by

$T = Z * (2/3) * \mu * ((r_0^3 - r_i^3)/ (r_0^2 - r_i^2)) * F$

Where

Z – No. of contact faces

μ – Coefficient of friction

r_0 – Outer radius of clutch plate

r_i – inner radius of clutch plate

F – Axial load

$F = 1200 * 3 * (19^2 - 15^2) / 6 * 2 * 0.15 * (19^3 - 15^3)$

$F = 78$ N

For slipping torque of 1.2 Nm, spring load required is 78N considering 6 no. of contact faces, 0.15 coefficient friction (lubricated – greased).

3.4.5.4 Wrap spring design:

Depending on the de-adjusting torque, wrap spring is designed such that it will not transfer rotation to tappet during return stroke. During forward stroke, it is designed to transmit maximum adjusting torque without slipping.

3.4.5.5. Overload spring design:

Considering load requirements and space available for spring, wire diameter, mean diameter, spring rate, stress etc., are calculated.

Fitted load – 86±12 Nm
Fitted length – 25.1 mm
Stress @ solid height – 44%
Maximum stroke – 4mm
Maximum working stress – 38%
Wire diameter – 2.5mm
Spring rate – 2 N/mm

3.4.5.6 Circlip design:

Circlip is required to hold the clutch drive against the overload spring load. Circlip is selected based on IS 3075-part 1- circlip for shafts. Circlip used is 11 * 1.

3.4.6. Manufacturing & assembly

A working prototype model is manufactured using conventional machining process. Figure.13 shows the picture of the actual prototype adjuster made.

Figure.13

Verification

Verification test is done in the developed adjuster assembly to check the normal working condition, forward adjustment, not adjusting during return, slip after pad touching the disc.

3.4.7.1 Setup:

A simulation setup that is very similar to actual application is made to verify this adjuster assembly. All forces & physics are considered in this setup. A stopper is placed at 1.5mm distance from piston, with piston pin being guided in the slot in the stopper (to avoid rotation of piston).

3.4.7.2 Normal clearance working:

Normal stroke is simulated by applying linear travel to the mounting plate which moves the tappet and piston. This closes the 1.5mm clearance and piston comes in contact with the stopper. This simulates the normal braking condition. Input force increases proportion to the reaction from the disc through piston, tappet and mounting plate.

3.4.7.3 Forward adjustment:

The stopper is placed at 2mm (considering 0.5mm wear has occurred). For this additional 0.5mm clearance, the tappet rotates and thread is unwound from tappet and piston advances linearly to close this additional clearance. The adjuster adjusts at the adjustment rate possible. It gradually closes the additional gap created.

3.4.7.4 Return stroke:

The adjuster should not adjust during the return which will again cause the winding of thread that is unwound during forward adjustment, as a net result being no adjustment. So this function is verified. Wrap spring does not allow to rotate the tappet during return.

3.4.7.5 Overload slip:

This is the additional feature that is intended to be incorporated in auto adjusters. It is assumed during verification that after the piston comes in contact with stopper, there is a deflection of 0.5mm. So the total clearance / stroke now becomes [1.5mm (nominal) + 0.5mm (Wear) + 0.5mm (Deflection/Compressibility of material/Expansion)] 2.5mm. A normal auto adjuster will adjust for this full 2.5mm stroke exponentially and gradually reduces the working clearance of 1.5mm.

4. Results And Discussions

In this design, after the piston touching the stopper, reaction force is experienced by the piston, which in turn increases the torque required to rotate the tappet. Hence, slip occurs at Multi plate clutches when it exceeds the compression spring load. Adjustment graph of a typical auto adjuster without load sensing and with load sensing feature is shown in Figure.14

f) Cir-clip design

3.4.7

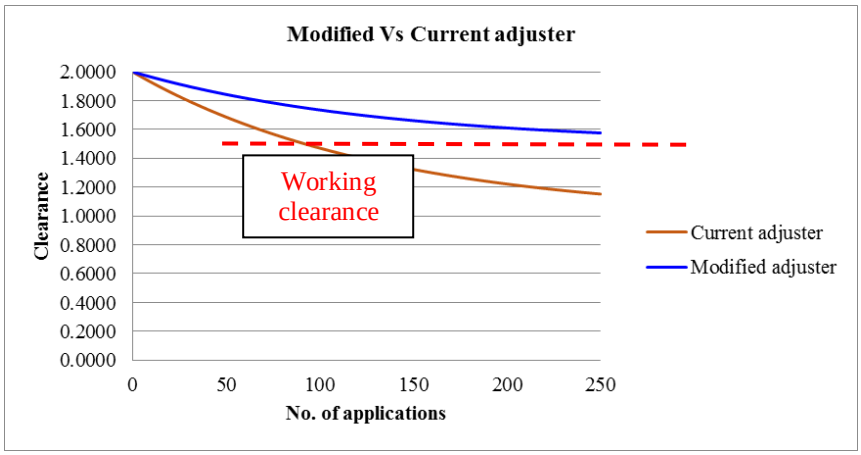

Figure.14

This shows the current adjuster reduces the clearance below the working range (1.5mm) as the no. of applications increases whereas modified adjuster maintain the constant working clearance. The slipping feature is working as intended.

5. Conclusion

Thus, a compact mechanism is arrived for auto adjusters used for wear compensation in many systems (like brake, clutch etc.,) with load sensing feature. Many concepts were generated, evaluated; one best concept is selected, designed, manufactured and verified.

6. Future Scope

Further, the adjuster can be made to operate electronically. It can be driven by a motor and sensors can be used to sense the overload. A controller will be used to receive the input from sensor and drive the motor in one direction till overload is reached. Once, overload is reached, ECU will stop the motor. In the same way ECU will not allow the motor to rotate in opposite direction. A screw-nut mechanism can be used to compensate the length for wear.

7. Acknowledgment

I thank Dr. G. Prabhakaran, HOD-Mechanical Engineering- SRM Institute of Science and Technology) for his guidance and valuable suggestions for this paper.

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DESIGN, FABRICATION, AND PERFORMANCE EVALUATION OF STANDING WHEELCHAIR

C.Uthirapathy[1], N.Manikandan[2], S.Ganesh[3], K.Vinothkumar[4] and S.D.Kumar[5]
Department of Mechanical Engineering, SRM Institute of Science and Technology, Ramapuram Campus, Chennai, India
vijaymeh51@gmail.com

ABSTRACT

Wheelchair users require a safe and an economical solution for raising themselves into an upright position and in our project we have aimed to design a new mechanical system in wheelchair to help paraplegics stand up. This mechanism is safer, simpler in structure, less power consuming and more economic. The standing wheelchair that we have designed and fabricated may help people with disability to surge self-esteem; reach objects placed high, deliver speech on podium and also helps in moving from wheelchair to bed easier in some cases. Standing enhances their feeling of well-being, it helps in maintaining the bones and muscles in reasonable condition and it improves the functioning of the abdominal organs and the circulation of body fluids and also helps in preventing pressure sores and urinary-tract infections. We have achieved this by using a remote controlled hydraulic system attached to the hinge of the seat that provides the inclination required for a standing/seated position. The wheelchair is a modified system yet is narrow enough to fit through most doorways and has adequate weight for mobility.

Keywords: *Standing wheelchair, Hydraulics.*

1. Introduction

In our project, we have worked on designing different mechanical systems in a wheelchair to help paraplegics stand up. These mechanisms are much safer, structurally simple, more efficient and economical. The standing wheelchair that we designed and manufactured can help people with disabilities to gain self-esteem; reach high-rise objects, deliver podium presentation and, in some cases, make moving from a wheelchair to a bed easier. Standing up improves their feelings of welfare, it also helps maintain the bones and muscles in reasonably good condition, the circulation of fluids in the body, improves the functioning of vital organs and for a large helps in the prevention of bed sores and urinary infections[8]. We have achieved this by using a remote-controlled hydraulic system attached to the hinge of the seat that provides the inclination required for a standing/seated position. The wheelchair is a modified system yet is narrow enough to fit through most doorways and has adequate weight for mobility. The ability to face up and move around has forever been considered necessary if an individual becomes a paraplegic. Wheelchairs have an invaluable and unparalleled role in helping individuals for quite a few years now [10]. Thus, innovations and updates to a wheelchair's performance and its physical structure need to be a prime concern for the well-being of societies and establishments. The chair features a selection vary of designs in the industry. Mild steel, aluminum and light-weight solid are the commonly used metals in manufacturing[1]. They are also divided by their operations: manual wheelchairs and Electrical wheelchairs. In present years, wheelchairs are developed as a brand new quite different design. When a patient needs to achieve a better posture or advance from a chair to a bed, or even give a talking on a stage, the disabled person is going to develop the confidence and the willpower that he needs by being aided and encouraged by this innovation. Standing chairs will help the disabled person to accomplish his or her goal. We checked the web for the most common kinds of standing wheelchairs[5]. It is seen that most purely manual wheelchairs require the use of physical strength in order to achieve a standing up position. Compared to the present quite a chair, an electrical wheelchair is a lot of advanced; however, the majority of automatic wheelchairs use no innovative structure to achieve stand up position due to the use of a complex working system and a large amount of energy gets wasted[13]. And our research has shown us that not all standing wheelchairs are compliant with the patient's ailment and the design tends to affect their regular upright position. Therefore, we designed our project to address such

problems. We have decided to combine electronic, hydraulic and mechanical structural elements in this project to improve its existing design and to create a better product [15]. In order to design our wheelchair, improved the answer to major issues that mentioned higher than. We think about our chair as a straightforward structure as ancient standing [4]. The disadvantage of using conventional methods such as crutches and physical aids is that some style of walking is typically potential and it causes pain and fatigue [9]. Moreover, the stress exerted is usually very high and the recovery rate is low and due to this most paraplegics reluctantly settle for the chair because of the only realistic means that of locomotion. Sadly, this often causes the disabled person outlay all his day in an exceedingly mundane seated position which can be boring and not fascinating [2]. It is therefore established that being upright or standing up is of utmost priority and profits a disabled person greatly. A standing position improves a handicapped person's feeling of welfare, it aids support and sustenance of lower limbs in poor condition, and it greatly improves the health and function of vital organs and prevents infection [7]. In spite of all these upsides to standing upright, some disabled people deliberately dislike doing it due to often partially owing to the time and energy needed to fix on the braces, however in the main as a result of being unable to move[14]. This project is therefore being carried out to beat such pitfalls. The goal of this project is to create a simple and an efficient means for a person with disabilities to attain a standing and upright position which can help him fulfil and to achieve things which he previously couldn't. It is very uncommon to find any place without individuals who are handicapped and unable to get into an upright position, mainly people who have been paralyzed from the hip down or lower limb amputees and the most popular aid of choice has been wheelchairs [12]. This aspect of mobility and welfare has therefore received a lot attention over the years and has become a continuing area for research and engineering developments. We have strived to achieve an advanced system in a wheelchair to assist such people to get on their feet; this system would be stronger, simpler in nature, less dominant control and a great deal of economic [11]. The standing chair we intended can facilitate individuals with incapacity to boost morale and to carry out normal day to day activities independently [6]. A solution needed to be deduced such that the gravitational force which opposes vertical motion had to be tackled in an energy efficient and cost effective manner. A simple solution involving a hinge balancing the center of gravity has helped tackle this problem and achieve the end result [3]. The improved design upgrade is much more secure, straightforward, easy to use, affordable and highly efficient.

1.1 Drawbacks of existing product

- Manual Standing wheelchairs require the application of physical strength and this can be a hindrance to people who are weak and frail.
- Stability issues have been noticed in low-cost manual standing wheelchairs.
- High-end powered standing wheelchairs have a complex assembly and this can be unreliable, less robust and results in increased cost of purchase and maintenance.
- Dependent on assistance to help in standing.
- Performance issues regarding stability due to imbalanced weight distribution.
- People with disabilities may experience low self-esteem or even mental trauma.
- Requires the application of physical effort which causes fatigue and is not very reliable (in case of a manual standing wheelchair).
- Difficulty in shifting from wheelchair to a bed for paraplegics.
- Decreased access by disabled people due to the lack of knowledge about it.
- The inability of disabled people to reach objects in high places from a seated position.
- Spinal issues and sores resulting from constantly remaining seated.
- Due to its elaborate construction and high cost, powered standing wheelchairs are inaccessible to disabled people in rural areas and underprivileged people.

2. Methods

2.1 Methodology

2.2 Design

The proposed model is designed with the help of Solidworks Software.

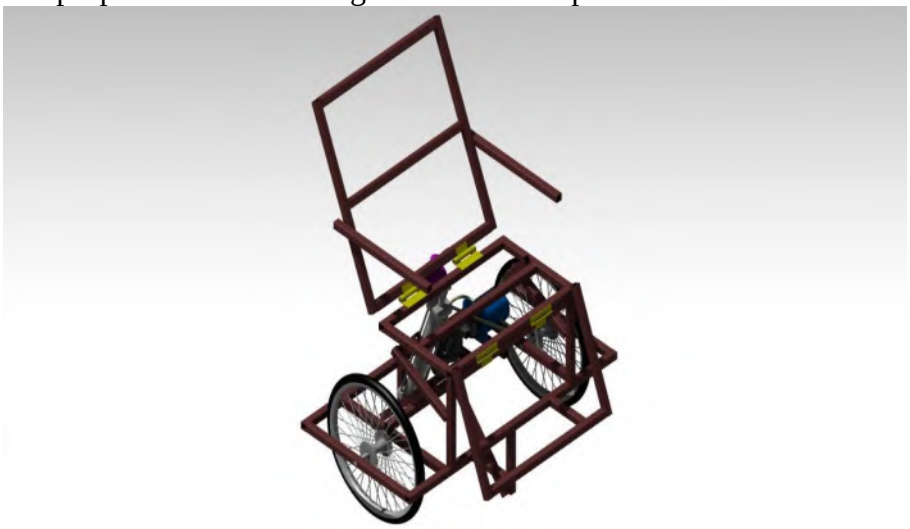

Fig 1. Isometric View of the wheelchair.

Fig 2. Side View of the wheelchair.

Fig 3. Front View of the wheelchair.

2.3 Selection of parts

The wheelchair consists of the following parts:

a) Frame
b) Dc wiper motor
c) Reciprocating gear pump
d) Hydraulic cylinder
e) Hydraulic Fluid
f) Reservoir
g) Battery
h) DPDT switch
i) Wheels

Frame

A frame is a structural system that supports other components of a physical construction or steel frame that limits the construction's extent. This frame was fabricated using MS pipe. Mild steel then called plain-carbon steel is presently the greatest extensively known kind of steel since its price is commonly small although it provides material properties that are fitting for a lot of applications. It is easily moldable and flexible due to its carbon percentage. Mild steel has largely low rigidity, yet it is modest and easy to shape; the hardness of the surface can be increased by carburizing.

DC Wiper motor

This motor was used to run the gear pump. The wiper motor is a DC (direct current) 12V motor that incorporates a lot of apparatuses and a recreation center switch. The motor has a system voltage of 12V, the polarity is Negative Earth. The ambient temperature range is between 20°C to 90°C.It draws about 1.5 Amps of current at Normal speed and 2.5Amps at high speed. The torque of the motor is 13.0Nm at 13.5V output. The nominal speed of the motor is 48wipes/minute and at high speed 70wipes/minute. The motor weighs about1.1 Kg. The life of the motor under constant use is 500 hours.

Reciprocating gear pump

A gear pump is used for controlling the motion of the fluid in and out of the cylinder. Reciprocating Gear Pump is used. It is a good sort of displacement pump. Positive displacement pumps permit the movement of fluid from one side of the pump to another using a rotational motion. The fluid is out when the diaphragm moves. This pump has a controller that acts as the entrance for the liquid. The controller captures the liquid inside also guides the fluid to a certain area. Reciprocating pumps can release high-pressure fluids in small intervals. These are also called constant flow machines.

Hydraulic Cylinders

A hydraulic cylinder is capable of producing linear motion and force by using only a fluid. The fluid is pressurized and sent it to the cylinder chamber which allows the linear motion to take place. Industries use hydraulic cylinders to form metals or other materials with a very high force but only with a moderately small amount of highly pressurized fluid. An excavator which is a heavy equipment count on the power of hydraulic fluid. The pressurized hydraulic fluid in the cylinder can be meticulous with the aid of a regulator connected to distributor hoses and tubes. The most common type of valve used along with a hydraulic cylinder is the solenoid valve because of its reputation for safety and reliability. The sole purpose of the valve is not only for releasing the fluid but often allows to mix gases and fluids as well.

Hydraulic fluid

Power is transferred to hydraulic machinery using this fluid. These liquids are generally made of mineral oil and water. The most important function of the fluid is to transfer power they also have an added responsibility to safeguard hydraulic machine components. Hydraulic fluid is non compressible because of high bulk modulus and it has a good thermal capacity and conductivity. The pump effectiveness is maintained due to the presence of appropriate viscidness to diminish interiors seepage and also has a high viscosity index. It can also act as a lubricant due to its properties of corrosion control, thermal and oxidative stability, and demulsibilty.

Reservoir

The purpose of a reservoir is to carry extra hydraulic fluid to house capacity variations from cylinder extension and contraction, Besides, it is also designed in such a way

that it helps in the partition of air from the fluid and also has the added responsibility to act as a temperature accumulator to take care of the losses as soon as highest power is consumed. Dirt and other particulates present in the oil can also be separated with the help of the reservoir, as those heavy particles settle at the bottom.

Battery

To run the motor a 12V DC battery is used.AC cannot be used as it needs a fixed power source. DC Battery offers moveable, self-sufficient current that has a limited lifetime. Direct Current is used by the batteries where the flow of current is in a single direction and used for running radios computers and other electronic components.

DPDT switch

DPDT is the abbreviated form for Double Pole Double Throw (DPDT) switch. It has two inputs and four outputs. It makes the transition to double pole double throw a rather adaptable move. With 2 inputs, it can be connected to 4 different outputs. It can redirect the circuit to 2 different process modes. The switch helps to monitor the chair's reciprocal motion.

Wheels

Wheels were used for facilitating the movement of the chair. The normal type of wheels was used. It is of size 26 inch and the tyre is made of nylon material. The rim of the wheels is generally made up of different materials. Commonly used ones are magnesium and aluminum alloy, chrome, and sometimes a Teflon coating is provided for extra protection. The tyre width is generally twice the internal width of the rim or one and half times the external width.

2.4 Calculations

Torque require to lift a person of mass 100 kg

Force = ma
Where m = 100 kg
$a_1 = a_2$-g
g = acceleration due to gravity(m/s)
a_2 = acceleration required to overcome gravity
Assuming a_2 = 12.3 m/s
g = 9.8 m/s
a_1 = 2.5 m/s
F = 100*2.5
= 250N
Torque =F*r
Where r = 1.15 m
Torque = 250*1.15
= 287.5 Nm

To find the power, torque and speed of a 12 volt DC motor

Power (watt) = V*A
Where V=voltage and A=ampere
V*A = 12*10= 120 W
Power = 0.12 kW
Torque of the motor
T = P/N
P=Power
N= Speed
Here N= 65 rpm
T= 120/65
T=17.6294 Nm

Cylinder Calculations

Piston / Bore Diameter = 50mm
Rod Diameter = 28mm
Stroke = 500mm
Maximum Pressure = 10 bar
Bore Side:
Area of bore = πR^2
where R=bore radius
= 0.0019 m^2
Volume of bore = $\pi R^2 L$
= 0.0009 m^3
Force = P*A
= 1.9635 kN
Time = 49.0874 s
Velocity = 0.0101 m/s
Outflow = 0.82368 lpm
Rod Side:
Area = X-$\pi r^2 \pi r^2$
X = Area on bore side
= 0.0013 m^2
Volume = X -$\pi r^2 l \pi r^2 l$
= 0.0006 m^3
Force = P*A
= 1.3477 kN
Time = 33.6936 s
Velocity = 0.01483 m/s
Outflow = 1.7483 lpm
Ratio = A(X)/A(Y)
A(X) = Area Bore side
A(Y) = Area Rod side
Ratio = 1.4569

2.5 Working principle

- The wheels were fitted into the side of the frame, two 26" wheels at opposite sides to each other and a pair of caster wheels placed at the front for direction control and at the back to provide additional support.
- The hydraulic cylinder is placed in an slanting angle where cap end is fitted to the back of the frame and the rod end is connected to the hinge of the seat.
- The Reservoir is placed at the bottom in the rear portion to which a reciprocating pump is connected.
- The Reciprocating gear pump is driven by a DC wiper motor.
- The hydraulic fluid moves in and out of the cylinder by means of a tube connected to the reservoir.
- The 12 volt battery is housed beneath the seat in the front portion to power the motor and to counter-balance the weight at the rear end.
- A DPDT switch is placed on the right armrest for easy access and is connected to the motor by means of wires.
- Elastic harness is provided at 2 places one over the chest for supporting the upper body and the other is placed over the knee to support lower body.
- Cushions were fixed into the seat and armrests for comfort.
- It is a basic wheelchair which is moved manually.
- The person after sitting on the chair and employing the harness, one must activate the DPDT switch.
- The fluid from the reservoir rushes to the hydraulic cylinder which is placed at the intersection of the seat.
- In about 45 seconds the person rises to a standing position.
- When the DPDT switch is activated again the fluid from the cylinder returns back to the reservoir.
- After 45 seconds the chair returns to the initial resting position.

3. Results and discussion.

The standing wheelchair was tested on the surface with weights loaded gradually. The following results are shown in the Table 1.
It was able to successfully push the people with weights up to 100kg. The disabled persons can able to sit comfortably on the wheel chair and with the help of wheels can move any place on the horizontal floor as well as slope. A total of 1 minute and 30 seconds is the time required by the chair to achieve the standing position and return back to the original state. In a standing position of wheelchair, the disabled person can assess the places as how the normal person does the things.

Table 1. Results after testing

LOADING CONDITION	LOAD ON WHEELCHAIR	RESULT
On flat surface	No-load	Successful
	20kg	Successful
	40kg	Successful
	60kg	Successful
	80kg	Successful
	100kg	Successful
	110kg	Unsuccessful

Fig 4. Hydraulic Assembly of wheelchair

Fig 5. Sit-to-Stand Transformation of wheelchair

3.1Advantages and disadvantages

3.1.1 Advantages

- The wheelchair can be used to help a paraplegic person to stand.
- The seat can be tilted to the required angle.
- The wheelchair can withstand people weighing of upto100kgs
- The operation of the wheelchair is easy.
- The wheelchair is economical compared to the products in the existing market

3.1.2 Disadvantages

- The wheelchair requires more maintenance than usual ones.
- The battery capacity required to run the motor the motor is more.
- The width of the wheelchair is more than the usual wheelchairs.

3.2 Applications

- Hospitals and public places
- Institutions and office
- Industries
- Home

4. Conclusions

The standing wheelchair is successfully fabricated and arrived the following conclusions,

- The design of the wheelchair is compact

and hence is able to move about in almost all pathways.

- It is designed very safe and given more comfort to sit and operate the wheelchair. Under normal working conditions, the frame, wheels or the mechanism works smoothly.
- According to the tests conducted, the standing wheelchair has a capacity of carrying a load of 100kgs on flat surface.
- The wheelchair has the ability to operate a slope of 20-degree elevation carrying a weight of 70kgs.
- It takes about 45 seconds for the chair to move from sitting to standing position likewise it takes around 45 seconds to return to the original position.

4.1 Future Scopes

- The weight of the frame can be reduced by using lightweight high- strength materials such as composites, carbon fiber, FRP etc.
- The wheelchair can be further automated by using more electronic sensors.
- The wheelchair can be manufactured to with stand more amount of load.
- The movement of the wheelchair can be semi-automated.
- More powerful motor and larger hydraulics can be used to make the movement faster.

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IMPROPER DISPOSAL OF HOUSEHOLD WASTE AND HEALTH IMPACT: A STUDY IN TIRUNELVELI DISTRICT OF TAMIL NADU

N. Sofia[1] and R. Selvaraju[2]
[1]Faculty of Humanities and Social Sciences, Assam Downtown University, Guwahati, India.
[2]Faculty of Education, ManonmaniamSundaranar University, Tirunelveli, Tamil Nadu, India.
[1]n.sofia2010@gmail.com, [2]dr.selvaraju@msuniv.ac.in

ABSTRACT

Waste is an unavoidable byproduct of human society. Industrialization, density of population and urbanization have greatly increased the generation of household solid waste in rural and urban areas. Open dumpingof waste leads to health and environmental problems like waterborne diseases, pollution in air and water also. Uncollected household solid waste can also block rain water runoff, resulting in the forming of stagnant water bodies that become the breeding ground of diseases. Direct dumping of untreated household solid waste in the nearby water bodies resulted in the accumulation of toxic substances in the food chain through the plants and animals that feed on it. It is also a big challenge for the sustainable development of the nation.The aim of the present study is to analyse the health impact of improper disposal of household solid waste in Cheramahadevi block of Tirunelveli District, Tamil Nadu.The researchers collected the data from 439 rural women respondents by using structured interview method. The study indicates that fifty-three percent of the children of women respondents interviewed for the study are affected by the cough, skin allergy, injuries and throat infection due to the proximity of the dumpsite.

Keywords: *Household Solid Waste, Improper Waste Disposal, Health Impact, Household Waste Generation, Methods of waste disposal.*

1 Introduction

Waste is a natural outcome of human activities. The wastes consist of bio-degradable or non-bio-degradable waste. Solid waste is referred to as rubbish, trash, garbage or useless or unwanted materials. Solid waste is one of the major environmental and health issues in the developing countries. It is also a big challenge for sustainable development of the nation. Solid waste is a broad term, which includes all kinds of waste such as municipal solid waste (MSW), industrial waste, hazardous waste, bio-medical and electronic waste (E-waste) depending on their values and sources. This garbage is generated mainly from residential and commercial activities. Improper collection and disposal of household solid waste cause health hazards to inhabitants. It also leads to intolerable conditions and spreads communicable diseases.

Solid waste blocks drains, creating stagnant water for insect breeding and floods during rainy seasons. Insect and rodent are attracted to the dumping waste and spread diseases such as Malaria and Dengue fever. Growing urbanization, density of population and industrial growth are leading severe problems of waste generation and disposal in Indian cities. Economic activities and technological developments lead to generation of large quantity of solid waste in urban areas. Moreover, the changing occupation structure, increases in consumption levels and changing lifestyles also lead to waste generation in the developing cities.

In 1947, cities and towns of India generated 6 million tonnes of solid waste; in 1997 it was about 48 million tonnes. More than 25 per cent of the Municipal Solid Waste (MSW) is not collected at all; 70 per cent of the Indian cities do not have adequate facilities to transport the waste and there are no sanitary landfills to dispose of the waste. The existing landfills are neither well equipped nor well managed and are not lined properly to protect against contamination of soil and ground water. Ancient culture of our society dealt with the disposing of waste in different ways; dump it outside their settlements; incorporate some of it into flooring and building materials; recycle some of it. Dumping or burning solid waste has been a standard practicing over the centuries. In developed nations, people have awareness about how to minimize the waste generation. But in the developing countries, people do not care about the waste and they are not involved to take efforts for disposing of waste properly(Source: http: swmindia.blogspot.in).

1.1Statement of the Problem

Rapid Industrialization and Population explosion in India have led to the migration of people from rural areas to urban cities for employment and education purposes, which generate large quantity of solid waste daily. Waste generation is a problem not only in urban areas but also in rural areas. It leads to unhygienic conditions and affects human health. The quantity of waste generated by the people will differ according to their socio-economic conditions, population and commercial activities. In the present time, the solid waste problem includes improper waste collection system, open dumping, inadequate equipment's and other forms of improper disposing of waste. Unless these problems are looked into properly, it will become a challenge for future generation.In this context, the present conducted to study about the improper disposal of household solid waste andhealth impact among the rural women in Cheramahadevi Block of Tirunelveli District of Tamil Nadu.

1.2 Objective of the Study

The main objective of the study is to study the impact of improper household solid waste among the rural women.

1.3Limitations of the study

The study focused on the rural women and concentrated only one block of the study district.

2 Review of Literature

Abul (2010)reported that the residents located less than 200 meters from the dumpsite are mostly affected by the dumpsite. And consequently, they become victims of malaria, cholera, chest pain, cough and diarrhea. Moreover, the researcher said who are located more than 200 meters from the dumpsite are also affected by bad smells spreading from the dumpsite.

Chandramohan et al. (2010) have researched on solid waste, its health impairments and role of rag pickers in Tiruchirapalli city, Tamil Nadu, India, which states that majority of the rag pickers suffered from skin allergies, and mixture of illness, following that 15 percent of them suffered from asthma and 5 percent of them suffered from wooping cough.

Mane and Hemalatha (2012),have described an existing situation of solid waste management in Pune city, India. The study revealed that the people living in this area are having health and hygienic problems such as allergic, asthmatic, bronchitis, skin irritation and gastro intestinal diseases. Alam and Ahmade (2013),have reviewed the impact of solid waste on health and environment in general aspect. The growth and development of urban areas and density of population are exclusively for increasing the rate of solid waste in the present scenario. Insect and rodent vectors are attracted to the waste and can spread diseases such as cholera and dengue fever. Aruna et al.(2013)in their study on Municipal solid waste management scenario of Kakinada city, which reports that the solid waste disposal methods at Cheedelapara dumping yard generate many environmental as well as health hazards within the surrounding area. The generation of leachate, gas, odour, noise, and dust, potential fire hazards etc. are the common environmental problems in the existing sites that pollute nature and affects human health.

According to Gogoi (2013), wastes heap up on the roads owing to the improper disposal system of Guwahati municipal. People in the study area clean their own houses and dispose of their wastes in the surroundings, which affects the neighbouring community and themselves. This type of dumping leads to unhygienic conditions. It also produces foul smell, breeds various types of insects and infectious organism besides spoiling the environment.

Sankoh et al. (2013)have examined an environmental and health impact of solid waste disposal on developing cities of Granville brook dumpsite, Freetown, Sierra Leone, which states that both nearby and far-away residents suffered from diseases due to the location of the dumpsite closer to their settlements. Increasing urbanization and population are fully responsible for high generation of solid waste and its improper management is a major problem of Municipal Corporation.

According to Singh (2013), improper solid waste disposal and management pollute our

natural resources.Uncontrolled burning of wastes and improper incineration contribute significantly to urban air pollution. Abandoned hazardous wastes create potential risks to human health.

Waste is also commonly dumped into watercourses or streams, thereby contributing to make water pollution and to spread waterborne diseases, such as typhoid, cholera, dysentery, diarrhoea, hepatitis A and a number of tropical diseases including malaria in the study area. Municipal solid waste pollution is a real pervasive and serious problem in Juba city that needs a very urgent solution (Loboka et al. 2014).

3. Methodology

3.1Study area

The Tirunelveli district is the sixth largest Municipal Corporation in the Tamil Nadu state. It has three revenue divisions namely Tirunelveli, Cheranmahadevi and Tenkasi. The solid waste generation of Tirunelveli Corporation, Municipalities and town Panchyats are 48 tonnes, 49.75 tonnes and 66 tonnes respectively. The solid waste collection of Tirunelveli Corporation, Municipalities and town panchayats are 38 tonnes, 36.5 tonnes and 27 tonnes respectively. The nature of ground water in the study district is generally good. But, the quality of surface water in the surroundings areas of Cheranmahadevi block, Ambasamudram Taluk and Papanasam areas are affected by the discharges from Industries. A series of legal measures have been enacted all over the world and particularly in India since 1986. Recently the government of Tamil Nadu has implemented a new regulation on the form of domestic solid wastes in order to save our environment from further degradation. However, any number of laws and acts cannot bring the preferred results unless people come forward to accept it and adopt it.

3.2 Concept and Operational Definition

Impact

The concept of 'impact' in this study, refers to the negative influence of improper disposal of solid waste thereby affecting the normal conditions of environment and human health.

Household Solid Waste

The term 'solid waste' in this study, refers to the solid waste materials generated in the households of the respondents and in their residential streets, which come under the jurisdiction of Cheranmahadevi block of Tirunelveli Municipal Corporation.

3.3 Universe of the study

The Universe of the study comprised all the rural women coming under the age group of 18-59 years and residing in Cheranmahadevi block of Tirunelveli District in Tamil Nadu**.**

3.4 Study Population

The study population consisted of 439 rural women coming under the age group of 18-59 years, who are selected from the study village panchayats through proportionate sampling method.

3.5 Sampling

The study covered one block of Cheranmahadevi of the total 19 blocks of the Tirunelveli District. The study block is chosen through simple random sampling technique using lot method.

3.6 Sample size and Study Respondents

The list of villagers in the study block furnished in the census report 2011 forms the sample frame. For the purpose of the present study, five per cent of the rural households each from every study village panchayat are selected through proportionate sampling technique.Totally 439 households are selected for the study. These households are selected from the list of village panchayats as per 2011 census. One woman from each of the households is selected and interviewed for the purpose of the study. Thus, 439 rural women coming under the age group of 18-59 years belonging to the study households are selected. In the case of more than one woman available under the age group of 18-59 years in the study households, the woman who is reportedly mostly involved in collection and disposal of household solid waste are selected as the respondents in this context.

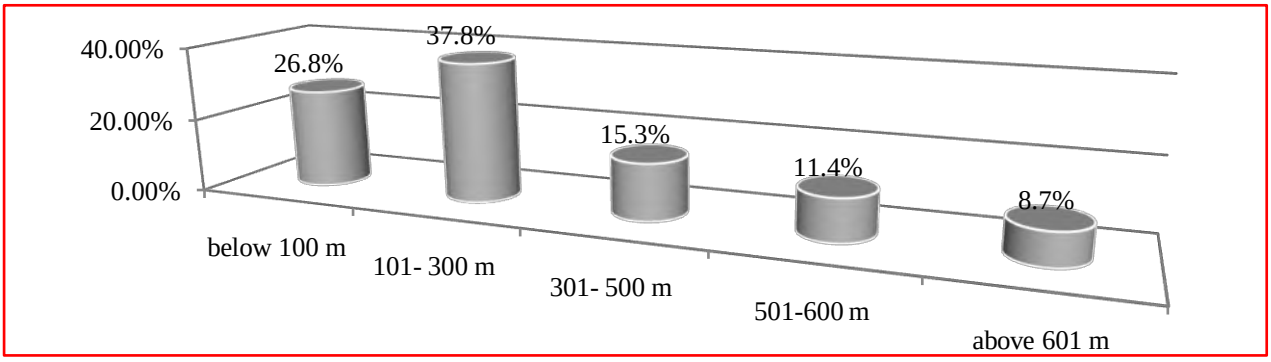
3.7 Tools of Data Collection

Structured Interview Schedule has been adopted in the present research to collect the data from the study respondents.

4.Results and Discussion

Figure 1 clearly indicates that 37.8 per cent of the women respondents selected for the study report that the distance between residential area and dumpsite ranges from 101-300 Metres followed by below 100 Metres (26.8%), 301-500 Metres (15.3%), 501-600 Metres (11.4%) and only in the case of 8.7 per cent of the women respondents, the distance is above 601 Metres away from their residential areas.It is inferred from the figure-1that for number of women respondents, the distance between residential areas and dumpsite varies from 101-300 Metres. Hence, the figure(1) implies that there is every likelihood of affecting health of people and polluting environment. However, it is noted from the figure1 that at least for a little less than one tenth of the women respondents, their dumpsite is above 601 Metres away from their residential areas.

Figure 1 - Distance of dumpsite from their residential areas



Source: Field Visit

Regarding the emissions of the odour from the dumpsite, just half of them report that emission of odour is felt by them frequently followed by sometimes on certain occasion due rain, burning, clearing, being mud shelter for village pigs and grazing by the cattle (32.8%), always (12.0%) and rarely (6.2%). Majority of the women respondents in the study area have felt the emissions of the odour from the dumpsite and half of them state that the emissions from dumpsite is felt frequently i.e many times at short intervals. Thus, the study shows that the environment, in which the women respondents and their family members live is filled with odour emitting from dumpsite and to that extent, the health of the people living in thestudy areas is getting affected in course of time.

Study respondents have reported the time and season of emissions of odour from dumpsite, which is intolerable, about 50 per cent of them refer to 'rainy season' to the emissions of stench from dumpsite followed by 'day time' (38.0%) 'summer season' (10.4%) and 'night time' (1.3%). About seventy per cent of the women respondents interviewed for the study, say that they are affected by diseases during three months period prior to the investigation of the researchers in the study area whereas thirty per cent of the women respondents' state in the negative regarding their getting affected by diseases.

The researchers have probed further to find if the respondents' family members are affected by diseases and how they are affected during the past three month's period prior to the date of investigation by the researchers due to the improper disposal of household solid waste. About fifty-one per cent of the respondents selected for the study, say that their family members are affected by diseases during three months period prior to the investigation of the researchers in the study area. A little less than fifty per cent of the women respondents' state in the negative regarding their family members getting affected by diseases.Among those who have stated that their family members are affected by diseases, forty-one per cent of them refer to cold and cough followed by fever (30.9%) by which their family members are affected.

Having come to understand the seriousness of health issues caused by living near the dumping yard, the researchers focused on how the most vulnerable group of the society, viz., children, are affected due to the proximity to the dumping yard.The study reveals that fifty-three per cent of the children of women respondents interviewed for the study are affected by the diseases, while forty-seven per cent of the women respondents' state in the negative. Among those children of the women respondents affected by the diseases, vomiting is reported by twenty-five per cent followed by cough (19.3%), skin allergy (15.5%) injuries while playing (15.0%) nasal stiffness (13.4%) and throat infection (11.2%).

Regarding the taste of water, more than half of the women respondents' state that the taste of drinking water is soft. Among who have stated in the positive regarding the difference in drinking water, all of the women respondents attributed to the waste thrown in water bodies, to their response of differences in quality of water followed by out flowing of industrial waste water and mixing in the Tamiraparani river water (94.1%), improper maintenance of drainage system (88.2%), the quality of land is spoiled due to the mixing of untreated hazardous solid waste (82.3%) and improper dumping of solid waste in all purampokku land (waste land of village).It is evidently felt that the three sources of availing water in the study area is purely at nature's resource depends on purity of ground water, which should not be affected by the worst effect due to improper and unhygienic management of solid waste of the area. Getting of soft or salt water with mild or hard taste is the yield partially because of arbitrary dumping of solid waste in the surrounding area without proper evacuation and lethargy in maintaining the ground tidy and waste free.

Table 1 reveals that 99 per cent of the women respondents' state that mixing of solid waste with water bodies affects the nature due to corrosion of water quality thereby making water unsuitable for human consumption followed by spreading water borne diseases (95.6%), water stagnant through floating of household solid materials (93.3%), disruption of food chains (92.2%), destruction of aquatic animals (91.1%) and decrease of dissolving oxygen level (79.7%).

The mixing of household solid waste with water bodies affects the nature due to corrosion of water quality thereby making water unsuitable for human consumption, spreading water borne diseases and water stagnant through floating of household solid materials.

It is observed in the research area the acute scarcity of qualitative water to a specific level is caused due to mixing of household solid waste with water resources because of lack of awareness among the respondents and less motivation from the government or other service-oriented organization including primary health level outlets and secondary hygiene protection social activists. This problem can be eradicated through motivational campaigns and involvement of government sectors concerned with an attitude of service towards the wellness of the people.

Table 1

Nature is affected due to mixing of household solid waste with water bodies	**Frequency**	**Per cent**
Corrosion of water quality thereby making water unsuitable for human consumption	435	99.0
Spreading water borne diseases	420	95.6
Water stagnant through floating of household solid materials	410	93.3
Disruption of food chains	405	92.2
Destruction of Aquatic animals	400	91.1
Decrease of dissolving oxygen level	350	79.7
Total	**N=439**	**100.0***

Source: Field Visit

As per the above Table 1, the dumpsite for household solid waste comprises along the site of the panchayat road (35.8%), in the purampokku land of the village (28.2%) near to village pond (19.1%) and river bank (10.5%). The Table 1 implies that more number of the village people especially women selected for the study and the local body members are not bothered about the kind of negative impact, which will be created on the life of the villagers as well as the ground water used both for domestic and agriculture purposes. The

very fact that the disposal of household solid waste material should be carried out in such a way that it should not affect the life of the villagers, health of the cattle and fertility of the soil, environmental sanitation, seems to be not realized. The people who pass by the dumpsite get affected by intolerable stench and the health of the cattle, which consume the plastic materials while grazing nearby the dumpsite get spoiled leading to loss of life in course of time.

Hence, the villagers especially women in the study area are to be sensitized to these problems so as to find out the solution through the application of Participatory Rural Appraisal (PRA) method involving people, in the main, facilitated by officials,non- officials and by the educational institutions.

The women respondents are asked regarding the problems faced during the transportation of waste from the street container kept in the village to the dumping yard. The study clearly shows the problems confronted while clearing the household waste for purpose of disposing of it. The problem of 'improper cleaning' (42.0%) is reported by more number of women respondents followed by transportation of waste materials in such a way that they fall off from the vehicle all the way from village street bin to dumpsite (17.5%) and noise pollution resulting from clearing the waste materials by the sanitary workers (12.5%).

Table 2

Social life affected by the improper handling of household solid waste	**Frequency**	**Per cent**
School going children are affected by the odour while crossing the dumpsite	400	91.1
Burning of waste creates smog and ashes affecting the environment and health of people	435	99.0
Villagers are reluctant to attend the public meeting due to improper handling of waste materials and open dumpsite emitting foul smell	410	93.3
The dumpsite prevents other villagers from visiting the study village and reduces the frequencies of visit	405	92.2
The meeting of village non-student youth in the common place of the village for holding sports and creation of awareness programmesetc come to an end cut sorting the time schedule of meeting because of nuisance caused by dumpsite.	415	94.5
	N=439	**100***

The social life of the villagers get affected because of burning of waste, which creates smog and ashes affecting the environment and health of people (99.0%), followed by the meeting of village non-student youth in the common place of the village for holding sports and creation of awareness programmes etc., come to end cut sorting the time schedule of meeting because of nuisance caused by dumpsite (94.5%) and the villagers are reluctant to attend the public meeting due to improper handling of waste materials and open dumpsite emitting foul smell (93.3%).The above analysis is related to the theory of Anomie.

The respondents are asked about the sufficiency of sanitary workers and their activities like the frequency of collection and segregation of waste, clearing of waste bins, cleaning and maintaining public toilets, treatment of hazardous waste, keeping the surroundings of the waste bin clean, transportation of waste from the bins to the yard, handling of waste in a precautious manner etc. They are also asked about the sanitation awareness camps conducted by the village panchayats during the rainy seasons for dealing with seasonal diseases; dissuading the villagers from using and burning of plastic waste, whether the vehicle transporting the waste was covered properly with suitable thick cloth/ jute material as well as the disposal of dead animals. Less than half of the women respondents (46%) opined that the solid waste collection and disposal system are not satisfied, the scores of which have been prepared based upon the Likert scale, followed by satisfied (36.2%) and highly satisfied (17.8 %).

Conclusion

The study concludes construction of resource recovery park might go a long way in preventing the children from getting affected by the diseases. Since, this type of arrangement paves the way for recycling of the waste to be used for constructive purposes thereby maintaining pollution free environment to the benefit of people at large.The study implies

that the periodical meetings of primary health centre doctors, health inspectors and sanitary inspectors and staff nurses, male and female health workers are to be conducted in the village involving all the villagers, especially rural women in order to make them get acquainted with the seriousness of the problems faced while clearing the waste. And also, the necessity of the people's co-operation in such matter is to be instilled in the minds of the people with help of village school teachers, officials, non-officials, traditional leaders, student and non- students' youth of the villagers. The minds of the villagers, especially of women, is to be impressed upon towards constructive way of disposal of household solid waste through screening short films, documentary films etc., specially created for that purpose.

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KINNARS OF GUWAHATI: A SOCIOLOGICAL STUDY

S. Dhar
Sociology Programme, Faculty of Humanities and Social Sciences Assam downtown University, Gandhi Nagar, Panikhaiti, Guwahati, Assam,India
drsupu00@gmail.com

ABSTRACT

A man whose body is not fit to reproduce due to malformation of his manhood or a woman whose body has some undeveloped body parts specially the reproductive organs and since they could not fit in the blocks of the society i.e. male and female they are looked down upon by the society.Kinnars are neither man nor women. The Study was conducted in Guwahati City using purposive sampling method. The Kinnars have expressed that they live a life of hardship and have experienced abuse in their life.The study divulge that the kinnars face so much of humiliations and abuse that too without any fault of theirs.

***Keywords**: Kinnars, abuse, society, Hijras, Social life, Guwahati*

Introduction

Indian society has always been tolerant of diverse sexual identities and sexual behaviours as iswasclear from its mythologies and ancient scripts like the *Kamasutra (Kalra: 2011).* Indians tolerate and respect a wide range of cultures, religions, languages and customs. However in spite of this outlook, there seems to be ainadequate public awareness and understanding about the people whose gender identity and expression are unlike with their biological sex.

Kinnars commonly known as hijras in India, are neither male nor female, and are socially excluded in Indian society. (*Mal: 2018*) Kinnars face discrimination in all walks of life such as barring from social and cultural involvement, economic participation and lack of social security, political participation and a like.

Kinnars are neither man nor woman. A man whose body is not appropriate to reproduce due to malformation of his manhood or a woman whose body has some undeveloped body parts specially the reproductive organs, has some qualities of a underdeveloped manhood due to which she can neither be designated as a man nor a woman and is termed as a Kinnar commonly addressed as transgender. Kinnars are devotees of Buhuchara Mata, a version of the Indian mother goddess

Most families find it difficult to accept if their male child starts acting in ways that are considered feminine or inappropriate to the expected gender role. Kinnars even face problems in the healthcare settings. Often healthcare providers rarely had the chance to understand the sexual diversities and they do not have sound knowledge about the health issues of sexual minorities. Thus they face unique barriers when accessing HIV testing and sexual health service, verbal harassment by the hospital staff and co-patients and also due to hijra status. The kinnars face problems in their surroundings in the society. Kinnars are controversial community in the Indian society and their existence disrupts essential ideas about sex or gender(*Mal*: 2018). Thus they need to be recognised as having a space in the society. Considering all these a study was conducted to investigate the socio-economic hardship of the kinnars.

Methodology

The study was carried out in Guwahati, India. Primary data was collected from 20 Kinnarsof the city. Field observation and interview schedule was well thought of as appropriate tools for gathering the primary data, besides a case study was also conducted. Using Purposive Sampling method data were gathered from Ganeshguri, Sijubari, Lachit Nagar, Railway Station, Kahilipara, Gandhi basti andJyoti Nagar (Bamunimaidam).This study is concentrated on the social life of **Kinnars.** There is a lack of understanding among the masses regarding the Kinnar community and are looked down by the humanity. Thus the study is a modest effort to understand the quandary faced by the Kinnarsin their day to day life.

Discussion and Interpretation

Table 1 Age Group of the Respondents:

Age Group	Number of respondents	Percentage
20- 30	**15**	**75%**
31- 40	**03**	**15%**
41- 50	**02**	**10%**
TOTAL	**20**	**100%**

Source: Field Data

The above table displays the age of the respondents. Out of the 20 respondents 15 (75%) are in the age group of 20 – 30 years, 3 (15%) are in the group of 31 – 40 years, 2 (10%) are in the age group of 41- 50 years. Thus considerable number (i.e.,75%) of respondents are in the age group of 20-30 years. All the respondents are feminine in terms of gender orientation, they have uttered that they love to present themselves as females. The respondents are Andhrophile in nature.

Table 2 Religion of the respondents:

Religion	Number of Respondents	Percentage
Hindu	**11**	**55%**
Muslim	**9**	**45%**
Total	**20**	**100**

Source:Field Data

Out of the total respondents 55% were Hindus and rest of them were Muslims. Though the respondents belong to different religion background but they celebrate all the festivals together. However they added that at the time of their death they are buried according to their religious practices in which they were being born.

Table 3Relationship status of the respondents

Relationship status	Number of respondents	Percentage (%)
Single	12	60%
Relationship	05	25%
Married	03	15%
Total	20	100%

Source:Field Data

The respondents were also asked regarding their relationship status out of the total respondents 60% of the respondents were single 25% respondents were in relationship and 15% of the Kinnars in the study were married. Some of the married respondents also added that there is lack of acceptance from their in-laws. Besides this one of the respondents who was in a relationship has painted a gloomy picture of the future because the Kinnar feels that there is no destiny of the relationship and has also added that she had asked her partner to get married as she cannot give him a baby.

Table 4 Educational Qualification of the respondents

Educational Qualification	Number of respondents	Percentage (%)
Illiterate	07	35%
Upper Primary(5-8)	05	25%
Seconary (9-10)	06	30%
HSSLC	02	10%
Total	**20**	**100%**

Source:Field Data

The study revealed that out of the total respondents 35% are illiterate, 25% respondents have studied upto upper primary level, 30% have crossed their secondary level and 10% respondents have completed their HSSLC.

Table: 5 Invited in any social gatherings

Invited to any social gatherings	Number of respondents	Percentage%
Birth of baby boy and wedding	12	60%
Other Social Occassion	03	15%
Not Invited	05	25%
Total	**20**	**100%**

Source: Field Data

The kinnars taken for the study have asserted that they have been invited to various social gatherings. 60% respondents were invited for birth of Baby boy and weddings, 15% respondents were invited to others gathering and remaining 25% were not invited at all.The kinnars said that they are invited in birth ceremony and also marriage ceremony because it is believed that the blessings of kinnar are pure and brings happiness and peace. They are invited to sing and dance and give blessings to child and newly married couple. The kinnars make their living by begging and by attending the various social gatherings where they were invited.

Table 6Experienced any Physical or Sexual abuse

Physical or Sexual abuse	Number of respondents	Percentage
YES	18	90%
NO	02	40%
TOTAL	**20**	**100%**

Out of the total respondents 18(90%) have added that they have experienced physical and sexual abuse and the rest did not face such abuse.

ome Town of the respondents

The Kinnar'staken for the study hails from different parts of Assam and are residing in different areas in Guwahati city. The respondents were taken from the areas like Sijubari, Kahilipara, Narangi, Lakhtokia andBamunimaidan etc. and their home town is in Barpeta, Nalbari, Boko, and some are permanent resident from Guwahati . They leave their hometown in order to protect their family's name. They faced eve- teasing, insult and mockery due to which they are forced to leave their home town now they find it difficult to return in their hometowm. The respondents who were from different parts of Assam added that they are still in contact with their family members and do visit their home towns, however the respondents have also expressed that they face humiliation while visiting home.

Relationship of the kinnars with the social world

The Hijra's(kinnar) are located at the extreme margin of exclusion having no Socio-political space where a hijra can lead life of a human being with dignity. (khan et al:2009). The kinnar taken for the study added that people victimize them in all walks of life. They were subjected to mockery. The respondents even recollected that during their childhood, children from the neighborhood were not allowed to be with them. Later they also added that their neighbor use to comment on the family disrespectfully especially the mother. Schools which is an agency of social change became a place of humiliation since they were addressed as half-ladies. Many of them could not complete their school education.

Their neighbours not only tease them but their families had to face lots of hardship. The respondents were also asked regarding the relationship among the kinnar community, to which they added that they share a cordial relationship with each other and their exists a great sense of integrity within the community. They stood with each other in times of need and share and care for each other.

People's perception towards the Kinnar community is not good. People perceive them as abnormal and untouchable group of the society. They further asserted that the society thinks of them as unholy and curse them. People do not respect them, they hit them, spit on the side when they see them and laugh at them. But there are also people in the society who asks for their blessings and talk with respect.

In the process of gathering primary data, a case study was also conducted to have an in-depth understanding about the social life of a kinnar.

Case study(Shelly Kinnar) name Changed

The case study is about Shelly Kinnar. Shelly held a high position among the Kinnars in Guwahati as she is the Guru to many other Kinnars. She is manily from Barpeta. Shelly's journey has been a painful one from childhood onwards. In school she was treated as half-ladies, so she continued her study only up to 9th standard and then left her home. According to Shelly a common problem which every Kinnarface inthe society is that people feel that they are pretending to be Kinnarto earn their living. Shelly added that Kinnars do not get angry when they are addressed as Hjara but the word Kinnar is more preferable.

Shelly expressed that with the onset of Adolescence she was more oriented towards the feminine gender. Loved wearingsarees and salwars, it is during that time that Shelly started getting attracted towards the boys.

Shelly also talked about the "Murga Mata". She said that the Kinnarcommunity celebrate the festivalof Murga Mata with great zeal and enthusiasm. Shelly also informed about the "Guru-Sisha" relationship among the kinnars community. Guru is addressed as Guruamma among the Kinnars. Shelly first meet her in the train.

When Shelly first came to Guwahati She started her collection from Candmari by clapping her hands. The shopkeeper even asked

her why are you begging being a woman to which Shelly replied that she is a kinnar. Sometimes collection was good and sometimes bad. She was also physically assaulted, was put behind the bars and was there for 3 days but when it was realized that Shelly was a Kinnar through medical checkup she was released.

After her release from jail she was in Bhaskarnagar, Shely also added that in spite of her hardship in her life, she did her best to help her fellow kinnars. She advised her fellow kinnars where to go where not to go, how to protect themselves from the boy, how to earn money and so on.Kinnars are commonly labelled as half-ladies by the society. Shelly recalled her childhood days and said that she also attempted suicide and was in hospital for three days. Shelly expressed that she have first seen a Kinnar in the train, who had drapped a makhela. The Kinnars addressed each other as "boini"

Shelly was not satisfied with the way she was earning money, as she was ashamed of begging, Shelly then joined oriflamme, through some of her contacts with a theatre person she had learned acting also. She continued working there in oriflamme for some days but could not continue her work as an oriflamme agent because one day unconsciously she left the products in the bus in Zoo tinali stoppage. She also talked about foot cream and diamond cream.

Shelly also shared her experience of working as a domestic servant, there also she was physically assaulted. Her life has been full of pain and suffering when asked about her relationship status, Shelly said that she is married but could not stay with her husband for long because of lack of acceptance from her in laws. She also explained her role as a Guru. She said that she also gives names to her chelas. It is the role of Guruma to give new name to her chelas. Hair is termed as "JugMushi" in the language of Hijra and clothes are called as "satra" in the Kinnars language. Presently Shelly is living in Bamunimaidam and is earning her livelihood through collection and attending social occasion. She added that her neighbors are very good and have always stood by her in time of need.

Conclusion

On the whole it can be concluded that the transgender community even after being officially recognised by the Supreme Court of India in 2014 as 'third gender' have to go through many hardships when it comes to their existence and acceptance. In certain parts of India they are treated with respect, as in North India where they are called kinnar. The term kinnaris even preferred by the third gender for themselves. They considered the term hijra as derogatory and offending. But in reality people in society refer them as hijra. It may be case of people calling them hijra unknowingly, while some are unaware of them and some do this as a discriminatory act. It is found that most of the third gender people are marginalised section and have a very low standard of living. They too arenormal beings it is the norms and values of society which creates abiasness against this community. The kinnars face so much of humiliations and abuse at the hands of the so called normal people that too without any fault of theirs. Thus the study was an effort to bring out the facts, problems of and about the kinnars.

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25. Retrived from https://www.researchgate.net/publication/275465522_Let_Us_to_Live_Social_Exclusion_of_H ijra_Community (15:41 28/11/2018)
26. Retrived from https://www.tandfonline.com (08:30 27/11/2018)
27. Retrived from https://scholar.google.co.in (09:05 27/11/2018)
28. Retrivedfrom https://www.indjsp.org (09:30 27/11/2018)
29. Retrived from https://www.journals.sagepub.com (09:15 27/11/2018)
30. Retrivedfrom https://www.tandfonline.com (11:10 29/11/18)
31. Retrived from https://www.indianexpress.com (08/55 12/12/2018)
32. Retrivedfrom https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2928103/ (20:50 14/10/2021)
33. Retrived from https://www.bbc.com/news/world-asia-india-27031180 (21:06 14/10/2021)

STATUS AND ROLE OF WOMEN: A SOCIOLOGICAL STUDY OF AMRI KARBI COMMUNITY, ASSAM

P. Barua
Department of Sociology, Assam down town University.
pinkysociology@gmail.com

ABSTRACT

Gender is a constitutive element in all relations. The term 'gender' refers to the social classification of men and women as 'masculine and feminine' (Oakley, 1972,16) and their expected behaviour based on their assigned social roles (Basin, cited in Buongpui, 2013,75). The different roles that are ascribed to men and women are socially and culturally determined and influenced by traditional practices, institutions, customs and beliefs. Most of the societies in Northeast India are patriarchal societies where men dominate and exercise control over most of the resources and are considered superior to women (Buongpui, 2013,75). Further, the pattern of gender socialization in the region has been shaped by a deeprooted culture of patriarchy (Buongpui, 2013,76). Hence, gender socialization is 'the process which teaches children their gender roles' (Basin cited Buongpui, 2013,76).

***Key Words**: Role, Status, Gender and Community.*

Introduction

The status of a woman is often described in terms of their level of income, employment, education, health and fertility as well as the roles they play within the family, the community and society. The status of any social group is determined by the standard of health-nutrition, literacy education and way of living. The tribal women, as women in all social groups, are more illiterate than men. The low educational status is reflected in their low literacy rate, low enrolment rates and their absence in the school. United Nations has defined the status of women as the "conjunction of position a woman occupies as a worker, student, wife, mother...of the power and prestige attached to these positions, and of the right and duties she is expected to exercise" (UN, 1975 cited in Bhasin, 2007, 01). Such attitudes towards a woman reflect her status in the family and society.

'Status' denotes position in terms of rights and obligations in the society. The status of women has two dimensions (i) the extent of control enjoyed by women over their lives and (ii) the extent to which they have access to the decision-making process and are effectively in position of power and authority. Besides, certain indicators such as level of literacy, employment, political participation, decision about marriage, management of domestic affair, etc. are also adopted to assess the status of women (Zehol, 2003,297).

According to Majumdar and Madan (1956), the status of women in all type of societies, particularly in patrilineal societies, is determined by various types of taboos that are attached to women generally. These taboos can be protective, preventive or productive. It would be a scientific error to approach the women of a society with a rigid bias to the view that they have either a low or a high status, such dichotomies are generally misleading. There can be so many intermediate statuses, and there can be polarity, though it may not be so stinking. The status of women in the Indian context cannot be defined simply (Zehol, 2003,299).

Bhattacharjee (1986) in his work Sociology of Karbis mentions that women occupy an inferior status than man and they have no role in traditional administration. Likewise, Jeuti Barooah (2007), in her work Customary Laws of the Karbis of KarbiAnglong in Assam, states that the Karbis have well-formulated customary laws of inheritance of property and succession to office. The Karbis follow the rules of paternal inheritance. If there is no son to inherit family property, the daughter or daughters can inherit property under certain circumstances (when there is no male issue or when parents want to transfer the property to daughter/s). If there is no heir to inherit ancestral land and other property, the rights of inheritance passes on to one's brothers and brothers' children and to the patri-kin, in the given order.

Discussion

The role and the status of AmriKarbi women of Kamrup District in different dimensions are discussed below.

Institution of Marriage and Amri Women: AmriKarbi society is clan exogamous. In marriage they follow clan exogamy; the Karbis call it as 'Kur'or 'Gharia'. The Karbis are divided into five clans or Kur namely Terang, Teron, Inghee, Inghti and Timung. Marriage within the clan is looked upon as incest. Monogany is the prevailing practice among Karbis and polygamy is not a custom in AmriKarbi society and there is no status in the society for man having two or more wives at the same time. No man has been found of having more than one wife in the area.The Karbis follow a patriarchal system. By rules of descent, they trace the line of descent through the male members only. Though the common form of marriage is monogamy, however, asymmetrical cross-cousin marriage is preferential among them (Das, 2003,119). Cross-cousin marriage is ideal as per their customs to maintain purity and harmony within the family, while at the same time to keep the ancestral family property intact. They have no concept of the system of bride price as is prevalent in some other tribal groups. Again negotiated marriage is preferable and it is most common among the Karbi people. Consent of the girl is most important in selecting her mate. After marriage, the wife continues to use the surname of her father. It is to retain her original family identity and believed that she can be reborn to the clan of her father. So, it can be said that the karbi society is mainly male dominated (Bhuyan, 1993,42).

Family Structure: Plain Karbi clans, as discussed above have kinship categories, but they donot form any compact residential units. The household units, among the plain Karbis, are the families and they are also the smallest residential unit in their social system. Patriarchal social system is dominant among the plain Karbis. Eldest male member is the head of the family and he gives the final decision on every matter.

The common family norm for them is a nuclear family consisting of father, mother and unmarried children, and having a common hearth. However, joint family system is observed too. The father is considered the head of the unit like any other patriarchal society. Traditionally, the females take charge of the domestic chores and are entrusted with the family treasure (Barua&Saikia, 2012,31).

Status of Women in the Economic Sphere: Mainly Amri Karbi society is an agrarian society; Karbis living in the hill areas generally practice shifting cultivation and those living in the plains practice permanent cultivation. Both married and unmarried women perform the similar duties in the paddy field. Amri Karbi men do plough cultivation and if he sells any agricultural product in the market he keeps the money. Phangchoo (2003) mentioned that a woman is an inseparable partner of a man in the field of agriculture. Right from tilling, the jhum land up to the harvest, girls actively participate with boys and married women do it too. In the plains, of course, where tilling is done with the plough, the question of women's participation does not arise. Livestock is one of the main livelihood occupations of Amri women and it helps in meeting the household food needs and adds to household income. They rear animals for their own consumption, and for religious purposes means offering sacrifices to God or Goddess and livelihood. The pattern of livestock strength is mainly influenced by various factors such as farm size, cropping pattern, availability of lands including fodder and pasture. It is seen that these women earn extra income from the sale of these animals and they are involved in all livestock related activities and livestock management. Men however help them in the construction of the shed for animals or poultry and men do share

Women and Property transfer: Traditionally women are not given inheritance rights in any society both in tribal and non-tribal societies. The AmriKarbi of Sonapur area is a patrilineal society like the Karbis of the Hill, and the line of decent is traced through the male line. It is seen that Amri Karbi society is patrilineal in nature. According to customary practices, women have no right to participation in decision making process at village level.

Women and Political Status: AmriKarbis still follow their own traditional systems of administration. Dimoria-Sonapur area (Kamrup) has its own administrative system

which is different from the Karbis of KarbiAnglong. The King of a particular area has strong control over the socio-cultural, religious activity and issues related to the land under his jurisdiction. Under the king, the Bangthe (Village Chief) is assisted by some selected elderly members from the village who constitute a court. The courts solely engage in cases of local matters of the place. The Tarang Ahem (Court House) is the seasonal court; the court sits once or twice in a year to hear the complaints of the villagers. But sometimes they sit on the request of the villagers to solve serious cases of the village. It is found that the members of the traditional village court are all male, and no women can be a part of it and participation of women in political activities in traditional AmriKarbi setting is nil.

Women, Rite and Ritual: Rites and ritual practices play a very important part among the Karbis. Aswini Bora (1993) in his work The Status of Women in the Karbi Society- An Observation explains that Karbi society observes different God and Goddesses, only the elderly male members are allowed to worship the God and Goddesses and women are prohibited; they are not allowed even to enter the place of worship. Women are restricted from killing of sacrifies offered to diety; it is the religious taboo for the womenfolk. It is the male of the household who always performs all the rites in community fest, sacrifices or any religious ceremony among the Karbis. Women cannot participate in any religious ceremony, sacrifices and community fest. Apart from this, in the community feast and other religious ceremony, women are not allowed to take food along with men folk. They are allowed to take separately (1993, 13). But

Women and Education: Education plays a vital role for social mobility and livelihood. Most of elderly people are illiterate in all the sample villages and women are illiterate too even till today. It is clear that the drop-out rate increases because interestingly puberty starts among the (11-15years) age group of girls and secondly the girl needs to take care of her younger siblings; while the mother teaches her about cleaning, washing and how to manage household. Churches of the concerned villages are taking a small initiative for spreading education in the villages through music and reading. The state government has implemented various educational schemes and scholarship for the up-liftment of the tribal women but they are still unaware of the existing of many of these schemes.

Conclusion

Amri women are professed to enjoy equal status in the entire cultural sphere and they lead a respectful life in their society. Yet, there are certain spheres where the women are strictly prohibited because of the rites and ritual which they are following from time immemorial. It has been seen that women's roles and the status is determined by customs, norms, ideology (patriarchal) and taboos. A woman's social life is restricted by customary practices and social institution. It has been seen that women's roles and the status is determined by customs, norms, ideology (patriarchal) and taboos. A woman's social life is restricted by customary practices and social institution.

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DIALECTICAL MATERIALISM: A MARXIST ANALYSIS OF JOHN STEINBECK'STHE GRAPES OF WRATH

K. S. RamaKrishnan[1] and S. G. RajaImmanuel[2]
[1]P.G. & Research Department of English, Rani AnnaGovernment College for Women, Tirunelveli.
[2]P.G.& Research Departmentof English,Nazareth Margoschis College, Pilliyanmanai.
siva59ram@gmail.com

ABSTRACT

The present study focuses on reading the novel, The Grapes of Wrath, in a Marxist perspective. The researchers have emphasised much on Marxian concept of 'dialectic materialism'. Dialectic denotes the contradictory opinions in the debate. Here, the conflict between Capitalist and Proletariat is seen as dialectic. The researchers use Marx's prediction of future history where the society will become socialist society. The research takes John Steinbeck as a socialist writer and perceives the novel as a 'political propaganda'. The researchers have analysed the work with different aspects of Marxism and especially the exploitation of the working-class and their way of resisting the injustice. Here, we see characters, Jim Casey and Tom are highly radical and therefore revolutionary. The novel moves towards a self-less society with humanity. Therefore, the researchers attempt to see a pattern of history which moves from a revolutionary form to a socialist form and eventually ends with a reconstruction, which is 'communist' paradigm.

***Key Words**: Dialectics, Materialism, Marxism, and Socialism.*

Introduction

Marxism is a sociological concept which actually originated from the works of nineteenth century German philosophers Karl Marx and Friedrich Engels. The Brainstorm of Marxism, according to Marx and Engels, first occurred in the initial line of their collaborative Essay, "Communist Manifesto" which says,"The History of all hitherto existing societies is history of class struggle" (7). Marxism is a political theory which scrutinizes how social classes, money and most importantly means of production affects the society. Dialectic Materialism actually adopts the concept of Hegelian Dialectics, which is comprised of three stages,

Thesis→Anti-thesis→Synthesis
(Action) (Reaction) (Solution).

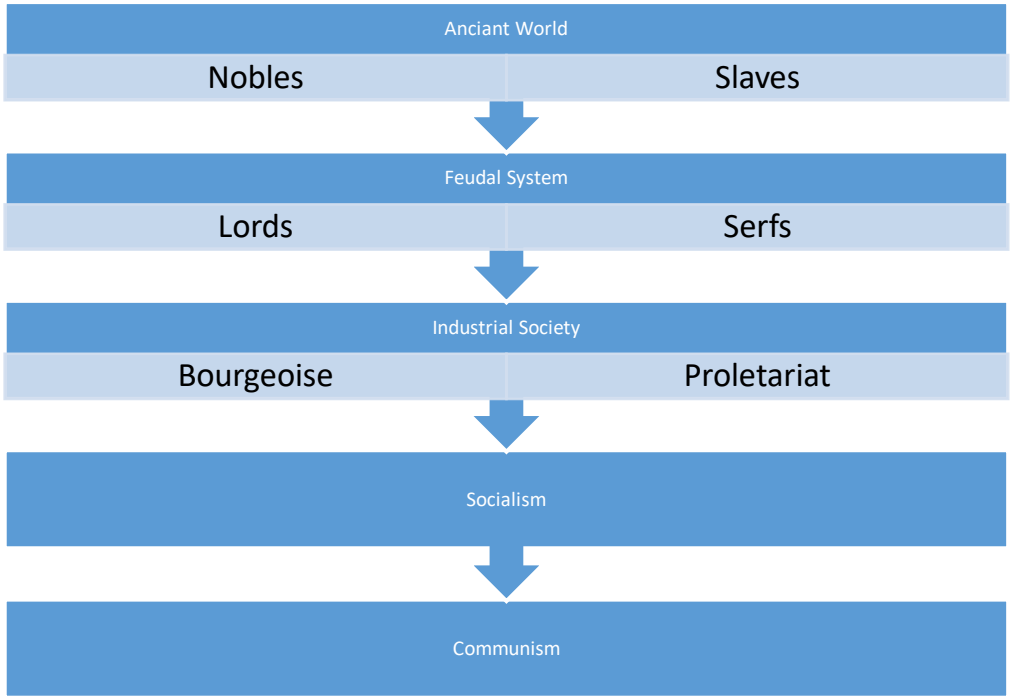
'Dialectics' denotes two different conflicting ideas and 'Materialism', focuses on matter rather than ideal. Hegel, who is the originator of the idea of 'dialectics', focuses only with ideal things; but Marx, in contrary, rejects the ideal notion of dialectics and embraces the material notion of it. Therefore, it is evident that, according to Marx, the history is a history of class struggle and the struggle is an outcome of what he calls, Marxists call, 'Dialectical Materialism'. The one who has wealth and the one who does not have wealth confronts one another. The notion of dialectics is used by Marx to delineate the contradictions and opposite ideas existed in society. According to Hegel's notion of dialects, these contradictions result in social change. Marxism, is in nature, a radical philosophy which attempts to change the world through protest and revolution(14).

The idea of contradictions provide change is promoted by Marxism. The change is believed to be something new. Therefore, Marxism advocates a new change, which occurs because of the opposite ideas. Hegel's idea of Thesis and Anti-thesis creating a Synthesis is thus explicated. Marx's idea of social change is evident in his statement in Theses on Feuerbach:"The philosophers have interpreted the world, the point however is to change it." (10). Julian Wolfreys defines 'Dialectic Materialism' thus:

Marxist theory that postulates that material reality exists in a constant state of struggle and transformation, prioritising matter over mind. The three laws of dialectical materialism stress: (a) the transformation from quantity to quality making possible revolutionary change; (b) the constitution of material reality as a unity composed of opposites; (c) the negation of the two oppositions in the condition of material reality, as a result of their antagonism, out of which historical development takes place which, however, still retains traces of the negated elements (32).

Dialectic Materialism and Historical Materialism are used synonymously in certain contexts. Historical Materialism is a theory of history which sees history as a stereotype and the historical change as typical. Historical Materialism traces the social change as certain paradigm. Marx traces that in every change the mode of production changes. Every negation is once again negated and new change is originates. Marx postulates certain main modes of production. The earliest mode of production existed, according to Marx, in primitive tribal society. The society, in the course of time changes to ancient society of slavery. The subsequent changes, which happened, according to Marx, are: Feudalism and Capitalism.

The Following Smart Art illustrates the social changes as postulated by Marx:



Thus, Marx believed that, eventually, the capitalistic Industrial society will lead to socialism and socialism will pave way to communism (communist 15). The present study focuses on the social change as propounded by Karl Marx as represented in the novel, *The Grapes of Wrath*. Steinbeck's Narrative represents the problem whichis created by the capitalist to the working class. Marx's philosophy insists that society should live for good of all and not for an individual, but here, the interest is on material things. . In the chapter five of the novel, the real problem is revealed by the author.

The conflict is actually between two groups: the bank and the tenants. Tenant farmers have been working for decades in the same place. When the capitalist cease to get benefits from the working class they are driven out of the land where they lived for decades. Here, the conflict is based on material need. In the novel, Joads undergo suppression and exploitation wherever they go. The socio economic relationship between the bourgeoisie (the haves) and proletariat (the have nots), have been clearly depicted by Steinbeck. Here, the land owners represent bourgeoisie and Joads represent proletariat. In the novel, the bank owners are depicted as materialists who are only after profit. Throughout the novel, Joads face the cruel treatment of capitalist ownership. The injustice done to the Joads are faced by various characters in the novel, which exemplifies that the injustice is collective rather than individual.

The novel, The Grapes of Wrath is a perfect example of Marxist propaganda in the literature. Brian Cordyack in his article, "Steinbeck, John: The Grapes of Wrath", expresses:

John Steinbeck, as a Socialist promotes socialist principals in his book grapes of warath. Steinbeck was attacked as a propagandist and a socialist from both the left

and the right of the political spectrum. The most fervent of these attacks came from the Associated Farmers of California, as they were displeased with the book's depiction of California farmer's attitudes and conduct toward the migrants. They denounced the book as a "pack of lies" and labeled it "communist propaganda".

As BrianCordyack suggested, many socialist thoughts can be seen in the novel, *The Grapes of Wrath* (TGOW). The notion that John Steinbeck is a socialist writer, is furthermore strongly vindicated by Brian Railsback, thus:

Some early critics labelled the work as a socialistic or communistic tract, considering it more propaganda than artistic accomplishment. Citing the fact that *The Grapes of Wrath* included scathing criticisms of banks, agricultural monopolies, the political practices of former president Herbert Hoover, and the federal prison system, such critics saw Steinbeck as an advocate of radical reform and even as a supporter of the revolutionary overthrow of democracy. (131).

Therefore, it is estimated that John Steinbeck is a socialist. The reason for the speculation is the depiction of working-class and satire on the bank in his novel, TGOW. The hypothesis is nullified by Jeffrey Schultz and Luchen Li's research outcome which says, "Though not a Marxist or socialist, Steinbeck became identified with the radical left after the publication of The Grapes of Wrath, and in later years suffered unwarranted criticism from the liberal intelligentsia for his supposed abandonment of communist ideology as his attention shifted away from the plight of the impoverished and oppressed." (90). Thus, it is evident that because of the socialist way of writing, John Steinbeck is criticized all over the world. Yet, it is also obvious that his work TGOW has socialist representations. John Steinbeck's idea of social change which the characters of TGOW desires resembles Marx's idea of history. Therefore, it can be taken thus: though he is neither a socialist nor a Marxist, he insists and promotes Marxian themes in his novels and the characters are shown as experiencing the exploitation. The paper, actually, studies such designs in the light of Marx's Dialectic change.

The novel primarily exhibits the way in which the proletariats are exploited and manipulated by the capitalists. Steinbeck, as a Marxist, portrays the government as capitalist and the citizens as labours. In the second chapter of the novel, Tom is released from the McAlester State Penitentiary. The driver of the truck, though interested to help Tom, is controlled by the owners with a label "NO RIDERS". The rule is interpolated within the minds of the workers. Tom is always anti-establishmentarian in nature, and asks the driver to be a good guy, though "some rich bastards makes [him] carry a sticker" (7). Tom reveals that his father is a sharecropper, who is a tenant farmer, who has to pay taxes to landowner. This clearly shows that the means of productions are owned by the capitalist. There are more implications of communism are there in the novel. Casy's philosophy of 'Holy Spirit' and human spirit is actually philosophy of communism, where everyone is equal and man's love for his fellow men results in classless communist society. The hierarchy of dialecticism is evident in the fifth chapter where Steinbeck reveals "All of them were caught in something larger than themselves" (36). The owners threaten the tenants because they are threatened by the bank. The phrase, "Banks cannot live on hope" (41) reveals the opposition between material and ideal tendency. Muley is a communist, who shares the meal he has with Casy and Tom. Muley is a dissent tenant who revolts against the owners and shows his resistance by being in the land even after other leave. Tom is also revolts against the power by breaking the parole.

The title of the novel itself is reflective of the crux of the novel. The Grapes of Wrathimplies the anger of the workers who have been exploited. As Karl Marx predicted (7), the workers, after much suppression, begins to revolt against the owners. The reason for the revolution is limited number of works. Grampa also shows resistance when he protests to leave Oklahoma (Steinbeck 56). Steinbeck describes the exploitation and moves on to depict the resistance showed by people of Oklahoma. He gives an alternate solution to the problem. Casy who attempts to begin a revolt is killed by the police. This shows the Repressive State Apparatus of the state government. The

solution is given in the twentieth chapter where the people reach the government camp. The government camp symbolically means the socialist government, which is slightly different from communism. The workers are given proper wage, thirty cent, which was far better than the money they received in the previous estate. Floyd, who is called as Red, attacks the contractor as a sign of resistance to exploitation. As casy points out, "who demands decent wage is labelled as Red" (216). The farmers are alienated from their products. Steinbeck notes that, "Men who have created the new fruits in the world are not allowed to have it. People try to net the potatoes thrown into the river, but guards hold them back." (273).Finally, the novels ends with Tom becoming a communist who fights for proper wages. Thus, Steinbeck gives a solution the problems of labour exploitation. The solution much resembles with Marxist idea of revolution. As Hegel's dialectic materialism signifies, the conflicts thesis and antithesis results in synthesis called socialism, where the government own the means of production and gives appropriate wages.

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ENUNCIATING THE GENDER INEQUALITY IN POLITICAL REPRESENTATION OF INDIA

D. Ayekpam
Assam down town University

ABSTRACT

For achieving gender equality, there is need of empowerment of women in many sectors viz. education, health, social, economic and political sector. According to the Global Gender Gap Index, there exists a gap in these sectors, out of which the political empowerment gap is the biggest. There is need of equal political representation of both men and women in order to bring equality, order, stability, progress and development in the society. The present paper attempts to throw light on the political empowerment of women in India and focuses on analysing the political representation of women in Lok Sabha and Rajya Sabha since independence. The major factors for the low political representation of women has been discussed and it also stressed on the Women Reservation Bill, which has been pending since its introduction in the year 1996 as 81st Amendment Bill.The present study is descriptive in nature and based on secondary sources collected from government reports, websites, newspapers, articles and journals.

Keywords: *Gender Inequality, Political Empowerment, Political Representation, Women.*

Introduction

Political empowerment is one of the important element needed for the process of development. It is significant for making legislations which will bring a change in the society. According to the data available, reports and various studies conducted by different organizations, researchers and academicians, it is apparent that in the political domain, men are dominatingthe women with a huge margin but for the overall development, it is essential to bring equality by giving opportunities to the women to participate in the political sector. United Nation Women also emphasized on the amplification of women's participation in the political sector for economic and social development.

The Beijing Conference of 1995 accentuated the empowerment of women and their participation in all the phases including the political sphere or access to power as necessity for securing gender equality, progress and stability in society. There are variations in terms of political representation of women all across the globe. Country like India, with a diverse and unique culture placed women at a different status. The position of the women has gone through many changes over the ages. On one side, the people pray the women as Goddess and on the other side, women are discriminated and illtreated lifelong and sometimes even before the birth.

Recognising the gravity of the political empowerment, the present paper attempts to enunciate the gender inequality in political representation in India. The paper also highlights the political representation of women in the global and national level and the major factors responsible for low political representation of women in India. It also underline the Women's Reservation Bill as one of the prospect which will promote in achieving the gender equality in the political sphere.

Methods and Methodology

The present paper attempts to throw light on the political empowerment of women in India. It focuses on analysing the political representation of women in Lok Sabha and Rajya Sabha since independence. The major factors for the low political representation of women has been discussed and it also stressed on the Women Reservation Bill, which has been pending since its introduction in the year 1996 as 81st Amendment Bill. The present study is descriptivein nature and based on secondary sources collected from government reports, websites, newspapers, articles and journals.

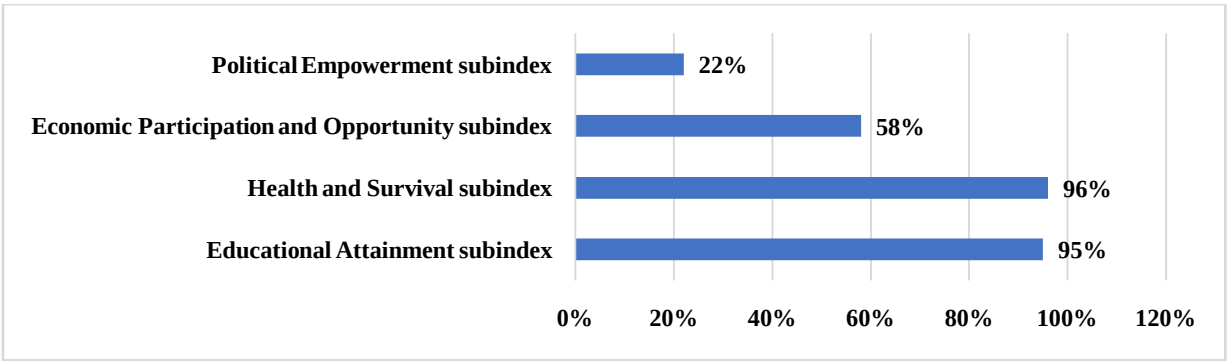
Global Gender Gap

The Global Gender Gap Index assess the gender gaps in four key dimensions i.e. in terms of economic participation and opportunity, education attainment, health and survival and political empowerment. These major dimensions are significant for the empowerment of women. Countries are being ranked on the basis of these dimensions, ultimately contributing to portray the

predicaments of all the countries in terms of gender disparity. Among all the sub-index, the educational attainment sub-index is found to be the best sub-index while achieving progress towards gender equality, which is followed by the sub-index of Health and Survival and Economic participation and opportunity. Political empowerment bagged the lowest position with only 24.7 per cent of the global political empowerment gap closed in the year 2020.

According to World Economic Forum, Global Gender Gap Index, 2020, the political empowerment gap is found to be the largest among all the sub-indexes, which continue to be the same in the Global Gender Gap Index, 2021. The gap in fact, widens in the Global Gender Gap Index, 2021 with only 22 per cent gender gap closed. The World Economic Forum projected that the countries of the world will take 145.5 years to achieve the gender equality in political sector. It is a matter of great concern that such important sub-index has been neglected and it is high time to understand that we need to focus and uplift this particular sub-index in order to bring parity in the political dimension which will led to the political empowerment. Iceland bagged the first position as the most gender equal country for the 12th time, still this country has yet to close 24 per cent of gap in political empowerment.

Table 1: Subindexes of Global Gender Gap Index, 2021



Source: World Economic Forum, Global Gender Gap Index, 2021

Table 1 highlights the percentage in terms of the four subindexes used in the Global Gender Gap Index, where Educational attainment and Health and Survival subindexes topped, while Economic Participation and Opportunity attained more than 50per cent and Political Empowerment hasn't achieved even a quarter, making it the worst subindex among the four subindexes.

Regional performance 2021, by subindex exhibited that Western Europe region has the highest percentage of 43.8 per cent in terms of Political Empowerment followed by North America region with 33.4 per cent, South Asia with 28.1 per cent, Latin America and the Caribbean with 27.1 per cent, Sub-Saharan Africa with 20.8 per cent, Eastern Europe and Central Asia with 14.2 per cent, East Asia and the Pacific with 13.5 per cent and the lowest was found in the region of Middle East and North Africa with 12.1 per cent, making a global average of merely 21.8 per cent(World Economic Forum, Global Gender Gap Index, 2021). From the data, it can be seen that the state of political empowerment of women all over the world, is in deplorable condition. Number of factors, major being the religious and cultural variables limits the political participation of women in Asia (Kazuki Iwanaga, 2008).

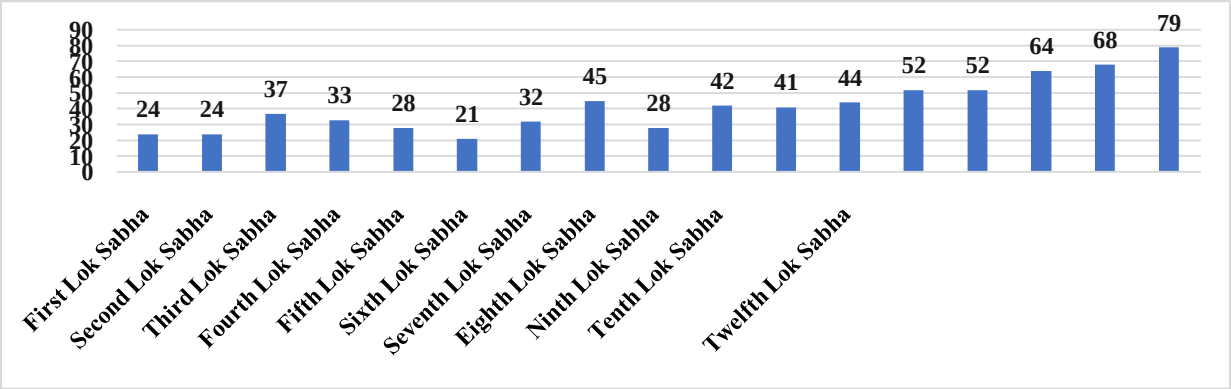
Political Representation of Women in India since independence:

In the context of India, the number of women contestants in 17th Lok Sabha was 726, out of which 78 were elected, forming a percentage of 14.36 (Election Commission of India), which is far below the global average percentage. Only 4.4 per cent of women members were there, in the first Lok Sabha. Considering the meagre percentage in the first Lok Sabha, the country is moving forward to 14.36 per cent but the pace is not significant.

According to the report (November, 2019) provided by the Inter-Parliamentary Union, in the monthly rankings of the percentage of

women in Parliament across the countries of the world, India hold the 149th rank. Out of 542 seats, only 78 women and out of 244 seats, only 28 women were elected in the Lower House and Upper House of India. It means that only 14.39 per cent and 11.48 per cent are represented by the women in the Lower house and the Upper House of the country respectively. Further, according to the ranking as of 1st June 2021, provided by the Inter-Parliamentary Union, India hold the 146th rank with 14.4 per cent represented by women in the Lower House and 11.2 per cent represented by women in the Upper House. Though we can see the improvement in terms of the ranking, it is not significant in terms of the percentage.

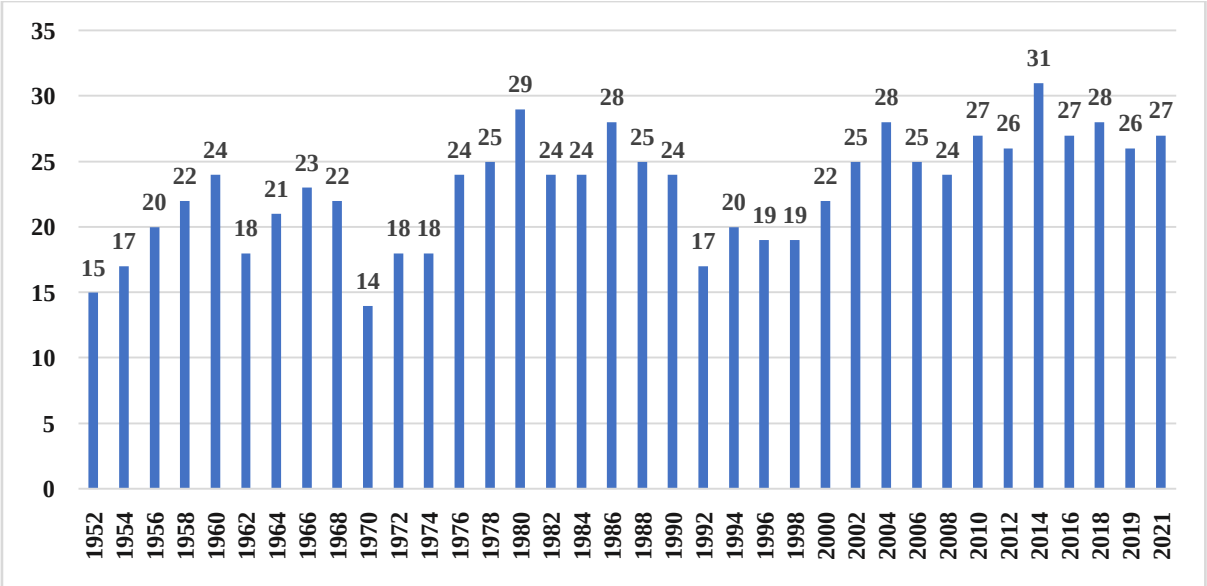
Table 2:Representation of Women in Lok Sabha (1952–2019)



Source: Lok Sabha, Parliament of India

Table 2 shows that, the number of women in the Lok Sabha in India is very low. According to the report collected from the Lok Sabha website, Parliament of India, gender wise representation of members, out of 543 seats in the Lok Sabha, only 79 members are women which is merely 14.63 per cent. Even after many years of independence, the women are not able to secure a good place in the political sphere. Socio-economic factors play a very important role for such deplorable political representation. The proliferation in terms of the number from the fourteenth Lok Sabha till the seventeenth Lok Sabha is welcoming but not noteworthy.

Table 3: Representation of Women in Rajya Sabha (1952-2021)



Source: Rajya Sabha, Parliament of India

Table 3 exhibited the representation of women in the Rajya Sabha since independence. The highest number of women members, so far as achieved in the Rajya Sabha is 31, which was in the year 2014, after which the figure declined.

Table 2 and 3 depicts the deplorable conditions of women in the political sector in India. Emphasizing on the pace, there is a long way to go to achieve gender equality in the political domain in the country.

Factors for the Low Political Representation of women in India

The presence of glass ceiling remains intact despite the rapid socio-economic changes and political restructuring over the past two decades (Kazuki Iwanaga, 2008).The socio-economic factors including the religious and cultural factors are the major factors for the low political representation of women in India. First and foremost, the low level of education of the women hampers the awareness about the political affairs which led them not to involve in it and though the literacy level of the women is improving, the lesser quality of the education also affected in gaining the political empowerment. Further, the social status of the women in India placed the women in the inferior position which acts an obstacle on the path of political empowerment or participation. Patriarchy system conditioned the mindset of the people because of which the women doesn't get support or votes. The system also makes the people of all gender to feel that men are the ones who have the rights to take the major decisions, not the women.

The socio-economic variables viz. education, culture, community, income, race, religion, age, profession, family members, area of residence, political system, ideals of political parties affect the political representation of women. Generally, it has been found thatpersons with higher educational qualification and higher socio-economic status have easier access to the political spheres than the uneducated and the lower status people (Khanna, Manuka).

The passion of the women to involve in political realm can be induced by the family members, political parties, political system etc. which are emanated from the society. Studies also suggested that men are more competitive than women (Niederle and Vesterlund), which hampers their participation in political precinct, an area which is consider to be highly competitive. The under representation of women's participation suggests the existence of gender stereotypes, patriarchy, non-availability of funds to support the female candidate, violence and corruption associated with the politics, lack of awareness, lack of role model (Commonwealth Secretariat, 2013).

Further, one of the major factors which can also be discussed is the linkage of politics with criminal activities. In many countries, criminal organizations and criminals are found to be associated with the people in power, especially the politicians. It has been reported that over half of the newly-elected Member of the Legislative Assemblies(MLAs) of Assam, Kerala, Tamil Nadu, Puducherry and West Bengal had criminal cases (The Hindu, 2021). 233 Member of Parliaments out of 539 winners were declared having criminal cases, with an increase of 44 percent in the number of Member of Parliaments with declared criminal cases (India Today, 2019). The nexus of politics with crimes hindered the political participation of women or deter their interest towards the political domain.

Women's Reservation Bill

The women's reservation bill was first introduced in the year 1996 as the 81st Amendment Bill. The bill was for the reservation of one-third of the total seats for women in the House of the People and in Legislative Assemblies. Further, one third of the seats to be reserved for women of the Scheduled Castes and Scheduled Tribes from the total seats reserved for Scheduled Castes and Scheduled Tribes.

Many countries of the world have also introduced the reservation of the women through amendments in order to achieve fair representation. Countries like Argentina, South Africa introduced quota system which lead to the achievements of good ranking in terms of the political representation of women.[2, 3, 6]

Reports and Studies have also shown that reservation is a way to increase the representation of women in political facet. Without the reservation, very few women, SCs or STs are elected in the political domain (Esther Duflo, 2005). The reservation policy helped the people in the decision-making process and is one of the major redistribution tools for the welfare of the people. It enhanced the inclusion of inexperienced and less

educated politicians, yet there is no evidence for the quality of the decision-making being compromised (Esther Duflo, 2005).

Many legislations and policies are ruminated to address the determinants for under representation of women in political sector. Different countries formulated different policies for political empowerment of women. Many countries adopt the reservation policy or quota system as the major policy for closing the gap existing between the genders.

The year 2021 marked the 25th year for the introduction of Women's Reservation Bill in the Parliament of India. Many eminent women and organizations spoke about the deferral of the bill to convert into act. CPM's Brinda Karat opined the power of patriarchy as one of the obstacles in the Indian society, blocking the women's bill. Bringing more women in the political spheres will reduce the inequality existing in the public domain. The reduction in the political gap between the genders will strengthen the Indian democracy for which the country takes a huge pride (Hindustan Times, 2021).

The difference in the outlook towards the women's reservation bill evoked strong sentiments among the people. Those who are for the bill acknowledge the benefit of the bill to uplift the women in the political realm which will automatically bring progress in other realms too. Those who are against the bill opposed the reservation policy by emphasizing that only the women from political families and well-off families will get benefitted from the proposed quota and demanded a reservation within the proposed quota for women belonging to backward sections of the society (Mishra, Soni).

Conclusion

The political representation of women in India is in a deplorable state with less than 15 per cent of representation in both the Lok Sabha and Rajya Sabha even after 75th year of independence. There is an immense need to increase the number of women in the political realm to create a balance society. To change the concept of Gender Equality from myth to reality, the women should be provided the privileges to be a part of the political sector. Considering the pitiable situation of the women's political representation in the country, the reservation policy i.e. the Women's Reservation Bill in the context of India has many prospects. It has the potential to bring impeccable outcome which will assist the women to come out from within the four walls of their houses on the platforms to weave development programmes and policies for their own half of the population, which were neglected for many years.

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A CONCEPTUAL MODEL TO MEASURE THE DEPTH OF SUPPLY CHAIN COLLABORATION IN MEDICAL TOURISM INDUSTRY

F. Zafar, J.A. Farooquie and A. Ponnam
Case Research Center, ICFAI Business School Hyderabad, Telangana, India
Operations Management, Dept. Of Business Administration, Aligarh Muslim University, UP, India
Department of Business Analytics, NMIMS Hyderabad, Telangana, India

ABSTRACT

A strong Medical Tourism Supply Chain Collaboration(MTSCC) is necessary to provide a quality service to medical tourists. This study suggests a conceptual model to measure the depth of collaboration between medical tourism providers and healthcare providers and also develop a collaborative index to help the chain members in discovering the most important collaborative practices and the least important collaborative practices. This will help them improve the quality of service delivery and also reduce cost of operations, which can be passed on to the customers. The proposed model uses formative index construction method to develop the index for MTSCC. The model is based on analysis of relevant literature. The model is built upon the theories and practice of medical tourism industry, supply chain management, and supply chain collaboration. This study contributes to thetheory of medical tourism supply chain and extends the existing knowledge in the field.Members of the Medical Tourism Supply Chain (MTSC) could use the results from the study to focus on the most important MTSCC enablers, hence improving collaboration among them as well as offering improved service quality to their customers.

Keywords: *Medical Tourism, Medical Tourism Supply Chain, Supply Chain Collaboration, Supply Chain Collaboration Index, Formative Index Construction, Conceptual Model*

1. Introduction

1.1 Medical Tourism Industry

Medical tourism (MT) can be defined as the voluntary travel taken to another country to seek healthcare services (Ryan, 2011). Medical Tourism industry has been growing at a fast pace. In 2019, the global medical tourism market size was $104.68 billion and it has been forecasted to reach $273.72 billion by 2027 at a CAGR of 12.8% from 2019 to 2027 in terms of value. In 2019 the global medical tourism market stood at 23,042.90 thousand patients in terms of value. According to forecasts, by 2027 there would be 70,358.61 thousand patients at a CAGR of 15.0% from 2019 to 2027 (Gill and Sinha, 2021).

The MT market is dominated by the Asia-pacific region (Table I). Asian countries have introduced various marketing strategies to attract medical tourists. For instance, while Thailand positioned itself as a dual-purpose destination for both medical and economic holiday with an attractive location, Singapore promotes itself as a destination for fine quality in medical treatment (Wong, Velasamy and Arshad, 2014). India is known for its cost-effective medical treatments along with high standards. It is further known for its alternative treatment options such as yoga and Ayurveda (Maini, 2013; FICCI, 2015). Malaysia is also a cost-effective destination for medical care along with its tourist attractions (Natarajan, 2015).

Table I

Top 10 Medical Tourism DestinationsWith Average Cost Savings

Country	**Average Cost Saving**
Asia/Middle East Region	
India	65% - 90%
Singapore	25% - 40%
Malaysia	65% - 80%
Thailand	50% - 75%
Turkey	50% - 65%
South Korea	30% - 45%
Taiwan	40% - 55%
The Americas	
Brazil	20% - 30%
Mexico	40% - 65%
Costa Rica	45% - 65%

Source: Patients Beyond Borders – Fact and Figures, 2020

1.2 Medical Tourism Supply Chain (MTSC)

A critical part of any organization's endeavor to compete in present competitive scenario is the design of their supply and distribution network (Sakhuja and Jain, 2012). Effective supply chain management (SCM) helps in building a strong relationship with partners of the supply chain. It also facilitates in achieving smooth and accurate information flow. SCM also lowers overall operational costs of the chain partners which includes warehousing, distribution and transportation costs (Horvath, 2001). Almost all organizations have a supply chain within them though they might slightly differ based on variables like size of the organization, product of organization, etc.

Growing importance of medical tourism has also intensified the competition in the industry. Providers of medical tourism are leaving no stone unturned to provide best and timely services to medical tourists. This has brought the focus on medical tourism supply chain.

MTSC is an interdisciplinary area of tourism supply chain (Lee and Fernando, 2014). Both tourism industry and medical tourism industry are unique since they encompass a mobile population who visit destination areas to consume a product, service or experience, whereas the supply elements are fixed geographically at certain places (Page, 2011).

Medical tourism supply chain does very much the same things as any other supply chain, that is, plan, develop, make, deliver and return. The partnerships formed in MTSC help in performance enhancement as any other supply chain. But MTSC is different when it comes to the structure of the supply chain. Medical tourism has a complex structure and comprises of generally five sectors – accommodation, pharmaceuticals, hospital, transportation and insurance (Lee and Fernando, 2014). Some of the operational objectives of manufacturing supply chain can also be found in medical tourism supply chain to a certain extent (Ferrer and Medhekar, 2012).

The three key service supply chain factors – cost, waiting period and privacy, play an important role when medical travellershave to make a decision to travel abroad for medical reasons (Ferrer and Medhekar, 2012). The members of MTSC collaborate with each other to deliver a comprehensive medical and holiday service to the tourist. This supply chain collaboration helps the chain members in reducing costs and increasing efficiencies of their service delivery (Lee and Fernando, 2014).

1.3 Supply Chain Collaboration Index

Globalization has increased competition and companies are trying their best to stay ahead of their competitors. This intense competition has directed companies towards close relationships with their supply chain partners, giving way to supply chain collaboration. Supply chain collaboration (SCC) goes beyond the normal day to day activities of any business (Benavides *et al*., 2012). It aims at delivering significant improvement in the supply chain over the long term.

SCC facilitates the cooperation of participating members along the supply chain to improve performance (Bowersox *et al*,. 2000). SCC is difficult to implement (Sabath and Fontanella, 2002) and needs a focused corporate culture to produce effective results. SCC has many benefits like revenue enhancements, cost reductions, and operational flexibility (Fisher, 1997).

Companies are widely adopting SCC dues to the numerous benefits it provides. But there is also a need to have some measurement to evaluate the performance of SCC. The measurement of supply chain collaboration helps in understanding the shortcomings of the collaboration and finding out ways to improve the same. The collaboration index will help the supply chain members in understanding the most important and least important collaborative practices (Simatupang and Sridharan, 2005).

2. Literature Survey

2.1 Medical Tourism

Medical tourism, also referred to as medical travel has been defined as "the organized travel outside one's natural healthcare jurisdiction for the enhancement or restoration of the individual's health through medical intervention" (Carrera and Bridges, 2006). Medical tourism has been in existence since many years (Pafford, 2009).

There are many reasons that pave the way for medical travel:

1. Significant increase in demand for healthcare

There have been many demographical changes globally like increased life expectancy, reduced infant mortality, increasing disease burden and emergence of new diseases.

All this has increased the demand for healthcare services. People are getting more aware about diseases, therapies and alternate medicines which has further boosted the demand for high quality healthcare services. The increase in demand for healthcare has also put quite a tremendous pressure on the healthcare systems of countries across the globe.

2. Easy cosmetic surgeries

Cosmetic and dental procedures happen to be a major reason why people take up medical tourism. But the problem is that generally it is not covered under health insurance as it is not a life threatening procedure. Hence people prefer lower cost options for these procedures. The assurance of privacy and confidentiality is an added benefit in such cases.

3. Unavailability of quality healthcare in many countries

In some countries, healthcare spending is less by the government. These countries do not have very sophisticated healthcare service. Even private sector healthcare has not evolved well in certain countries across the globe. These countries do not have the infrastructure and capability to meet the healthcare needs of their population. Many African, South American and Middle eastern countries fall in this category of nations. People from these countries are continuously looking for healthcare options outside their country.

4. Rising rate of health insurance premiums

Health insurance premium has seen an exponential growth in USA. Insurance premium has risen much more than the salaries of workers.Health insurance in US is largely employer driven. Employers have been passing the rising insurance cost to employees, which have become unaffordable for employees.

These rising costs of insurance premiums have also increased the uninsured population in USA. Though the American government has been bringing out plans to help the uninsured, but it was not enough to get over the insurance woes of Americans. Majority of this uninsured population takes up a decision for medical travel. Even the employers encourage their employees to take up medical travel as it reduces costs for them too.

Insurance companies in western countries are offering full cover and care in home country at a higher premium payment. Insurance companies are offering packages where customers can choose a lower premium but will have to get them treated at hospitals with comparable quality outside the country, with which they have tie-ups. Indian accredited hospitals can choose to compete for a share of this segment.

5. High cost of treatment

The rising medical costs eventually drive the people from the developed nations (e.g. the US, United Kingdom, Australia) to seek treatment overseas, particularly for treatments which are not covered by their insurance (e.g. eye, dental, cosmetic and fertility treatment) (Wong, Velasamy and Arshad, 2014).

High rate of chronic disease and worsening life style habits are also contributing to high cost of healthcare (FICCI, 2015). With job instability increasing, companies closing business and more people getting unemployed, it seems quite natural that people across the globe would look out for cheaper options for medical care. The money saved is big enough to compensate for time taken for travel. Even the cost of drugs is very high in in the industrially developed nations. Many health plan providers are also in negotiation with healthcare service providers in medical tourist destinations to provide suitable health plans for medical travellers. (Jeffrey C. Bauer). Though the medical inflation rate in somewhat stabilizing, in some countries it is still even higher than the general economic inflation rate(FICCI, 2015).

Medical tourism destinations are offering medical treatment at extremely competitive rates, usually at one tenth or less of the prevailing prices in the US, UK and other developed countries. Figure below shows a comparison of some of the treatment costs. The

prices are approximate prices, which also include an estimate of airfare for the patient and the companion. The prices will differ on certain factors like hospital, doctor's experience, accreditation, currency exchange rates, etc.

6. **No referral from doctors required** (Underwood and Makadon, 2010)

Patients and healthcare providers can be in contact directly without any mediation or referral from doctors in the host country. This has made the procedure more flexible and easy to access.

7. **Long waiting times for treatment** (Yap, Chen Nones, 2008)

Access to healthcare is not easy in most of the developed nations. People have to deal with long waiting times to see a doctor for any consultation or procedure. Even though the physician – patient ratio is high in some of the countries, still the waiting time has seen an average increase of 8.6 days from 2004 to 2009 (Meritt Hawkins, 2009). Countries that operate public health-care systems are often so taxed that it can take considerable time to get non-urgent medical care. Using Canada as an example, an estimated 782,936 Canadians spent time on medical waiting lists in 2005, waiting an average of 9.4 weeks (Fraser Institute, 2005). Non-critical surgeries in UK, for instance, sometimes have a waiting period of about 16 months. The countries around the Asian continent and some parts of Europe offer treatment at low waiting time. Wealthy patients therefore have an option to get their problems addressed immediately.

8. **Treatments not available in home country** (Wong, Velasamy and Arshad, 2014)

There are some non-economic reasons as well for people opting for Medical Tourism. Treatments that are simply not available inhome countries (e.g. surrogacy, organ transplant, stem cell therapy) are also a motivating factor for medical tourists to go overseas.

There are certain treatments that are not accepted by medical agencies of some countries. For example, shark cartilage is not an accepted cancer treatment in USA but it is available in some countries. People who believe in the treatment travel for it.

Another non-economic reason cited for medical travel is getting treatment for procedures that are not available is home country due to political and administrative reasons. For example, therapies for stem cell research are yet not available in USA due to some administrative decisions but they are acceptable in other countries, where Americans chose to go for medical travel.

9. **Eastern system of medicine** (FICCI, 2015)

Eastern system of medicine like Yoga, Homeopathy, Ayurveda, Naturopathy has become very attractive for the western world. Americans have started showing preference to these systems of medicines. Many Americans visit Kerela for Panchkarma treatment for rejuvenation and orthopaedic treatments. Other East Asian countries are also well known for these ancient medicine systems. People from all over the world are travelling to make best use of treatments offered by these medicines.

Many healthcare organizations of developing countries are marketing their country as a holistic medical tourism destination to the developed countries of the world. Employers in developed countries have incentivized their employees to have medical care abroad (Pafford, 2009).

Medical tourists take decision regarding their travel based on many factors. Cost, quality and access to care are the three outstanding factors that patients consider while making medical travel decisions (Helble, 2011; Hopkins et al., 2010). A 2013-14 Medical Tourism Patient Survey in the US found that nearly 80% of the demand for medical travel is driven by cost (FICCI, 2015). Patients chose a particular country as a medical tourism destination only if they are provided quality healthcare service. Patients determine the quality of healthcare based on the following factors (FICCI, 2015) :

- Accreditations
- Availability of skilled doctors and specialists.
- Availability of good nursing care.

While travelling for medical reasons, medical tourists have to take two major decisions – choice of country and choice of facility. They

consider several factors when deciding upon the two. When making a decision about the choice of country economic factors, political climate and regulatory standards are major considerations and cost, physician training, quality of care and accreditation are important factors considered while deciding on the facility for medical care in foreign country (Smith and Forgione, 2007).

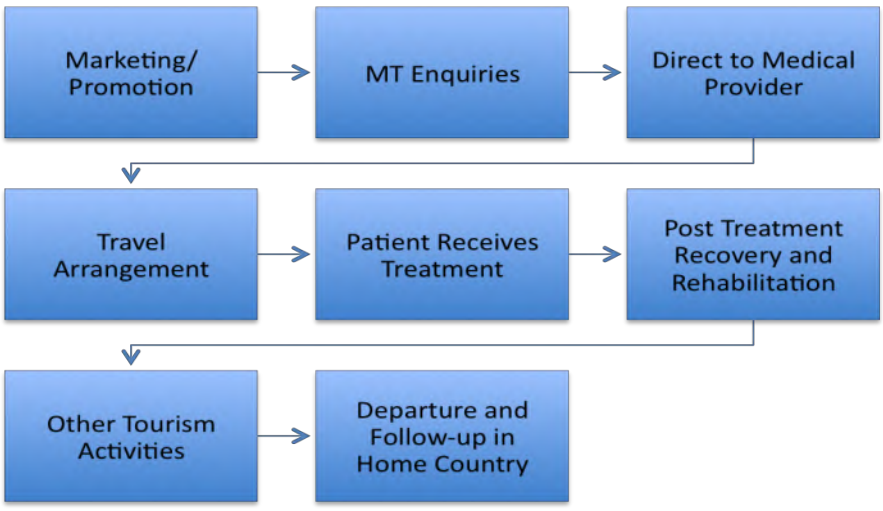
Though more industrialised countries like USA, UK and Canada have advanced technology and state of art infrastructure in the field of healthcare, India and other medical tourism destinations are able to provide *almost* the same quality of healthcare at much affordable prices. The economies of the world that come in the tag of underdeveloped and developing like that of Africa, South America, the Middle East and South East Asia have sub optimal solutions in the field of medical know-how. Medical tourism destinations like India are again able to provide good quality healthcare to medical tourists from these nations, at competitive rates.

2.2 Medical Tourism Supply Chain

The growing relevance of medical tourism has also brought about the importance of providing the best in class medical service to the medical tourists. Companies are trying all possible strategies to gain market share. Supply chain management has been one such concept that is helping the medical tourism industry in improving their quality and operational performance. Supply chain management is one of the most advantageous management approaches for integrating and coordinating relevant suppliers and producers and business activities to deliver products and services in a timely manner to the end user (Chen, 2009). Though MTSC has a complex structure as compared to SCM in other sectors, certain operational objectives of manufacturing supply chain are applicable to MTSC (Ferrer and Medhekar, 2012).

An economic view of MTSC states that growing relevance of MTSC phenomenon is based on two key factors : (1) the number of foreign medical tourists travelling (2) the amount of revenue they generate in terms of foreign exchange (Bookman and Bookman, 2007; Chanda, 2001). It is also necessary to have a smooth flow of information and other resources between the MTSC links.

The structure of MTSC is very complex and requires support from different sectors to provide goods and services to the customers (Lee and Fernando, 2014). MTSC is also similar to other manufacturing and service supply chains in a way that they operate through business to business relationships and work together to improve the business operations in supply chain (Tapper and Font, 2004). MTSC is a network of entities that organizes, sources, funds, distributes medical services and manages associated information (Ferrer and Medhekar, 2012).



Medical Tourism Supply Chain Links (Ferrer and Medhekar, 2012)

2.3 Supply Chain Collaboration

Medical tourism is not a one-time business and for getting repeat business successful treatment associated with satisfactory services is required. In highly competitive environment of present times, companies need to move beyond coordination of supply chain members to gain competitive advantage (McLaren *et al,* 2002). Hence companies are trying to shift to collaborative supply chain management so as to reduce the information imbalances and hence also reduce the "bullwhip effect" (Lee *et al,* 1997). This has helped the companies in increasing their responsiveness to market demands and customer service (Mentzer *et al,* 2000). Supply chain collaboration is the latest strategy taken up by companies to gain competitive advantage (Horvath, 2001) since the traditional arm's length relationships are no more effective in a dynamic global environment (Bowersox *et al,*. 2000).

Supply chain collaboration is defined as "two or more chain members working together to create a competitive advantage through sharing information, making joint decisions and sharing benefits which result from greater profitability of satisfying end customer needs than acting alone" (Simatupang and Sridharan, 2005; Whipple and Russell, 2007).

Collaboration is considered as the driving force behind successful and effective supply chain management (Ellram and Cooper, 1990). Some benefits of supply chain collaboration are:

- Revenue enhancements, cost reductions, operational flexibility to cope with demand uncertainties (Fisher, 1997; Lee, Padmanabhan and Whang, 1997; Simatupang, *et al,* 2005).
- Increased sale, improved forecasts, more accurate and timely information, reduced costs, reduced inventory, improved customer service, (Barratt & Oliveira, 2001; Whipple et al., 2007).
- Division of labor, exchanges of knowledge about products and processes (Kotabe, Martin, &Domoto, 2003).
- Cost and/or problem avoidance (Whipple, 2007).

Thailand is a major medical tourism destination and is favored by medical tourists for its low-cost good quality health services. And it has reached this level of popularity by achieving an effective collaboration (internal and external) among its supply chain members. The Thai government realized early the need for coordination across various sectors to realize the industry's potential. Hence it developed a common vision, strategic direction, joint-strategy and shared objectives for various sectors in order to facilitate better coordination between the concerned players of MTSC (Nagarajan, 20014). Example of Bumrungrand International Hospital further establishes this fact. Bumrungrand International Hospital is a leading medical tourist destination offering a range of medical services. Its website is available in different languages and provides valuable assistance to patients in planning their visit to the hospital; like booking the doctor's appointment, airport pickup, and accommodation. The hospital has a large number of interpreters, international/airport concierge service, embassy assistance, VIP airport transfers, international insurance coordination and international medical coordinators, and visa extension counter.

Malaysia, another major player in the medical tourism industry has also improved its service offering by developing coordination among the supply chain members of medical tourism. Malaysia Healthcare Travel Council (MHTC) was established under the Malaysian Ministry of Health. The purpose of MHTC is to streamline healthcare travel service providers and industry players in both private and government sectors so as to drive the industry to greater heights. MHTC was mainly established to facilitate public private sector collaboration with an aim to effectively address the issues affecting the industry. The council also coordinates promotional activities for Malaysian healthcare providers and related stakeholders.

Incheon medical tourism foundation (IMTF) of Korea has leveraged the benefits of MTSCC to introduce The One Hour Medical Service program. This program ensures that patients will get to the hospital within one hour after their arrival at the airport.

A look at the benefits of supply chain collaboration will strengthen the need for a strong collaboration in MTSC. The most

common benefits of supply chain collaboration are cost reductions, operational flexibility, improved customer service, problem avoidance and exchange of knowledge about products and processes (Fisher, 1997; Lee, Padmanabhan and Whang, 1997; Simatupang, et al, 2005; Barratt & Oliveira, 2001; Whipple et al., 2007; Kotabe, Martin, &Domoto, 2003; Whipple, 2007). Hence an efficient collaboration among the members of the MTSC is urgently needed to overcome the limitations stated above and encourage the medical tourism services of India. Best practices of MTSC need to be adopted by medical tourism providers to improve organizational performance. A good MTSCC practice will help the industry and in turn the country to gain competitive advantage in the medical tourism industry. And to have the best in class MTSCC, companies also need to measure their collaboration practices and improve upon them. Medical tourists look for good hospitality when going for medical tourism. Hospitality includes basic infrastructure such as road connectivity to accommodation, culture, language, adaptability, food, political scenario, etc.

2.4 Supply Chain Collaboration Index

The benefits of supply chain collaboration include revenue enhancements, cost reductions and operational flexibility to cope with demand uncertainties (Fisher, 1997). These and many more benefits of SCC have triggered a wide adoption of this. But there is also research that tells about the failures of SCC. It could be due to poor implementation of the strategy. It has been suggested that :

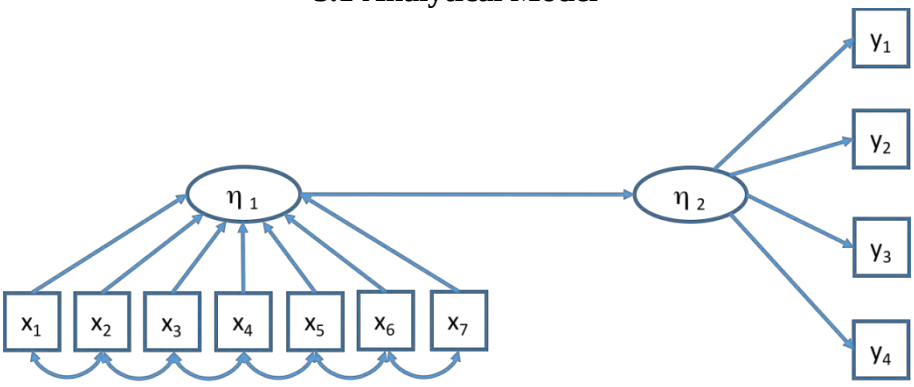
- Supply chain collaborations has proved difficult to implement (Sabath and Fontanella, 2002).
- There has been an overreliance on technology while implementing SCC (McCarthy and Golocic, 2002).
- A failure to differentiate between whom to collaborate with, that is, segmentation of customers or suppliers (Sabath and Fontanella, 2002).
- Lack of trust between trading partners (Ireland and Bruce, 2000).

With so many issues cropping up in SCC, there is also a need to measure the external as well as internal levels of SCC practices. There is very less amount of research focussed on measuring the collaboration (Lambert and Pohlen, 2001; Simatupang and Sridharan, 2004).
The collaborative index helps the chain members in discovering the most important collaborative practices and the least important collaborative practices (Simatupang and Sridharan, 2004).

3. Research Design

The study focuses on the collaboration between the members of MTSC. Medical tourism supply chain comprises of generally five sectors – accommodation, pharmaceuticals, hospital, transportation and insurance (Lee and Fernando, 2014). Medical tourism providers take care of accommodation, transportation, appointment with doctor, paper work with the government (Specially in case of infectious diseases) and other tourism activities. Services related to hospital and pharmaceutical are taken care of by the health care providers. So two major players of MTSC have been identified viz. the medical tourism providers and the health care providers, between whom the strength of collaboration can be determined using the following analytical model.

3.1 Analytical Model



η_1 – Medical tourism supply chain collaboration
η_2 – Competitive advantage
x_1 – Information sharing
x_2 – Trust
x_3 – Decision synchronization
x_4 – Incentive alignment
x_5 – Joint problem solving
x_6 – Environmental uncertainty
x_7 – Interdependence
y_1 – Price/Cost
y_2 – Delivery dependability
y_3 – Product innovation
y_4 – Quality

Formative index construction method (Diamantopoulos and Winklhofer, 2001) can be used to develop the index for MTSCC. Based on research it has been found that index construction with formative indicators goes through the following four critical steps:

- Content specification – scope of latent variable is specified (MTSCC in this case)
- Indicator specification – indicators will be specified that cover the entire scope of the latent variable
- Indicator collinearity – multicollinearity is an issue with formative indicators as the model is based on multiple regression (Diamantopoulos and Winklhofer, 2001). So indicators with high collinearity will be removed so as to get rid of redundancy in the indicators.
- External validity – reflective indicators will be used to estimate a multiple indicators and multiple causes (MIMIC) model. Further elimination (if required) of indicators will be done at this point. A new construct (Competitive Advantage in this case) will be introduced for nomological validity of the indicators. The previous construct (MTSCC) will act as a predictor of the new construct Competitive Advantage. The new construct will be further evaluated using reflective indicators price/cost, delivery dependability, product innovation and quality.

Research has time and again stated that supply chain collaboration helps the chain members in achieving competitive advantage in their line of business (Horvath, 2001; Simatupang and Sridharan, 2005; Whipple and Russell, 2007; Chen, 2009; Wittmann et al, 2009). Hence in this study competitive advantage has been taken to validate the formative indicators of MTSCC.

The analytical model was developed based on the following hypotheses:

H1:Information sharing positively impacts MTSCC
H2: Trust positively impacts MTSCC
H3: Decision Synchronization positively impacts MTSCC
H4: Incentive Alignment positively impacts MTSCC
H5: Joint Problem Solving positively impacts MTSCC
H6: Environmental uncertainties impacts MTSCC
H7: Interdependence positively impacts MTSCC

Information Sharing in a supply chain is the ability to see data in the system of the chain partner and being able to monitor the service delivery progress as they pass through each process in the supply chain (Simatupang and Sridharan, 2002). Real time information sharing among supply chain members improves the business operations of the supply chain in terms of speed, agility, control and customer response by focusing on communications, relationships and knowledge (Manthou*et al*, 2004; Myers *et al*, 2000). Information sharing improves the overall performance of supply chain (Lambert and Cooper, 2000).

Transparency and quality of information flow plays a vital role in the supply chain collaboration performance (Popp, 2000). Formal guidelines and proper communication channels are needed to be developed to facilitate critical information sharing among supply chain partners (Kohli and Bensen, 2010).

Shared information between supply chain partners can only be fully leveraged through process integration (Baratt, 2004). Process integration means collaborative working between buyers and suppliers, joint product development, common systems and shared information(Baratt, 2004).

This formed the basis of a hypothesis to be tested in the research:

H1:Information sharing positively impacts MTSCC

Information sharing can happen between supply chain partners only when there is trust between them (Ebrahim-Khanjari, Hopp and Iravani, 2011). Studies have shown that developing trust is an important factor in an alliance approach to inter-organizational relationship satisfaction (Sharfman et al., 2009; Benton and Maloni, 2005). Trust forms the basis of forming productive SCC among chain members (Agan, 2011). Trust contributes to the long term stability and sustainability of SCC (Yeung, Selen, Zhang and Huo, 20009). Building of trustworthy relationships among supply chain members helps reduce costs, promote cooperation, enhance timely reactions and strengthen competitive abilities (Chen, 2009). Internal trust is equally important and can be difficult to implement (Ireland and Bruce, 2000).

Building trust among chain members requires commitment and cooperation from them to be unselfish so as to work towards betterment of supply chain, rather than being opportunist and egocentric (Kohli and Bensen, 2010). Fear of opportunism sometimes discourages chain members from establishing trustworthy relationships and risk taking, leading to performance reduction (Tucci et al., 2005). Unethical business behaviour can cause damage to trust and long-term inter-organizational partner relationships (James et al., 2009). Hence the next hypothesis is postulated as below:

H2: Trust positively impacts MTSCC

Decision Synchronization refers to the joint decision making in planning and operational contexts while working towards a common goal of optimising the profitability of the supply chain (Simatupang, *et al*, 2002). Decision synchronization manages aligning strategic objectives, policies and metrics amongst the chain members, synchronizing mutual improvements and synchronizing supply chain planning and execution (Simatupang and Sridharan, 2004).

Decisions about selecting target markets, product assortment, customer service level, forecasting are planned jointly. The operation context of decision synchronization deals with order generation and delivery processes. This formed the basis of the next hypothesis to be tested in the research:

H3: Decision Synchronization positively impacts MTSCC

Incentive Alignment refers to the degree to which chain members will share costs, risks and benefits (Simatupang and Sridharan, 2002b). There have to be mutual benefits arising from the collaboration (Sparks, 1994). Similarly there should also be mutual risk sharing among the chain partners (Crew and Davenport, 1992). Administration and technology costs need to be shared fairly among all the members of the supply chain to maintain their commitment in the collaborative efforts (Simatupang and Sridharan, 2004). This risk sharing is not only in terms of cost but also in managing demand, supply and price uncertainties (Fisher, 1997)..

Incentive alignment, by the use of suitable incentives, motivates the chain members to build trustworthy relationships, share information and make joint decisions towards improvement in supply chain (Simatupang, *et al*, 2002).

Hence the next hypothesis is postulated as below:

H4: Incentive Alignment positively impacts MTSCC

Joint problem solving is an important dimension of SCC (Kumar and Banerjee, 2014). Joint problem solving deals with issues like disagreement between partners, technical problems and conflict in day to day business. Joint problem solving leads to a mutually satisfactory solution and better performance through mutually developed process improvement (Min *et al*., 2005).

This formed the basis of the next hypothesis to be tested in the research:

H5: Joint Problem Solving positively impacts MTSCC

Environmental uncertainty is a significant external force affecting SCC (Chen and Paulrah, 2004). Studies have shown that supplier pressure, rapidly changing technology and changing habits of customers are contributing in the increase of environmental uncertainties (Dilts and Prough, 2001). The rise of economic exchanges has brought uncertainty in external environments and opportunities. The situation has boosted cross-organizational

cooperation and demand for travel agency services (Ruden, 1997). Furthermore, external environments must be considered in strategic alliance affairs (Miles and Snow, 1978).

Uncertainty can be supplier uncertainty, demand uncertainty and technological uncertainty. Increase in uncertainty in the environment also increases the collaboration in the supply chain (Betts and Tadisina, 2009). Another major uncertainty in terms of MTSC is government regulations and policies regarding visas and other international travel issues, which can hamper the travel of medical tourists.

Collaboration in supply chains gaining importance as it has the ability to reduce environmental uncertainties in the chain (Hoyt *et al*, 2000; Peters and Hogensen, 1999).

Hence the next hypothesis is postulated as below:

H6: Environmental uncertainties impacts MTSCC

Interdependence among SC members is a critical factor. Interdependence means that both internal and external agent who holds vital resources or competencies can make decisions to move an organization forward (Lin, Hsieh and Chen, 2013). Building up effective cooperative relationships based on the consent among cooperative partners to combine and contribute individual resources will nurture competitive advantages within alliance networks (Madhok and Tallman, 1998; Wittmann et al., 2009). Increased interdependence prompts a willingness to negotiate functional transfer, share key information and participate in joint operational planning (Heikkika, 2002).

Research shows that relationship satisfaction is a necessary condition for relationship quality (Ruben and Nicholas, 2007). Readiness of trading partners to exert effort in developing long term commitment of resources strengthens the relationship (Bensaou an Anderson, 1999). Building up effective cooperative relations based on the consent among the chain members to combine and contribute resources promotes competitive advantage in the supply chain (Wittmann *et al*, 2009).

This formed the basis of the next hypothesis to be tested in the research:

H7: Interdependence positively impacts MTSCC

Conclusion

A strong and healthy collaboration between the members of the MTSC would lead to the delivery of quality service to the customers. The proposed model could be tested by surveying the MTSC members. The survey questions could be based on the parameters mentioned in the analytical model.

The proposed modelwould eventually develop an index to measure the depth of supply chain collaboration in the medical tourism industry. Itwould also bring forward the extent to which the seven stated enablers of SCC namely information sharing, trust, decision synchronization, incentive alignment, joint problem solving, environmental uncertainty and interdependence affect the supply chain collaboration in medical tourism industry.

Another important output from the model would be the most important and least important enabler in collaborative relationships that exist in medical tourism industry.Members of the MTSC could use the results from the study to focus on the most important enablers, hence improving collaboration among them as well as offering improved service quality to their customers.

The benefits of improved MTSCC would also come forth with this model. One such benefit would be understanding the effect that MTSCC would have on the competitive advantage of the organizations. That would also include the impact of MTSCC on price, delivery dependability, product innovation and quality of service in the medical tourism industry.

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AN EXPERIMENTAL INVESTIGATION OF PARTIAL REPLACEMENT OF CEMENT BY PAPER SLUDGE ASH

Krishnakumar P.[1*], Vijayakumar M.[2] and Athipathy M.[2]
[1,2]Department of Civil Engineering, Rathinam Technical Campus, Coimbatore, Tamilnadu

ABSTRACT

Concrete is a strong and tough material but it is a less porous material also which interacts with the surrounding environment. The concrete durability depends on the water movement and gas enters and moves through it.To produce low-cost concrete by blending various ratios of cement with paper sludge.At least to reduce the disposal and pollution problems because to paper sludge it is most essential to develop profitable building materials. The use of paper sludge in concrete preparations as a supplementary cementation material was tested as an alternative to conventional concrete. Present study is concerned with the experimental investigation on strength of concrete and optimum % of the partial replacement by replacing cement via 5%, 10%, and 15% of paper sludge. These tests were carried out to evaluate the mechanical properties like compressive strength and split tensile test up to 28 days. As a result, both compressive and split tensile test shows that strength increased up to 5% and further increased in paper sludge reduces the strengths gradually. While testing more than 5% strength of concrete is decreasing because cement bonding capacity is slightly more than paper sludge ash.

Keywords: *cement, paper sludge; OPC*

Introduction

Industrial wastes are being produced in a chemical and agricultural process in India and create the major health hazards, and aesthetic problems to the environment [1]. Paper and pulp industries produce large amount of sludge in the paper making process [2,3]. However, the quantity of sludge generation varies from mill to mill. The amount of sludge generated by a recycled paper mill is dependent on the type of product being manufactured. Every year, million tons of paper mill sludge produced throughout the world. On the other hand, the disposal of the paper mill sludge leads to create the uneconomical landfills [5, 6]. Same time, the paper mill sludge behaves like cement due to the presence of silica and magnesium and which can improve the setting of the concrete. Present study, paper sludge ash used as a partial replacement material for cement and experimentally investigated the concretes strength with different cement replacement levels [4]. Along with the fresh concrete workability by slump cone test, compaction factor test, compressive strength test and split tensile test were carried in the study.

Materials and Properties

In this study various materials like Cement, Aggregate, water and paper sludge ash were used and their properties are examined based on IS codes [7, 8].

a) Cement

The most common cement used is an ordinary Portland cement. The type 1 is preferred according to IS2269-1976, which is used for general concrete structures.

b) Aggregate

The crushed aggregates used were 20mm nominal maximum size and are tested as per Indian standards and results are within the permissible limit.The specific gravity of coarse aggregate is 2.66.

Fine aggregate conforms to zone II as per the Indian standards. The specific gravity of sand is 2.68.The bulk density of fine aggregate (loose state) is 1393.16kg/m^3 and rodded state is 1606.84kg/m^3.

c) Paper Sludge

Paper sludge was burned and sieved through 90micron sieve and collected the sludge ash.

Result & Discussion

Mix Proportioning (Mix Design)

M25 Concrete mix designs were prepared. with paper sludge ash replacements by 5%, 10% and 15% of the waste paper sludge ash. A control mix with no waste paper sludge ash

replacement was produced to make a comparative analysis.

Test on Fresh Concrete

Slump cone test:

The concrete mix design was proposed by using IS 10262. The grade of concrete used was M-25 with water to cement ratio of 0.45. The mixture proportions used in laboratory for experimentation are shown in table 3. The significant slump value reduction noticed that 10 and 15% replacement.

Compaction factor test

The compaction factor test was conducted on fresh concrete and results are presented in Table.4.

Tests on Hardened Concrete

From each concrete mixture, cubes of size 150mm x 150mm x 150mm and 150mm x 300mm cylinders have been casted for the determination of compressive strength and splitting tensile strength respectively. The concrete specimens were cured under normal conditions as per IS 516-1959 and were tested at 7 days and 28days for determining compressive strength as per IS 516-1959 and splitting tensile strength as per IS 5816-1999 [10, 11].

Conclusion

Comparison of results normal concrete and added by the paper sludge ash concrete test has been done. Up to 5% of paper sludge concrete, the compression strength has been increased and also the split tensile strength has been increased.

If silica is added the strength will be considerably increased because of lack of silica in paper sludge. Considerably this type of concrete will be used for road works effectively with less consumption of cement.

Replacement of paper sludge 5% gives optimum value of compressive strength in comparing to other mixes.

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10. IS 4031(part-5) – 1988 using this code book by determination of initial and final setting times.
11. Tested the material properties as per Indian standards code (IS 383–1996) procedures.

Table 1: **Properties of paper sludge ash**

S.No	Cement Properties	Value	Permissible limit as per IS: 12269-1987
1	Initial Setting time	55 min	Not be less than 30 Min
2	Final Setting time	292 min	Not be more than 600 Min
3	Fineness test	1%	<10%
4	Specific Gravity	3.14	3.1 to 3.15

Fig 1:Dry Paper Sludge

Table 2: Properties of raw paper sludge ash

S.No	Constituent	Values in %
1	Magnesium Oxide(MgO)	3.3
2	Calcium oxide (CaO)	46.2
3	Silica (SiO2)	9.0

Table 3: Slump value

Paper sludge ash	W/C ratio	Slump (mm)
0	0.45	25
5	0.45	24
10	0.45	20
15	0.45	16

Table 4: Compaction factor value

Paper sludge ash	W/C ratio	C.F (mm)
0	0.45	0.85
5	0.45	0.84
10	0.45	0.88
15	0.45	0.86

Table 5: Compressive Strength

Paper Sludge ash %	Avg .load at 28 days	Compressive strength at 28 days N/mm^2
0	633	28.07
5	657	32.3
10	593	26.29
15	557	24.74

Table 6: Split tensile Strength

Paper Sludge ash %	Avg .load at 28 days	Compressive strength at 28 days N/mm^2
0	180	2.547
5	190	2.688
10	177	2.510
15	165	2.334

ARCHITECTONIKA OF MANAGEMENT SYSTEM IN AGRARIAN SPHERE IN CONDITIONS OF SANCTION ECONOMY

Ilya V. Sorgutov
Department of Building Technologies, Federal State Budgetary Educational Institution of Higher Education
Perm State Agro-Technological University named after Academician D.N. Pryanishnikov
Street Petropavlovskaya, 23, 614990, Perm, Perm Territory, Russian Federation

ABSTRACT

The development of management systems for the agro-industrial complex is complicated by the presence of the following negative trends that formed in the 90s: deterioration of rural infrastructure, low material and technical equipment of agricultural enterprises, the lack of highly qualified specialists and a massive outflow of the able-bodied population from the village. The study was carried out on the basis of generally accepted methods of analysis and interpretation of the results obtained. Consideration of the development of management systems is necessary for the adaptation of existing management systems for enterprises in the agro-industrial complex in the context of the introduction of economic sanctions to ensure the country's food security, the development of rural areas and their infrastructure. In the course of the research, theories and approaches to managing subjects of various levels of management were reviewed and analyzed. The fundamental differences of various control systems are highlighted and systematized, their weak and strong sides are established. The author classified the types of sanctions in the context of legal and economic sciences. Having studied and analyzed the existing terminology in the field of sanctions and economics, the author for the first time gave a definition of the sanctioned economy characterizing it as a system developing within the framework of the socio-historical formation of the state, functioning on the basis of the existing productive forces and production relations, the strategy and tactics of economic activity of which covers all links commodity production and distribution of material goods, existing within the framework of economic and legal measures of influence of a destabilizing nature for violation of any world norms, as well as with the aim of imposing the policy of the interested state (group of states). A classification within the framework of international relations is presented, which differs from the concepts of sanctions for legal entities and individuals, as well as states, in a more complete content and classification on economic grounds of measures of influence. The article also ranks the sanctions for export sanctions, import sanctions and economic isolation sanctions. The main goal and motives in the agri-products production and distribution may be allowing for producers and processing companies on the different study of the movement commodities for the reaching high income getting and low decreasing risk of uncertainty. Globally structural changes are going in the agri-food system. These changes are based on the growth of consumer demand, technological innovations and food safety. This aspect of vertical integration building is correlated on the between form regulation and changes in the structure of farm production and infrastructure. The developed countries there are important indicator is total value production, GDP, export an employment. Vertical coordination is provided to the achievement of competitiveness and minimization of cost production and growth of quality characteristics through contracting relations at all steps of the supply chain management.

Keywords: *Management system, agro-industrial complex, sanctions, agrarian sphere.*

Introduction

The evolution of management systems began from the very beginning of the conscious mankind activity due to the constant complication of relations and systems of labor cooperation in production systems. The development of scientific and technological progress, labor specialization and cooperation make management systems acquire increasingly complicated forms, becoming integrated into complex hierarchically organized structures that exist in conditions of uncertainty and multifactorism. So they determine the specifics of the agro industrial complex activity. Each country forms its own management system, which has unique differences from others, and is closely connected with the political, social and economic life of the state. However, these factors do not play a decisive role in the formation of specific types of management activities due to the vertical subordination in a hierarchical management system, which initially forms the leading role of an individual – a leader. Owing to the close interconnection of each of the factors and the difference in their influence on the formation of the population worldview of a

particular country and economic relations in society, it is impossible to assess the significance of each of them in the management system development.

Authors developed the scenario of planning for state regulation on the base of forming and de-velopment of vertical cooperatives in the agribusiness in Samara oblast. The basic value was being an idea of long-term forecasting and investing decision, which got accepted through business pro-jects that were developed on the western program of Project Expert Holding 6.0. The investment projects got provided the agribusiness in Samara oblast (regional level) by the line of Ministry of Agriculture and Food Industry. The Agribusiness has been forming through rural development for 197

taxation optimization and benefits for rural territories from vertically integrated agricompanies as well as corporations (agroholdings) and new generation cooperatives.

The scenarios of planning and forecasting were basically gotten through branch structuring in Agribusiness and making decision taking for that. Moreover, these scenarios got included not only big business and, by the way, family and corporative industrial farms with high level of final com-modity production, processing and distribution. These structures have been as satellites through con-tracting with big business agricompanies.

Theory:

H.O. Repp in the scientific report stated that "management is a conscious, active, creative, labor activity aimed at achieving the set goals. Management of an economic system is a complex process in nature, continuous in execution time and clearly directed towards a specific goal. It is a process of influence of a control system on a controlled object, carried out according to a certain technology using various forms, methods and means in order to achieve the best economic and social results "(Repp, 1994). He also notes that "the management system of an industry (Fig. 1), an enterprise or an institution is a specific set of these elements, which are in qualitative and quantitative ratios, interrelationships with each other, forming certain integrity, unity. It is characterized by the presence of causal links between the elements, governing and controlled subsystems, the dynamic nature of the system "(Gerchikova, 1997)

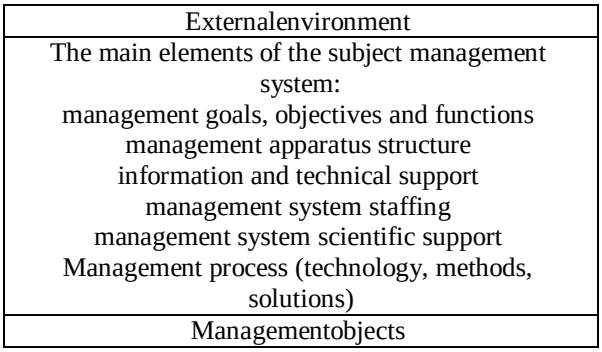

Figure1. Diagram of the industry management system.

In the process of evolution of management systems at the micro and macro levels, various theories of organizing management economic activities of institutions and countries have been proposed by scientists. Table 1 examines and analyzes the main and most popular theories of managing business entities.

Table 1.-Theoretical aspects of management organization

Theory	Authors	Essence	Economylevel
Situational approach (Gerchikova, 1997), (Moreno-Luzon, Peris, 1982), (Aldrich, 1972), (Papworth, milne, boak, 2009), Samtselson, 1984)	F. Taylor, A. Fayol, A. Church, G. Emerson, G. Ford, P. Drucker, K. Knight, M. Star	The search for efficient production management mainly due to the internal reserves of the enterprise (association), considered as a closed system	Entity

Complex approach (Blauberg, Sadovsky, Yudin, 1970), O'Connor, McDermott, 2011), (Sadovsky, 1980)	A.A. Bogdanov, E. de Bono, G. Simon, P. Drucker, A. Chandler, S. A. Chernogor, Malyuta A.N.	The search for an effective management solution is carried out due to the most important factors of the external and internal environment.	Entity
Strategic management (Andrews, 1971), Ansoff, 1991), (Barney, 1986), (Caves, Porter, 1977)	Ackoff, G. Mintzberg, M. Porter	Considers an enterprise as an open system, the success of which is determined by the effectiveness of the internal organizational and economic mechanism, on the one hand, and the ability to adapt to the external environment, on the other	Entity
Monetarist theory (Friedmen, 1973), (Friedmen, 1958), (Maier, 1970), (Milton, 1974)	M. Friedman, K. Brunner, G. Simons, I. Fisher, F. Knight	Opposes any state intervention in the economy, in particular against the use of fiscal policy, accompanied by an increase in budget deficits	Macroeconomics
Keynesian theory (Samuelson, 1984), (Tobin, 1992)	John M. Keynes	Acts as a theoretical basis for government intervention in the spheres of production, distribution and consumption	Macroeconomics
Theory of supply (Thurow, 1993) (Wannicki, 1989), (Atkinson, Robert, 2006)	A. Laffer, J. Gilder, M. Evans, R. Mundell	Asserts that management efficiency is determined by reducing production costs	Macroeconomics
Rational expectations theory (Buiter, 1981) (Lucas, Sargent, 1991)	R. Burrow, R. Lucas, N. Wallace, T. Sargent, L. Leiderman, P. Minford, J. Mutt, W. Butter	Along with the state economic policy, the authors of the new classics call the imperfection of information, its limitations and distortion as a destabilizing factor in the economy.	Macroeconomics

The basic planning scenario development has been following activities [5, 7, 10]:

1. Identification of moved resources. There are political conditions for providing reforms, economy development, social development, environmental business –ecosystem, trends, technologi-cal changes and entity debt. These entire factors have been included at the forecasting of Samara oblast development.

2. Identification of peculiarities and entity debt control and management. Free ownership for liquidity resources gets through accesses to the markets of capitals, which are important goal, some agricompanies. The capital saving is gone through providing of credit and own resources. One of most important in the creation of stock capital as balance would be useful to get skill of projecting of organization structure, what is complicated the knowledge of effective investing projects at long-time perspective. The forming of porthole is based on the investment financing of bank rate. The cost of capital has an important meaning in the Economics, by the way, multifunctional role of in-vestments is being gotten through identification of high profitable

finance and real investments for high productive actives, fiscal policy, taxation, dividend payments, and added capital.

Methods

The research data is information on theories and management systems of the agri-food sector. This information is based on the famous scientists- economists researches. Among the research methods the generally accepted method of analysis and interpretation of the results obtained can be named.

Model: Within the framework of this article, the following model is used, which makes it possible to conduct an actual analysis of the theories and management systems proposed over the years of economic science development, as well as to draw objective conclusions based on the results of this analysis.

Results

The study examines the agrarian sector of the economy, which is characterized by the following definition: "The agro-industrial complex is a set of sectors of the economy interconnected by the social division of labor that ensures the reproduction of food products and industrial consumer goods from agricultural raw materials in accordance with the needs of the society and the demand of the population. The structure of the agro-industrial complex includes three main spheres. Sphere I includes sectors supplying agriculture and other spheres of the complex with means of production, rural construction, etc. Sphere II is agriculture itself. Sphere III is the spheres which includes the industries that procure, transport, process, store and sell the final products of the complex. Sphere IV is being formed in the developed agro-industrial complex. It includes production, social, service, scientific, information and other infrastructures that do not directly create a product themselves, but are necessary for its creation and normal effective functioning (http://abc.informbureau.com/ html / aadiidiiuoeaiiue_eiiieaen.html). H.O. Repp in his writings emphasizes that "highly efficient activities in agriculture and other industries are possible only in the conditions of a scientific approach to management. The scientific foundations of management include the relevant theory, methodology and specific knowledge about the interrelated elements of management systems - principles, goals, objectives, functions, information, structure, personnel, processes, methods, technology and technical means of management "(Repp, 1989). In view of the high importance of management systems in the sphere of the agro-industrial complex for the country's defense capability and self-sufficiency, the study of the problems of their improvement is under the close attention of both Russian and foreign scientists, which is highlighted in the works of V.R. Boeva, A.F. Sarkova, E.A. Borisov, V.F. Garkusha, V. Ya. Gorin and others. Quite accurately, in our opinion, the well-known scientist B. Z. Milner characterizes the purpose of the management system. He considers the following: "The diverse experience accumulated in different countries of the world shows that among all the resources of enterprises (material, labor, financial, etc.), it is management that is of paramount importance, the ability to develop goals, determine value guidelines, coordinate the performance of tasks and functions, train employees and achieve the effectiveness of the results of their activities" (Milner, 2002). According to S.G. Kara-Murza, from a large number of various indicators in management activities, the reliability of the management system should be especially highlighted, which is understood as the ability of the system to make effective management decisions throughout the entire time under various modes of its functioning. Reliability is manifested in the stable, trouble-free functioning of all elements of this system. It includes the following indicators: stability (reliability), readiness, flexibility, recoverability (Kara-Murza, 2002). We fully agree with this statement and believe that it is the reliability of the system and the efficiency of the decision-making by the governing bodies that are the key aspects in the effective functioning of an industry or an individual enterprise. For the effective functioning of the enterprise management system, it is necessary to fulfill a

number of the following requirements: (Kara-Murza, 2002)

• existence of cause-and-effect relationships between the elements of the system;

• dynamism of the system, i.e. the system, without losing its properties, is able to vary under the influence of changes of external and internal factors;

• existence of parameters in the system, acting on which, it is possible to change the course of the process;

• ability of the controlled system not only to respond to the control action, but also to enhance it;

• ensuring the possibility of impact transmission;

• system integral character, its unity.

Analyzing all of the above, we can conclude that the management system is similar to a living organism and strives for constant evolution or improvement. But not all scientists support this approach and share the concepts of "improvement" and "development". So A.E. Gusev, in his writings, believes that: “The improvement and the development of the management system are diverse phenomena, the development of the system is deeper and, accordingly, determining. Many changes in the management system occur as a result of the improvement. However, not every improvement of the management system, and especially not every rationalization of it, can be considered as measures leading to the development of the system." (Gusev, 2002).

In our opinion, the management system improvement is impossible without its constant development and striving for the improvement. Under the conditions of a market economy and constantly emerging destabilizing external and internal factors, the system strives to modernize and search for permanent solutions, the tasks set for more effective functioning.

We believe that the management system of vital economy sectors is developing more efficiently and more rapidly under the influence of external factors, which include economic sanctions. To form the concept of a sanctions economy, let us consider the definitions of sanctions, their types and categories available in the literature. Sanctions against individuals, legal entities, as well as states are determined by a large number of wordings.

So, according to the Wikipedia encyclopedia "Sanction is a measure of influence applied to the offender and entailing adverse consequences for him" (https://ru.wikipedia.org/wiki/Sanction). According to this source, Soviet jurisprudence distinguished:

• criminal sanctions (imprisonment, etc.) imposed by a court decision;

• administrative and legal sanctions (fine, administrative arrest) imposed by administrative authorities;

• disciplinary and legal sanctions (displacement to a lower position, dismissal) imposed by officials in relation to subordinates;

• property sanctions (penalty) applied by the court or arbitration.

A big legal dictionary gives the following definition of sanctions (from the Latin sanctio - the strictest decision) - measures and decisions, as a rule, having a final character and having four main meanings (Sukharev, Krutskikh, Sukhareva, 2003):

• measures applied to the offender and entailing certain adverse consequences for him. Depending on the nature of the measures and the bodies applying them, they are divided into criminal law, administrative law, disciplinary law, property;

• structural part of the general rule of law, indicating possible measures of influence on the violator of the rules;

• a prosecutor's order authorizing coercive measures against a person suspected of a crime;

• in international law - measures of influence on a state that has violated the norms of law or its international obligations.

In the explanatory dictionary, the term sanction is defined as the approval of something by a

higher authority, permission, as a measure applied by the state to the offender. The measure that is taken against the party that violated the agreement, the contract (Kuznetsov, 1998).

The Big Encyclopedic Dictionary gives the following definition (Borisov, 2003): "Sanctions are coercive measures for violating the established order of economic and financial activities have a preventive, compensatory or repressive function.

1. An Internet source defines a sanction as an element of a law norm providing consequences for the subject implementing the disposition. Sanctions can be both negative, unfavorable - punishment measures (imprisonment), and positive - incentive measures (parole, a bonus to an employee for the conscientious performance of his official duties) (http://www.grandars.ru/college/pravovedenie /sankciya-normy-prava.html).

1. With regard to states, Wikipedia gives the following definition of sanctions: "International legal sanctions are collective or unilateral coercive measures applied by states or international organizations to a state" (https://ru.wikipedia.org/wiki/Sanction).

All of the above terms consider a sanction as coercive measures applied for failure to fulfill any obligations but without specifying certain measures of influence and consider this category within the framework of a legal prohibition or restriction.

L.E. Zernova and M. Farzanian, in their writings, propose to consider the sanction as an economic rather than a legal category and give the following interpretation of this concept: "An economic sanction is a legal restriction that is introduced by one country or several countries against one country or a group of countries, with the purpose of limiting economic, financial and trade activities and the adoption of certain social norms and patterns of behavior" (Zernova, 2014).

Having studied and analyzed the existing terminology in the field of sanctions and economics, we have for the first time given a definition of the sanctioned economy. It is characterized as a system developing within the framework of the socio-historical formation of the state. It functions on the basis of the existing productive forces and production relations. The strategy and tactics of economic activity of the sanctioned economy covers all links of commodity production and distribution of material goods. It exists within the framework of economic and legal measures of influence of a destabilizing nature for violation of any world norms, as well as with the aim of imposing the policy of the interested state (group of states).

L.E. Zernova and M. Farzanian propose the division of sanctions into economic and non-economic, which is presented in the following diagram (Fig. 2) (Gusev, 2002) and also present their vision of the classification of economic sanctions (Fig. 3) (Zernova, 2014).

Sanctions

Non-economicsanctions	Economicsanctions	By the size and limit of sanctions	By the number of targeted countries
	Tradesanctions	Limitsanction	Unilateralsanction
	Sanctionforservices	Complexsanction	Multilateralsanction
	Transportsanctions		International sanction(international sanction by UN resolution, UN Security Council sanction)
	Sectoralsanction		
	Targetedsanctions		

Figure 2. Classificationofsanctions

Economic sanctions

Tradesanctions	Financialsanction	Sanctionsforservices	Transportsanctions	Sectoralsanction	Targetedsanctions
Onexport	Onmonetarytransactions	Onbanks	Onairtransport	Againsttheenergysector	Against specificpersons
Onimport	Onpreciousmetalsoperations	For payment systems (Swift, Visa Card …)	Onmaritime transport	Againstthefinancialsector	Againstspecific individuals
Onaninvestment			Onlandtransport	Againstthedefensesector	

Figure 3. Classification of economic sanctions.

Furthermore, the Russian Agribusiness should be gotten out from tradition cooperation devel-opment and to be providing a new generation cooperatives, which are more effective and can be at-tractive for long-term investments for production modernization on the high quality boarding devel-opment. Besides, there is important to develop of contracting at all spheres of agrarian business that is soft form of vertical coordination and integration through supply chain linkages development.

The basic theses of modern state policy in Russia are shown in following legislative Acts: The Act about Agriculture Development in 2006 accepted; the State Program of the Agriculture Devel-opment and Farm and Foods Markets Regulation in 2008-2012 and planning in 2013-2020; Presi-dential Act «Doctrine of Food Safety» and Nationals Annually Reports prepared Agricultural De-partment. All countries are adopted the farm policy to the requirements of domestic agriculture and food industry sector. The state agrarian policy has been changing by the natural influence including line conditions between national and international markets [1, 2].

After WTO access development for Russia there is changed farm policy, which is oriented to the budgeted support and regulation to the Agro-Industrial Complex. Authors have developed the Investment Program Development for the Russian Federation. Furthermore, before for discussion of the State Program of the Agriculture Development and Farm and Foods Markets Regulation in the 198 planning in 2013-2020 has been declared the investment in the sum at 70 bln. USD dollars. Fistful, we would like to say that all people in Russia had the opinions that the Agriculture is black empty, where the investments have been returning never and no yet return rate last. The economic report has been got from the western program of Project Expert Holding 6.0, which was shown reverse side these discussion words. For the investment report there was got the date at 2008 because the years at 2009-2010 have been unperfectible for the climate cataclysm and World finance crisis get-ting. The estimates were developed as forecasting from 2008 to 2017 and the rate of ruble course to dollar as 23,5 as it has been in 2008. The investments have been developed on the record level at 1.650 bln. rubles. Moreover, the data has been discounting as value production and average aggre-gate indicator of the value cost for the Central Bank of the Russian Federation percentage rate per-haps 8,25% annually [6].

A net present value (NPV) is 7,5 bln. rubles then this more than 0, Profitability is 4,29 then more than normative (the normative is 1) and Internal nor of profitability is 47,9%, this is more standard indicator, which should be 35-38%. The investment indicators are shown about high net return rate of real investing in the agriculture in Russia. The cash flow and the data of rate returning in the Russian agriculture is 62 months [6]. The state support in the farm policy has been bringing on the basis that the GDP should be increased in two times and ,by the way, we took off 10% annu-ally growth for farm production

and distribution. The Agribusiness demonstrates an economic growth in 2009 in the Russian economy. We think that the Agribusiness is the strategic branch of the economy which can be earned to take money. Furthermore, in the estimates we did not take the processing and textile industries. As for as it's known one agricultural producer gives the work for 12-16 workers to the allied branches This is the effect of multipole and if a government makes the investment development, what private capital is being flowing to the economy. It looks like the indi-cator of directing movement [12, 16, 19].

Conclusion

To conclude, we can say that according to the author of the article, economic sanctions against states can be divided into export sanctions, import sanctions and economic isolation sanctions.

Export sanctions are measures of influence that restrict or prohibit the supply of a certain type of goods or tangible assets in general from enterprises of a targeted country.

Import sanctions are measures of influence that restrict or prohibit the purchase of a certain type of goods or tangible assets in general from enterprises of a targeted country.

Sanctions of economic isolation are measures of influence that restrict or prohibit the purchase and supply of a certain type of goods or tangible assets in general to a targeted country.

Thus, the author has given the definition of the sanctioned economy and its classification within the framework of international relations, which differs from the concepts of sanctions for legal entities and individuals, as well as states, by a more complete content and classification on economic grounds of influence measures.

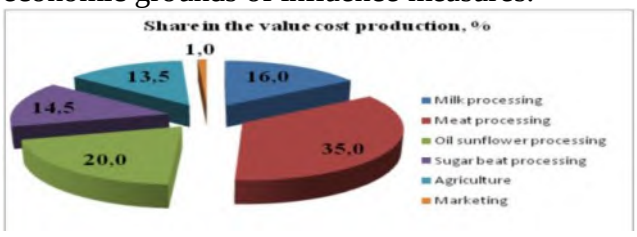

Figure 1– The investment structuring by the Program Development of Vertically Integrated

Cooperatives in the Regional Agribusiness (Samara oblast) at 2007-2017

Furthermore, these estimate reports are the building of branding economy in the Agribusiness in Samara oblast. Through good will from state government to the investing used to be speed Amor-tization of capital and that is increased the competiveness and food safety. We are sure that the new generation cooperatives will be making liquidation of inefficiency owners and giving out the work for family farmers by the production contracts should be invested in the financial resources. And 199 farmers provide this service for land and labor. There is the U.S. model for cluster Agribusiness on the example of Samara oblast (Figure 1) [5].

Very necessities for Russia that will be developed vertically and horizontally agricultural sec-tor what was done and biggest quantity of agro-holding companies has been created and successful-ly developed. Vice Minister of Agriculture in Russia, Academician Petrikov A.V. said on the Ni-konovReadings conference: Agro-holding companies was done the good result report for us and now we should be obtained contractual agriculture and contracting will be controlled by Ministry Department. I believe that the integrated structures will be receiving second life after reorganization process and restructuring. Probably, we should be got the real property farmers who will be closed territory problem and will be so positive politics vote of the electing in the Russian Federation. There will be possible decline of integration level and we are knowing that about 60% of the pro-duction volume was developed of family opportunism farmers. But sure we will be getting livestock supplying of feeds issues without public large vertically integrated companies [5, 12, 23].

The basic problems of Ministry of Agriculture on national level should be following ideas:

•Elimination of price disparity;

• Support of income for agroproducers;

• Increase in demand and, thereby, stimulation of economic increase in production;

• Financing of food stamp programs;

•Market protectionism;

•Rural development;

•Creation of the branded economy and active advance of integrally net production.

The economic and social scenarios got based through influencing and factorial instruments. To develop an effective scenario at factorial Project that is very important to find a goal of scenario planning. To be checking characteristics benefits for scenarios and limited factors.

Authors are sure that Samara regional level project development has been describing for fore-casting of increased bank percentages by the credits, devaluation and high inflation.

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EDUCATION AND DEVELOPMENT: AN ANALYSIS OF RURAL TRIBAL WOMEN WITH SPECIAL REFERENCE TO SIVASAGAR DISTRICT, ASSAM

P. Gogoi
Demow College, Assam, India

ABSTRACT

The researcher has conducted a study on Education and Development: An analysis of rural tribal women with special reference to Sivasagar district, Assam with the sample of 10 households of four villages in Sibsagar district. The size of the sample was 137 tribal women. The tools are used for data collection were questionnaire, interview, self evaluation, observation technique etc. The researcher prepared a self structured questionnaire to collect the data from the respondents and it analysed in a tabulate form. In this paper the study has been done on the present educational status of tribal women along with the role women in socio- economic development. As we know the tribal women are very hard worker and are experts in many fields like agriculture, piggery, poultry, weaving and fishing etc. They are playing a significant role in the income sustenance of their families. So in this perspective education is crucial for the improvement of the tribal communities. It can help them to bring the change to a better society.

Keywords: *Education and Development, Socio-Economic Background, Improvement, Tribal Women.*

1. Introduction

In its broadest sense, education is a process of learning and acquiring information. This process transforms each new born one from biological to social being. By the term "Education and Development" of women means the development of the mind, as all other development, is an advance form the indefinite to definite. In the present scenario education and development are used synonymously. As we know both are interrelated, without education development cannot be possible.

Women comprise almost half of the population of the world. Women as a strong part of the society; they should get all, which are mostly deserved. Women have greater ability to organise people, resources and work by nature. Simultaneously they have greater perseverance adaptability and attitude for discipline and cleanliness. They should provide vital role regarding the welfare of the society. A mother is the first women who can mould her children from initial stage. So every woman should be educated to teach her children properly. Education can bring the norms, values and status of the women. Education for women can improve the health, nutrition and economic status of a household that create a micro unit of a nation economy. But in the present context, if we see the rural areas of women, they are lagging behind of spheres of life. They are lagging behind economically, socially, politically etc. they don't get adequate facilities because of their lake of awareness and poverty as well. It can be argued that lack of women education can be an impediment to country's economic development. Because, women achieve far less education than that of men. As per the census report 2001, the literacy rate of women is 54.16% and that of men is 64.16%. The government of India provide facilities towards women education. The implementation of the policies and development of infrastructural supports on primary, secondary and higher education reflect the initiative of the government of India towards women education.

The tribal communities have their distinct physical and diverse cultural traits; have some common characteristics like- nature of rurality, economic backwardness, speciality of illiteracy, primitive religious belief, social deprivation and distinct language. Therefore they have remained isolated partially from the grater culture. The tribal community has been subjected to various forms of deprivation such as, alienation from land and other forest resources since the British rule. Therefore, education is an instrument which can help to satisfactorily negotiate with the transitional phase of socio-economic as well as cultural change. It is the key for generating new awareness among the people through knowledge and information. And also it helps

to eradicate all primitive values among the people.

Educational backwardness is a distinct gender dimension. An education system should provide a new culture of work, spirit and an arrangement of young talented, skilled and well equipped target group who will be able to shoulder the developmental duties and responsibilities. It should make all people better suited to the needs of the ever changing dynamic world. The structuring or restructuring of education system should also contribute to reduce the social gaps between man and women by enabling proper recognition to whatever extent one is able to pursue or acquire a skill.

2. Review of Related Literature

A comparative review of literature of immense help in any endeavor. The function of review of literature is to determine what theoretical and empirical work has already been conducted previously assist delineation of problems, providing insight into methods and procedures and thereby tress out research gap so as to abridge it on the basis of present investigation. With this express purpose in mind the researcher has upon reviewing the available and pertinent literature, related to this proposed work.

Kundu (1994) report states that tribal education in India is beset with a multiplicity of problems in the existing policy and programmes; socio economic, cultural and ethnic problems; linguistic problems and in the existing education system for tribal learners. He also observes that these problems in tribal education are responsible for the large scale dropouts among the tribal pupils, their poor performance in schools and colleges and ultimately for the spread of education among the tribal people of India.

Arya and Chauhan (2012) in their article," A critical study of tribal education: with special reference to women's" outlines that the nature of education and pertaining to rural development has been attempted even before and as part of community development. Tribal women are lagging behind in all spheres of life in comparison with other sections of the population. The rural tribes are very poor and literacy rate of women is very low and also identified the problems in promotion of tribal women especially in case of tribal women and suggest suitable strategies.

3. Statement of the Problem

The present study is mainly focused on Education and Development of rural tribal women in Sivasagar district. It is an analysis of educational development which can help them to change their socio- economic status and the mode of living as well. Though it had envisaged that education will bring change in the lives of the tribal women like other women .But it is sad to note, that after years of different plans and programmes related to education by the government the desired level of education and socio-economic development for the tribal have not yet been achieved. There may be a wide range of gap between planning and implementation as well as the implementing agencies and the beneficiaries in this regard. This gap should be abridged so as to bring the tribal at par with the main stream society. Considering the importance of recognizing as well as developing of tribal women the study is mainly focused on **Education and Development: an analysis of rural tribal women with special reference to Sivasagar District, Assam.**

4. Objectives of the Study

This study is mainly based on three objectives which are:

1. To know the educational status of rural tribal women in Sivasagar district.
2. To enquire the attitude of rural tribal women regarding the education system.
3. To study the role of women in economic activities for their socio-economic development.

5. Delimitation of the Study

Due to number of constrains it was not possible to include each and every corner of the area of study. The study is delimited which as follows-

- Out of 136 villages of Sivasagar district only four tribal villages- Sesamukh, Ahom Pathar, Rajabari and Katiyari which are from two panchayat by name Pani Dehing

and Gohain Pukhuri are included in the study.

- Only the Deuri, Sonowal Kachari and Missing tribes' women of those villages are included for the study.

6. Methodology of the Study

6(a) Method

To describe the present study the researcher has been adopted a method that is descriptive survey method.

6(b) Tools and Techniques

A self structured questionnaire was developed by the researcher for collecting the required data. The researcher also used observation techniques to gather related information.

6(c) Population and Sample

The study is based on primary data. All the tribal women belonging in rural area of Sivasagar district were included in the study. In order to ensure adequate representation of the population there are out of 136 tribal villages of Sivasagar district, only 4 tribal villages by namely ***Sesamukh, Ahom Pathar, Rajabari and Katiyari*** under the panchayat of ***Pani Dihing*** and ***Gohain Pukhuri*** respectively were included in the study. Out of total household of the representative 4 villages we have selected 10 household from each village and total numbers of sample household are 137 female out of 305 total no of family members. We have purposively selected these 4 villages and 40 household because of their representative character for representing the study. The sample comprised within the age from 25 years old of tribal women.

6(d) Source of the Study

For the present study both primary and secondary sources of data have been taken. The rural tribal women have been considered as the source of primary data and various books and journals were regarded as secondary data.

7. Discussion and Results

It is observed that a co-relation between education and development of a society. Generally educated women are skilled labour and able to avail all type of facilities provided by Government, rural developmental agencies and Panchayats etc. as compared to illiterate one. Therefore the levels of education of sample women is concerned, it is observed that only 18% of illiterate women are exist and other belong to different educational status as shown below:

Table 1: Educational Status of the Tribal Women

Educational Qualification	No of Household	Percentage (%)
Illiterate	18	13.13%
Below H.S.L.C	51	37.22%
H.S.L.C	39	28.46%
H.S	20	14.59%
Graduation and above	8	6.57%
Total	137	100%

(Source: Field Survey)

Table no 1 covers different categories of educational qualification which are illiterate, below H.S.L.C, H.S.L.C, H.S, graduation and above respectively. In the table we have seen that out of 137 household 18 are illiterate women. A large number covered in category of below H.S.L.C that is 51. After that the number of household who cleared H.S.L.C. is 39. And 20 household is from H.S. category. A small amount of number is from graduation and above that are 8. And the percentages of all the households are 13.13%, 37.22%, 28.46%, 14.49% and 6.57 respectively.

Table 2: The Attitude of Rural Tribal Women Regarding the Formal Education

Age Group	Household	Reponses				Percentage
		Positive	%	Negative	%	
25-35	56	56	100%	0	0	100%
35-45	28	21	75%	7	25%	100%
45-55	39	22	56.41%	17	43.59%	100%
55- above	14	6	42.86%	8	57.86%	100%

(Source: Field Survey)

Table no 2 reveals the attitude of rural tribal women regarding formal education. It is shown that most of the women have given their positive views regarding the formal education. To ensure the exact result the researcher classified their age groups in different category to collect the data. The data are collect from the age groups of 25 to above women. So the age group of 25-35 the number of household is 56, they provide 100% positive attitude towards the formal education. Because most of the women from this age group is educated. After that the percentage of the positive attitude in the age group of 35-45. It is shown comparatively low amount of positive attitude to the previous one. They provide 75% positive results and remaining is 25% negative. Subsequently, the age group of 45- 55 they also provide maximum positive views that 22 out of 39 household and the rest of numbers are from negative attitude. The age group of 55 to above there are 14 household out of 137, in this category we have seen that most of respondents provide maximum negative views due to various reasons which they have seen in different times. When the researcher asked the respondents about the reasons they said that students are not aware, present education is not useful, lake of basic needs, poverty etc. most of the women are illiterate from this age group.

Increase of income enhances the rate of savings, investment, production and consumption behaviour of the society at a multiplier process. But in the rural areas of India, there is income generation very slow as maximum people are engaged in agricultural activities where productivity is very low due to their traditional techniques. They still follow the traditional old techniques in agriculture rather than the modern skills. An attempt has been made to know about the various sources of income of the tribal women of Assam as shown in Table No. 3 The Table No. 3 indicates various types of income sources of the tribal women of Assam which are as like agriculture, weaving, poultry, piggery business, service, traditional industries and wage labour. Among these activities traditional industries like handicraft, weaving, preparation of traditional wine, piggery and poultry are the most prestigious culture of the tribal community which is prevailing mostly in the rural area. Such types of activities are generating a respectable amount of income for the tribal family but the rate of income generation in such activities is not satisfactory as compare to modern farming activates.

Table 3: Source of Income

Source of Income								
Village	**Agriculture**	**Poultry**	**Piggery**	**Business**	**Service**	**Traditional industries**	**Wage labour**	**Total**
Bhatgaj	64%	10%	7	1.9	7.9	8	1.2	100%
Ahom Pathar	57%	18%	13	1.4	5.6	4	1	100%
Rajabari	60%	13%	15	1.6	4.1	5	1.3	100%
Nemuku	61%	9%	12	1.3	6	9	1.6	100%
Total	24							

(Source: Field Survey)

Table No.3 shows that 55.08% income is generated from agriculture, 1.36% from poultry, and 2.5% from piggery, 10.09% from business, 22% from service, 7.41% from traditional industries and 1.26% from wage labour. If we add the income percentage of poultry, piggery, traditional industries, it will be 11.26% from these three types of activities which are directly guided by the traditional culture of the tribal Community.

7(a) Respondents Views Regarding their Social Status and Family Planning

We have already discussed that the tribal women have been playing a crucial role to ensure a sound society. Their social status cannot be measured only from their source of income. Their well mannered behaviour, honesty, loyalty also determine to maintain and run their family smoothly in the society. They have played various roles in the society from the time of immemorial. As we know, society

is dynamic so women should change their roles somewhere today. Because in the earlier time they are only busy with their day to day work. But now a day's tribal women are engaged in various activities which can help them to earn money to enrich their family properly. So that we cannot say that tribal are lagging behind all spheres of life. In the socio- cultural perspective, they are busy with the cultural activities to promote their culture. Women are always required to spend their daily life with traditional food, weave traditional clothes for all the members of the family, their customs and rituals etc. that is why it is must say that the contribution of tribal women to their community for the social progress is highly acknowledgeable.

At present, family planning is crucial for the better society. Because, the growth of population determine the socio- economic development of the society. From the earlier time to the present, they have more or less conservative attitude regarding family planning. They considered large family is better for socio economic growth. They think that children are gift from God and no measure to prevent it. But now a day's younger women are conscious about their family planning. As a result researcher observed that 102(74.45%) majority of women have shown their awareness regarding family planning due the impact of education. They also expressed their positive views regarding small size of family for better living and happy life. It is positive sign for reduce of population growth and enhance economical aspect of the family as well. On the other hand, 35(25.54%) of women provide their negative views with regard to the family planning. They have no idea about the family planning programmes, preventive cures due to their illiteracy, poverty and unawareness. Their attitudes are like the earlier time still today. They live in the midst of superstition, prejudice etc. but it is a positive sign that there is no child marriage system. So it is a positive ray of better society.

8. Major Findings

1. The literacy level of women among the tribal community has game up but they could not able to maintain the equal pace of progress with the women of non-tribal groups. More particularly the women of remote area are maintaining the same mode of living major changes over the years. That is why in this place the tribal women are far from taking formal education but education is the most important factor of socio- economic development of the community.
2. Maximum women are engaged in various types of allied activities. Their source of income are from agriculture, poultry, piggery etc. a very small portion of women are involve in service and business purpose. That is why their economic background not so well.
3. The attitude of tribal women regarding formal education is more or less positive. They are aware about educational plans and policies provided by government of India. Their children are able to get all the facilities provided by the government. So the women have given positive views regarding the present formal education.

9. Conclusion

The present study "Education and Development: An analysis of rural tribal women with special reference to Sibsagar District, Assam" is a modest attempt to understand and analyse the existing situation of educational development like educational status of the respondents, attitude of women regarding their education system, awareness related to educational policies and programmes formulated by government and the role of women to their socio- economic development. For this primary study we have collected data from 137 respondents selected from the village namely Sesamukh, Ahom Pathar, Rajabari and Katiyari in Sivasagar district. The demographic profile of the respondents depict that population in the sample is fragmented in different age group of women. While discussing the impact of education on the socio- economic development of the tribal the researcher found that a majority of the respondents opined that education has benefited them. It shows that education system has to be made effective and qualitatively rich so that the tribal can change lifestyle.

But still today, they have deprived from their proper educational facilities in the village. All-round development and harmonious growth of nation would be possible only when women are considered equal partner in progress with men. In a well developed and progressive nation each and every citizen must be educated and everybody should understand his/her duties and responsibilities. In the modern society, education is considered as a key instrument of social- economical change, which is responsible for national develop as well as their life. An educated, socio and economically developed women normally found to be efficient, aware of happening around her and capable of taking decision. In the modern time, educated tribal women are gradually started to become economically independent through establishment of self-employment, like handloom, poultry and piggery etc. They earn money by selling such products and such earnings are the part of family earning. Through agriculture is their main source of livelihood, other above are their household business and they sell their products only in the local market. Thus, the socio-economic status of tribal women is gradually improving with the help of modern education.

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EXPLORING EXISTENTIAL ELEMENTS IN TASLIMA NASRIN'S *FRENCH LOVER*

M. Kapoor, V. Mishra and M. Singh,
Research Scholar, Banasthali Vidyapith

ABSTRACT

The novel studied in this paper is French Lover which shows a woman's journey from being submissive to a self-reliant and self-aware woman. The key existential elements are identified and understood by the theory of existentialism, some aspects of feminism as they have been discussed throughout the novel. Further, the conflict between personal desire and patriarchal responsibilities is identified and understood. Liberal individuality and socio-cultural objectification constitute the basic theme of the novel. The novel ends with the key element of diversification of life and personified move from the protagonist. A woman's life, her feminist perspective, and the style of her life are some inevitable parts of the novel. A personal diversification, a socio-cultural scenario et cetera with her desire played key roles in the entire fiction. The novel is an impressive literary work about existentialism and feminism. The paper aims to identify and discuss the existential elements present in the novel. The paper also discusses the way women are portrayed in literary writings.

Keywords: *Diasporic identity, diasporic consciousness, diaspora, diasporic double consciousness, migration, immigrants, diasporic evolution*

1. Introduction

A new kind of novel with the theme of "new women" came into existence from the pens of new contemporary writers. Taslima Nasrin is one of these contemporary writers and projects women's struggles and sufferings from being trapped in the shackles of traditions and religion. The novel echoes the notion of feminism, personal desire, and responsibility conflict of the female protagonist and from a female point of view rather than male novelist's non-existential women's pathos and struggles. It is the foremost example of an existential novel where the protagonist comes to terms with her being and feelings in an unknown and hostile world.

French Lover by Taslima Nasrin depicts the story of a woman searching her independence and love in an unknown city. The novel is about the female protagonist Nilanjana, a simple Bengali girl married to Paris restaurateur, Kishanlal**.** The protagonist's husband treats her no better than a housekeeper at day and sex object at night. The depressing situation at her new home led to the protagonist's friendship with a blue-eyed, blond Frenchman, Benoir Dupont. The relationship blooms into a fully-fledged passionate and sexual affair with Nilanjana being introduced to the French city and world of passion. However, the relationship is short-lived as the protagonist realizes that Benoir is self-obsessed and would not be the person she could love or love her as she desired. The novel reaches its climax through Nilanjana or Nila's journey of self-discovery and her coming to terms with her own identity, freed from the shackles of religion, tradition, and patriarchy.

This paper aims to explore existential elements presented in character as they have been portrayal in *French Lover* by Taslima Nasrin. The paper aims to identify and acknowledge the various existential elements presented in the writings by the novelist. The elements of feminism, conflicts of personal desires, and patriarchy responsibilities are analyzed to identify the existential elements present in the literature work. Along with it, relationship and liberal individuality and socio-cultural objectification are studied to present the existential elements in the novel.

2. Existentialism

Existentialism is a centuries-old theory that focuses on embracing personal choice and freedom. It advocates personal choices of selecting one's existence and defining its meaning. The themes of the novel have been; identity crisis and the quest for identity. Taslima Nasrin is identified with her female-centric novel that questions previous notions about female and female portrayal in male-centric novels or feminist novels written by male writers. The novel with the assistance of the female protagonist question's existential theory and the ways women's existential

identity is challenged in a male-dominated society. The novel reflects the novelist's reasoning about men-women relationship dynamics. The subjection of women in men-women relationships and ways leads to an identity crisis in women (Kayasheva, Kislyakov, 2020). As the prime protagonist, Nila retains her strong character and detaches herself from not only her husband and family but also from her French lover. The novel depicts her flawed as well as brave journey of self-identity and self-realization.

The novelist through her work in *French Lover* exhibits the traditional shackles that force women to be submissive to her husband even at the price of their happiness and desires. The protagonist, Nila has to shift to Paris, an unknown city with never seen before cultures and lifestyles. Nilanjana in her new home is like a bird in a cage with no personal freedom, trapped in a place where her dream of love and romance is crushed by her husband. The first few chapters discuss the existential crisis that arose from the protagonist's traditional values, upbringings, and her disturbing marital life. Traditional patriarchal and stereotypical conventionality and beliefs become thorns in the path of happiness and acquiring existential identity (Beyer, 2019). *French lover* uses existential philosophy to highlight the existence and existential crisis faced by all characters in the novel.

The strong character of Nila shines brightly throughout the novel. Nila refuses to bend down to her current situation and breaks free from her lackluster marriage. Her relationship with Benoir starts with a promising note but it soon loses its previous luster as the French lover was more self-inclined. The failed affair becomes the turning point of Nila's life and she breaks out from her existential crisis scenario**.** The existential perspective is conceivable from this part of the novel. Nila's married life, self-obsessed lover along with her traditional family and roots were the reason for her existential crisis (Arizah, 2019). To rebuild her life and acquire her own identity, Nila has to overcome several obstacles and destructive forces that were challenging her existential identity**.** The efforts by the prime protagonist to acquire the right of free choices and own identity show remarkable existential perspectives and philosophy in the novel.

3. Feminism in the Novel

The new contemporary writers portray women as assertive and awakened individuals with their own emotions, wishes, and aspirations. Taslima Nasrin is a Bangladeshi contemporary writer who portrays women as assertive and awakened figures in all her controversial novels (Nitol, 2018)). Feminism is not a new concept with several books, propaganda, and protests taking place to redeem women's position in society. Mary Wollstonecraft's *A Vindication of the Rights of Woman* written in 1792 is one of the earliest feminist literary books. *French Lover* by Taslima Nasrin falls in the category of "new woman", contemporary literature that questions women's roles in society and portrayal in literature as submissive and silent. The novelist herself views marriage as oppressive to women and her freedom, this every thought is projected in her writings (Bajaj, 2017). *French Lover* and *Lajja* are the two prominent novels of Taslima Nasrin where the protagonist's search for identity is highlighted. The novel *French Lover* reflects Nila's feminist journey of self-discovery by defying the patriarchal roles and norms imposed on her by religion and society.

The feminist aspects in the novel are acquiring a self-identity and to lead a full-filling life that is not dominated by anyone or anything. *French Lover* like other works of Taslima Nasrin that disentangles traditional images of women in novels to be submissive and silent rather than being in control of one's destiny (Sengupta, 2020). Nila in her new home in Paris is like a bird in a cage with no personal freedom, trapped in a place where her dream of love and romance is crushed by her husband. The protagonist's husband treats her no better than a housekeeper at day and sex object at night. The dreams and desires of a new young bride yearning for husband love and attention are crushed. However, Nila due to her traditional roots tries to adjust to Kishanlal. The marriage reaches its stale point when Nila learns about her husband's dual life and walks out of the relationship. Nila leaving her husband's house and opting to be independent shows the first glimpse of feminism in the

novel**.** Later, she meets Benoir, her French lover, and enters a live-in relationship. A decision that was not supported by anyone, not even by her father. The existential elements of feminism are highly prominent in Nila's decisions to take charge of her life into her hand.

French Lover is one of the prominent novels written about women's struggle and oppression faced by women in marriage and daily life. The novel theme of feminism is not new; however, the projection of characters especially female characters had infused the feminist elements in the novel. Nila's relationship and eventual break up with Benoir show the mark the brightest feminist streaks in the novel. Nila tells her French lover that *"You love yourself, Benoir, your self. No one else."* (Nasrin, 208). The realization that Benoir is treating her as a substitute and not a priority led to Nila's understands of Benoir's character. Her realization that Benoir is not different from her husband leads to her self-discovery. Nila's bitter experiences with all male characters led to her transgression and offered her the courage to come out of male-oriented society beliefs, customs, and thinking. Nila poses as the flag bearer of women's liberation from age-old male chauvinist society.

4. Feminism and Relationship in Novel

Taslima Nasrin has always been known as an independent feminist writer who, in her writings, has always stood by the characters that face inequality and injustice. She has always challenged and reconstructed the traditional image of a woman and has introduced a 'new woman' image. She has finely depicted the theme of feminism and relationships in the novel *French Lover*. The protagonist of the novel, Nilanjana, gradually creates her way towards self-discovery and self-liberation (feminism) in the male-dominated society (Nasrin, 2018, 210). The novel depicts the story of her being patriarchal controlled and her relationship with her father, her husband, male friends, and lover. She moves to Paris with her NRI husband Kishanlal in the hope of living a new life, but the new life becomes suffocating for her. In the marriage of Nilanjana and Kishanlal, we can see that there is no harmony between their nature, feelings, and tastes. She was frustrated by her husband Kishanlal's poor treatment, and for that, she gradually abandons her husband. After leaving her husband's house, she goes through self-realization and a great transformation in the new city. At that time, she starts to work a small job, and there she involves in a lesbian relationship with her co-worker Gabriella. But that relationship doesn't last long. Nilanjana comes back to India after her mother's death but again goes to Paris in search of her lover. On the flight, she meets a handsome blonde French man named Benoir Dupont. He and Nilanjana soon become involved in a passionate relationship. But after some time, she realizes that Benoir is selfish and he always prioritized himself before the love of his life (D'ignazio, Klein, 2020). Nilanjana decision to break her unhappy marriage and her denial to accept her French lover's selfishness shows her strong feminist nature. After all the emotional trauma, her self-discovery and self-fulfillment clearly show that any woman can change her life and attain self-satisfaction if she truly wishes to do so.

The novelist has represented the character of Nilanjana as a preacher of the liberation movement who publicly and fearlessly supports freedom from the control of patriarchal society. Nilanjana conveys the message to society that equality and liberation are things that women must explore on their own. It is true that in a male-dominated society, the responsibilities of marriage and relationship fall solely on the woman, and when she tries to perform all the responsibilities, she starts to lose her own identity. But there is an exception in the novel *French Lover*. Here, the protagonist Nilanjana proves herself to be a very strong and brave feminist who successfully holds her individuality and identity against all the threatening and destructive forces. She has an intense feminist drive for self-realization, which allows her to end all of her suppressing and dominating relationships (Hambur, Nurhayati, 2019). Her traumatic experiences of her failed relationships allow her to explore herself and to become a self-dependent woman in the end. As described, it can be said that *French Lover* doesn't only revolve around the emotionless and dominated marriage life of the protagonist

Nilanjana but also revolves around the unfortunate women who are only treated as a liability and sex-object in a marriage.

Kishanlal and Benoir both are male characters that mirror each other. Nila's realization of both the characters being similar in the notion of women and flag bearer of patriarchy led to the female protagonist's realization. The novel through Nila's relationships with her husband, father, and lover brings out the feminist streaks of Nila (Hambur, Nurhayati, 2019). The brave and flawed self-discovery journey is based on her difficult and painful experiences with other characters especially male characters in the literary writings. The difficult and painful experience of the main characters encourages Nila to lead a fulfilling life where she is not obligated to be submissive to anyone or any relationship. Nila's journey from submissive woman to strong feminist is the main theme of the novel.

5. Personal Desire and Patriarchal Responsibilities Conflict

Taslima Nasrin always opted for a feminist aura, searching for individual love and independence out of her responsibilities and love for her family. She represented a female character, Nilanjana, who set her life by her own rule and desire to live life like a bird free from a cage. The protagonist character, the female lead (Nilanjana), is a reflection of adultery which can depict her happiness by choosing the style and adultery of her life. Personal desire is not bound with patriarchal control of society; that's why after reading the fiction *French Lover*, a person can identify the clash between patriarchy and female independence exceeding the limit of her social influence (Nasrin, 2018, 209). The leading character, Nilanjana, also has her own family, consisting of her husband, Kishanlal. But her desire enabled her to dive into French culture and the history of France. But what men desire, women shouldn't or may not impose the same desire as her other male family member. While her husband wanted to keep her as a sexual object and responsibility controller, she didn't want to keep her feminism just to bind her daily responsibility around her family. Not only for her but every woman, personal desire is an inevitable part as per the opinion of the writer. So, the writer reflected a social conflict between personal desire and patriarchal responsibility for her family (which she didn't want by her own choice). The choice between personal desire and patriarchal responsibilities like the man of the family wants can be either fatal or sustainable for a woman. If she chooses the right, she can lead life ever happily. If she chooses her choice as per peer pressure of her bread earner, she can experience detrimental aftermath in her life (Prasad, 2021). For this conflict, Nilanjana chose to be free and realized that her life should be on the sail of self-maintenance.

The French lover of Nilanjana helped her to explore the under-covered world, which she couldn't experience if she chose a stand for her undesired family. But at the end of the fiction, she revealed that this is not what she wanted the transformation in her life, though she traveled the immense flow of current. Though the fiction has many unrevealed parts, the best part is the action that raised her voice against patriarchy against the current society. Current society contains an orthodox mentality that reflects that woman objects to a man; they only have to carry the patriarchal responsibility of doing household works, bearing a child, and doing the exact things that a male member orders them to do. Exactly this orthodox mentality gets a hard beat in the fiction of *French Lover* by Taslima Nasrin. Patriarchy is defined as the ancestral hierarchy in society, which has no escape route for a woman (Devakumar, 2018). If a woman escapes from the cage, she is labeled as a rebel of patriarchy and is generally banned from society. If a woman chooses her desire, she should balance her personal desire and patriarchal responsibilities on her own to keep her life on the correct track. This mixed affair, the conflict between personal desire and her patriarchal responsibilities, is shown as the mental stress for women when she desires for her life a different wish to know herself. Nilanjana shifts to Paris, her uncontrolled love affairs, her keen desire to lead her life by her own choice; everything just denotes a similar point, rather the same point, and the inescapable personal desire.

6. Liberal Individuality and Socio-Cultural Objectification

The question that can arrive in reader's minds while reading Taslima Nasrin's fiction, *French Lover* is -

"Did she opt for individual liberalism by her penned characters? Did she point out socio-cultural objectification and bias between men and women?"

Well, the answer can be depicted by all the readers while reading her fiction. She also reflected her socio-cultural agenda and liberal individuality of women in her previous book *Lajja*. Ancient ancestral orthodox already has a deep root in society, especially in both men and women. Women are taught to be obedient to keep their family on single bread even after rejecting all their liberty (Nasrin, 2018, 222). No, the limit is not that for her. Male desires and orthodox mentality brags her to be just a sexual object and housemaid for her.

So, if a woman wants to identify her aura, where should she find it? That's why Nilanjana left her husband's house and moved to her desired opportunities to find her aura and liberal individuality. As a female writer, Taslima Nasrin penned down the current socio-cultural aspect and bias for women by her leading characters. In her analysis and theme of characters, Kishanlal is an NRI (Non-Resident Indian) who is a perfect reflection of social peer pressure and orthodox mentality as patriarchy, Nilanjana (a Calcutta girl) is a combination of self-desire and audacity to break the chain of social patriarchy, her French lover Benoir is a social reflection of liberal individuality and personal desire (Laso Cortabitarte *et al.* 2017). All three leading characters are bound with specific characteristics that revolve around the center of their priorities and the needs of their life. But there is one clash. They never met a point to satisfy the social meet. All the lives went parallel with each other with different fantasies. Each one has one's need to be fulfilled in life, and if the clash happens, they tend to be parted away from each other to maintain liberal individuality and socio-cultural freedom. The objectification of women is a symbol of the household keeper and physical desire. This specific social objectification can harm women on a global scale. As a female writer, Taslima Nasrin envisioned all the social objectification towards women and penned down the fiction regarding the social scenario of objectification towards women by the eyes of men (Reddy, 2021). The narrator, along with the female lead (protagonist), also reflects the female orientation of desire and objectification with personal individuality. Nilanjana female clover, Benoir, though taught her degree of freedom, still chose his individuality over his lover. After parting away from her attachments, Nilanjana also felt that she found a way to search for liberal individuality. Liberalism indicates civil rights and own desires and satisfaction, which can be revolved individually for everyone. Stereotypical ideas to access the limits of women's freedom are prohibited in this fiction, shifting the fiction from an emotional mix to personified liberal individuality and a strong voice against socio-cultural objectification.

Personal liberalism and socio-cultural objectification bear a strong rivalry**.** A woman, who can decide her life on her own, can't deal with both ideas to just keep her responsibilities and words forcefully. So, she left for new and brighter opportunities, showing full support to personal liberalism (Diaz *et al*, 2019). Socio-cultural objectification is not expected for any woman, especially by the writer and the protagonist, showing the result of choosing her life to live freely with her new lover in Paris.

7. Diversification of Life - For a Personified Move

The lead character experienced diversification of life. From a simple homemaker to a transformed lady, she has undergone a lot. The transformation of her life and her social and economic influence accelerated the diversification of her life (Nasrin, 2018, 225). Though she has full enthusiasm and support for her life to be transformed with her new lover, still the life's diversification couldn't happen if she would give her support to her forced destiny. She changed her destiny after shifting, and thus diversification showed its highlight for her life. A personified move**,** a self-obsession of freedom, changed the path of her life. By this fiction, the writer identifies the

diversification of life with the alteration from homemaker to bread earner by herself.

When life is transformed, the high chance of being blown like a log of wood aimlessly in the current of flow remains. Nilanjana also experienced this (Carroll, 2017). The strong life's diversification allows her to realize that she did everything in her life to attain freedom and self-desire, but she didn't want all of these in this way. Still, she found a way to live her life on her terms. The personal move can lead a woman to experience significant changes for the better or just can flow the person out of the favor of destiny.

The fiction also marked the diversification with a schedule of highlighting feminism and their obsession for leading her life without any social and patriarchal obstruction**.** Not only the female lead but also the male French lover of Nilanjana chose his priority over her, showing her the true side of life's diversification. After the story continued to the point of parting two lovers from each other, both persons, along with Kishanlal, experienced the diversification of life. The soft and restrained feeling of womanhood has shown beauty through the Nilanjana character (Daley, 2021). Self-chosen move to attend betterment of one thus provides a tough challenge of survival with one's parity. Nilanjana did it but was not satisfied after all. Thus life's diversification is highlighted by writers along with feminism and personal liberty for female protagonists (supporting the social condition of all women).

8. CONCLUSION

In this paper, a woman's search for love, independence, and the female self have prominently been shown in a strange city. It is reflected in *French Lover* that if a woman wants to get freedom, she can achieve it on her own. She shouldn't be bound to patriarchy and agony from her toxic family. The protagonist of the novel played a marvelous role in showcasing ways women are exploited in man-woman relationships. A woman needs to be self-reliant and self-aware for not being exploited by religion, age-old beliefs and patriarchal society. Nila, the protagonist, becomes the example of a new woman when she breaks away from her toxic relationships to acquire complete control over her own life.

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THE EFFECTS ON EGR AND INJECTION TIMING OF A DIESEL ENGIN'S, COMBUSTION, PERFORMANCE AND EMISSIONS BY USING BIODIESEL AND ITS BLENDS WITH 2-METHYLFURAN

R.Venkatesh[1], T.Raja[2] and R.Chandrasekar[3]

[1,3]Department of Mechanical Engineering, Vinayaka Mission's Kirupananda Variyar Engineering College, Vinayaka Mission's Research Foundation (Deemed to be University) Salem, Tamil Nadu, India

ABSTRACT

The impact of injection timing and EGR on combustion and emissions properties of biodiesel/2-methylfuran (MF) mixes are examined in this project work on a customized water-cooled four-cylinder four-stroke DICI engine. The experimental circumstances are to change injection time and EGR ratio at 0.38 MPa BMEP while keeping the engine speed constant at 1800 rpm. Peak cylinder pressure increased when injection timing was advanced, but maximum HRR fell at first, then increased somewhat Ignition delay and BSFC went down initially, then up, but combustion duration and BTE went in the other direction. NOX emissions increased, HC emissions decreased dramatically before increasing somewhat, while 1,3-butadiene and acetaldehyde emissions showed a downward trend. The ignition delay and combustion duration both increased as the EGR ratio increased.BTE decreased but BSFC increased. The emissions of HC, CO, 1,3-butadiene, and acetaldehyde increased, while NOX emissions decreased dramatically. Biodiesel could perform well in a diesel engine, making it a viable alternative fuel. Furthermore, adding MF to biodiesel may increase BTE, and BM20 has a greater BTE than BM10.However, when injection timing was set to 2.5 oCA, both BM10 and BM20 showed signs of worsening in combustion.

Keywords: *Combustion, performance and Emissions; EGR and Injection Timing, Diesel engine; Biodiesel , MF blends*

1. Introduction

Now days , the alternative fuels applied in a diesel engine have become an effective way to deal with energy issues caused by global warming and serious shortage of fossil fuel. Here after eco-friendly alternative fuels have been investigated in engine so far, such as alcohols, biodiesel and other Biomass fuels. The alternative fuel of diesel, composed of alkyl monoesters of fatty acids come from animal fats and plant oil. So a large number of studies about the application of biodiesel in diesel engine because of its renewability, non-toxic and sulfur-free property. Moreever of its analogous properties to diesel, direct-injection compression-ignition (DICI) engine fueled with biodiesel as well as its blends without modifying the engine structure. The analysis of combustion and performance to biodiesel and its blends of 70%, 20% as well as 5% with basic diesel were quite analogous to that of pure diesel in a DICI engine, while emission characteristics of biodiesel were better compared with traditional diesel. The difference with conventional diesel, the fuel-borne oxygen within biodiesel would facilitate the process of combustion, leading to a more complete combustion. However , the particular matter (PM), hydrocarbon (HC) as well as carbon monoxide (CO) reduced while the nitrogen oxides (NOx) increased in a diesel engine. Biodiesel applied in DICI engine produced less CO as well as HC and more NOx emissions compared with diesel. it is considerable NOx emissions produced from the blends added into biodiesel can be regarded as an issue using biodiesel on a diesel engine. As a kind of clean and efficient alternative fuel, alcohols have already been investigated comprehensively. Among the alcohols, ethanol has been studied widely due to its outstanding properties. Ethanol is commonly used in engines, however its water solubility, poor energy density, and high latent vaporisation heat have limited its use. As a result, high octane, high oxygen, and repeatability are required. Armas O, investigated are emissions characteristics of diesel-ethanol blends on a compression ignition (CI) engine. The mention the results are PM emissions significantly reduced while the rest gaseous emissions (CO, HC, NOx) had no substantial increase after fueled diesel-bioethanol blends. Ahmed I, verified the combustion, performance and

emissions characteristics on 15% diesel-ethanol and 10% diesel-ethanol on a DICI engine. They are compared to conventional diesel, NOx emissions slightly increased for the two blends, while PM emissions respectively reduced 41% and 27% for 15% and 10% diesel-ethanol. Some problems with the application of diesel-ethanol blends, such as worse lubricity, uneven mixing. Biodiesel can be a suitable additive in improving diesel-ethanol blends. Abhishek et al. He conducted An investigation on the properties of combustion and emissions was carried out in an experimental setting of diesel-biodiesel-ethanol on a CI engine. According to the findings, the D35B50E15 mix with 15% ethanol had improved engine performance characteristics, with a 21.17 percent increase in brake thermal efficiency at full load and considerably lower gaseous emissions.

2,5-dimethylfuran (DMF) and 2-methylfuran (MF) could be a feasible furan-based fuel replacement for CI engines if production technology improves. In recent years, there has been a lot of research into DMF's combustion and emission properties. Zheng et al. and Zhang et al. discovered that adding DMF to a CI engine reduced soot emissions considerably. On diesel engines without EGR, Hu et al. investigated the combustion performance and emissions characteristics of diesel, 20 percent diesel/n-pentanol, and 20 percent diesel/DMF fuels.They discovered that 20% DMF/diesel mixes produced reduced soot and THC emissions but increased NOx emissions than diesel.Under dual fuel RCCI mode on a CI engine, Zheng et al. investigated engine characteristics of biodiesel/ethanol, biodiesel/DMF, and biodiesel/n-butanol. They came to the conclusion that adding DMF to biodiesel increased ignition delay while reducing combustion length. Furthermore, when compared to straight biodiesel, soot emissions decreased dramatically, although THC and NOx emissions increased for the biodiesel/DMF blend. However, there are few studies on the usage of MF in the literature. Researchers discovered and developed a method for efficiently converting fructose to MF. Furthermore, because fructose is abundant and reproductive, MF may be a good fuel output by the technique. Ethanol is less appealing than MF, which has excellent physicochemical qualities. Feng et al. looked into it. Low fraction MF addition into gasoline performed better than gasoline-MF blends in terms of combustion performance and emissions characteristics on a spark ignition (SI) engine, revealing that low fraction MF addition into gasoline behaved better than gasoline-MF blends. Daniel et al. looked studied the performance of a DISI engine running on ethanol, DMF, MF, and gasoline. They discovered that MF burned more efficiently than DMF or gasoline, however there was still a problem with increased NOx emissions from MF. The effects of biodiesel, biodiesel-MF, and biodiesel-ethanol on combustion parameters, HC, and NOx at varied injection timings and EGR ratios on a diesel engine under low engine load were investigated in this study. Uncontrolled emissions could pose a serious hazard to human health and, by extension, other living things. As a result, unregulated pollutants such as 1,3-butadiene and acetaldehyde were explored. Based on the results of the study, appropriate injection time and EGR ratios might be used to enhance the combustion and emission process for biodiesel/MF mixes.

2. EXPERIMENT

2.1. INSTRUMENTATION AND LAYOUT OF THE ENGINE

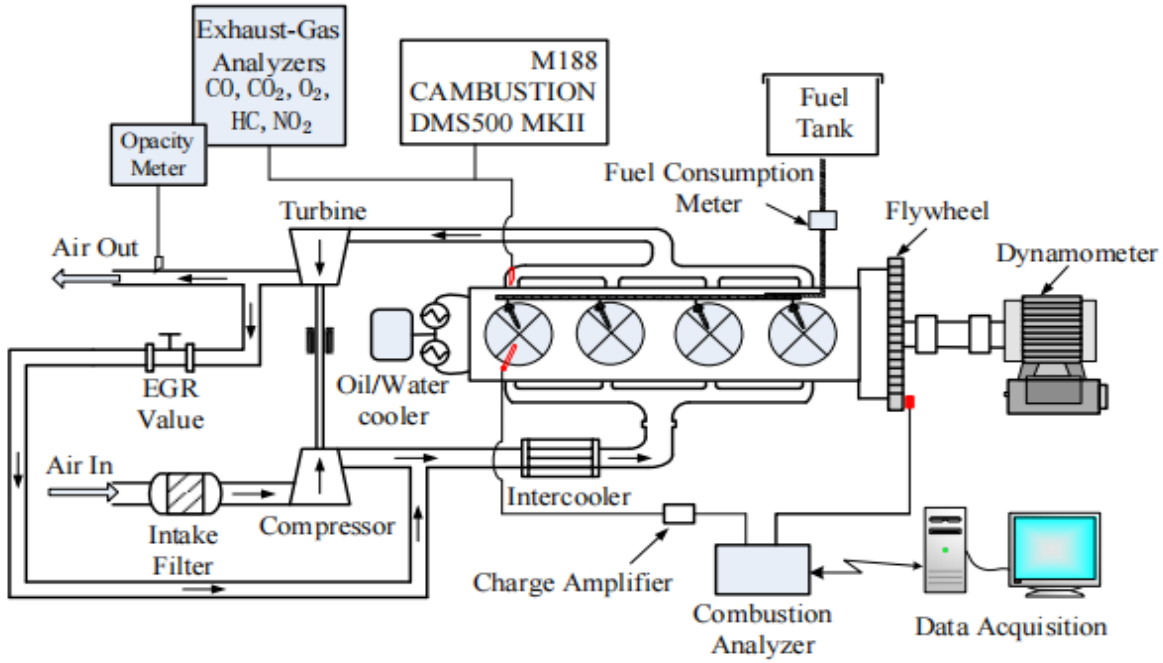


Fig.1.Illustration of engine layout and instrument

The tests were conducted on a customized DICI engine with a common rail fuel injection system and a water-cooled, 4-cylinder, 4-stroke engine, as illustrated in Fig.1. The engine's major specs are listed in Table 1. To govern engine torque output, an eddy current (EC) dynamometer was employed to keep the engine speed at 1800 rpm (five rpm) (the engine worked flawlessly at 1800 rpm). Controlling and monitoring engine operating parameters such as injection fuel quantity and injection timing with an Electrical Control Unit (ECU). Furthermore, a high-pressure cooled EGR system was used, and the EGR ratio was controlled using a combination of air-throttle and EGR valve control, with the EGR ratio defined as the proportion of CO2 concentration in intake air to CO_2 concentration in exhaust gas.A In-cylinder pressure measurements are collected using a Kistler 6025C pressure transducer installed in the cylinder head. These indications were first routed to a charge amplifier, and then to a CB-466 combustion analyzer. To produce average data readings and an in-cylinder pressure curve, a hundred continuous cycles of specimens were measured with a 0.25 CAD increment. Furthermore, the first thermodynamic law was used to compute the heat release rate (HRR).An air conditioning system and an extra compressor were used to modify the temperature (25°C) and intake air pressure (0.1MPa). Measuring gaseous emissions with an AVL gas analyzer, with HC and NOx accuracy of 1 ppm and 0.1 percent, respectively.A gas chromatograph (GC) that was accurate to 0.1 ppm was used to measure a variety of uncontrolled pollutants. Table 2 also shows the relative uncertainty for the primary measure.

Table 1 Engine Specification

Sl.No.	Type of engine	4-cylinder, 4-stroke, water-cooled
1	Type of ignition	Compression ignition
2	Method of starting	Electric start
3	Bore	96 mm
4	Initial injection	7.5 CAD BTDC
5	Stroke	103 mm
6	Displacement	2982 cc
7	Compression ratio	17.5
8	Rated power	85 kW

Table 2 Uncertainties of the acquired quantities

Sl.No.	Measurement	Uncertainty(%)
1	Air flow meter	±0.5
2	In-cylinder pressure	±1.0
3	Torque	±1.0
4	Fuel flow meter	±1.0
5	BTE	±1.72
6	BSFC	±1.93
7	EGR	±0.5

2.2 Experiment fuels and methods

The fuels employed in this experiment were biodiesel and biodiesel/MF, both of which have relative qualities listed in Table 3.MF was blended with biodiesel in fractions of 10% and 20% (by mass), which were labelled as BM10 and BM20, respectively. In the meantime, pure biodiesel was employed as a control. This testing was performed with the engine at 30% load, which equates to a BMEP of 0.38 MPa. The temperature value in each cycle should be steady to appropriately examine the impact of fuel quality on combustion performance and emissions.

Because the heating values of the various test fuels are so low, this experiment required adjusting the injected fuel mass to maintain the same energy input. In addition, several EGR ratios and injection timings were used in the experiment.To begin, close the EGR valve and modify the start of injection (SOI) time from 2.5 to 22.5 oCA before top head centre (BTDC) with a 5 oCA increment. Second, the SOI was kept constant at 7.5 oCA BTDC, while the EGR ratio was kept constant at 0%, 6%, 17%, 23%, and 30%, respectively. To provide valid and reproducible test data, the engine was first brought to a stable state under each operating condition. Meanwhile, the temperature of the cooling water and the lubricating oil were kept at 86°C and 85°C, respectively.

Furthermore, after switching to a different fuel, the engine had to run for about 15 minutes before data was collected to ensure that the newly added gasoline was not contaminated by the remnants of the previous operating condition.

Table 3 Properties of diesel, biodiesel, bioethanol, MF and gasoline

Sl.No.	Property	Ethanol	MF	DMF	Diesel	Biodiesel	Gasoline
1	Motor Octane number	90	86	88	-	-	85.7
2	Research Octane	109	103	101	20-30	-	96.8
3	Octane number	108	-	119	-	-	90-
4	Cetane Number	8	9	9	45	51	10-15
5	Density at 20 oC (kg/cm3)	790.9	913.2	889.7	826	871	744.6
6	Oxygen content(% mass)	34.78	19.51	16.67	0	10.78	0
7	Lower heating value (MJ/kg)	26.9	31.2	33.7	42.5	37.5	42.9
8	Stoichiometric air/fuel ratio	8.95	10.05	10.79	14.3	12.54	14.7
9	Initial boiling point (oC)	78.4	64.7	92	180 -370	-	32.8
10	Viscosity at 40 oC (mm2 /s)	1.2	-	-	2.86	4.38	-
11	Evaporation heat at 25 oC (kJ/kg)	919.6	358	332	270-301	300	373
12	Sulfur content(%)	-	0	0	0.2	<0.005	-
13	Water solubility at 20 oC (wt%)	Miscible	N	N	N	N	N

Note: N-Negligible

3. RESULT AND DISCUSSION

3.1 COMBUSTION PERFORMANCE

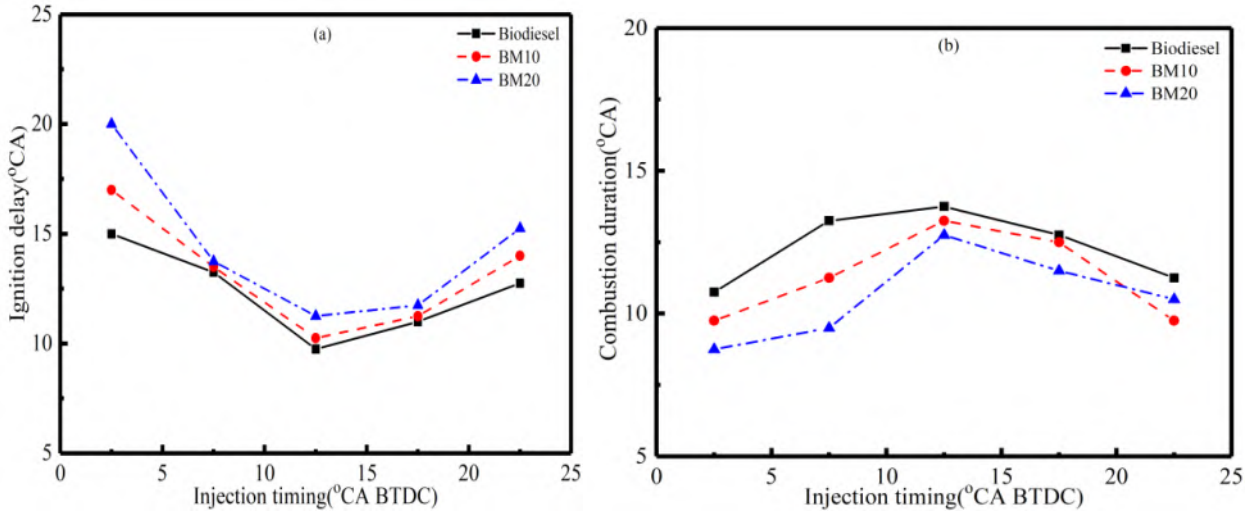


Figure 2: Combustion duration and ignition delay as a function of injection timing.

Figure 2 depicts the differences in ignition delay, which was described as the crank angle from SOI to 10% of total heat release, Fig.2 (a).With SOI in advance, the ignition delay decreased from 2.5 to 22.5 ^{o}CA BTDC, then increased. When injecting at 2.5 ^{o}CA BTDC, most test fuels atomized after TDC in the expansion stroke, resulting in a protracted ignition delay because both in-cylinder pressure and temperature were low.With advanced injection timing, the period for fuel atomization increased, making it easier to achieve the state of auto-ignition and reducing ignition delay. When injection time was increased to 22.5 oCA BTDC, both in-cylinder pressure and temperature increased. Fuel atomization was decreased, resulting in a longer ignition delay. Moreover, the ignition delay of biodiesel-MF blends grew longer as the MF proportion rose, potentially due to high latent heat of evaporation and auto-ignition temperature.

The variations in combustion time, which was defined as crank angle from 10% to 90% of total heat release, were shown in Fig.2 (b).When injection timing was known ahead of time, combustion duration followed the opposite pattern as ignition delay. The ignition delay was increased to increase the premixed combustion ratio while decreasing the diffusion combustion ratio and shortening the combustion time.As is well known, oxygen in fuels can speed up the chemical reaction process and hence increase the rate of burning. Because of the greater oxygen concentration, the combustion time of BM10 and BM20 was shorter than that of biodiesel. Furthermore, BM20 has a shorter combustion time than BM10.On the one hand, a higher oxygen level aided the combustion process for the length of the fire. The greater ignition delay of BM20, on the other hand, created more premixed gas, resulting in higher combustion temperature and pressure, which might boost combustion and minimise combustion time.

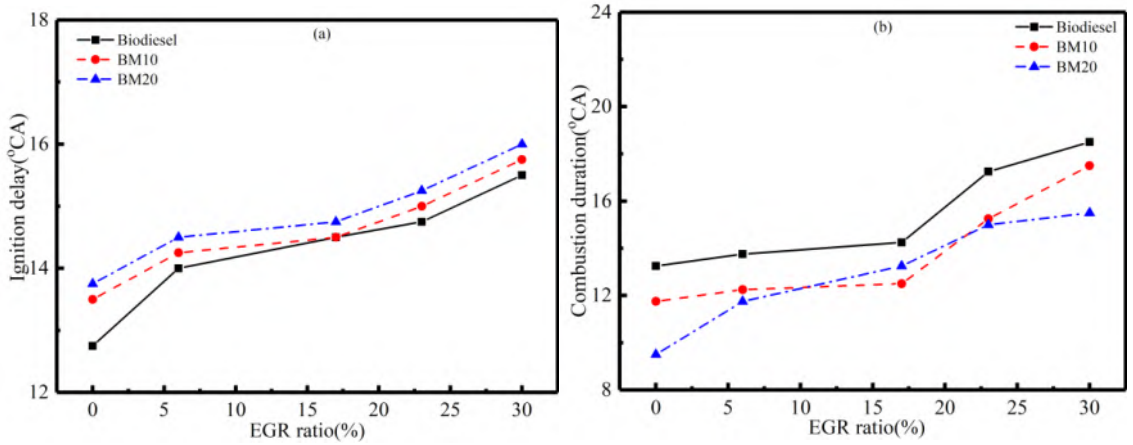
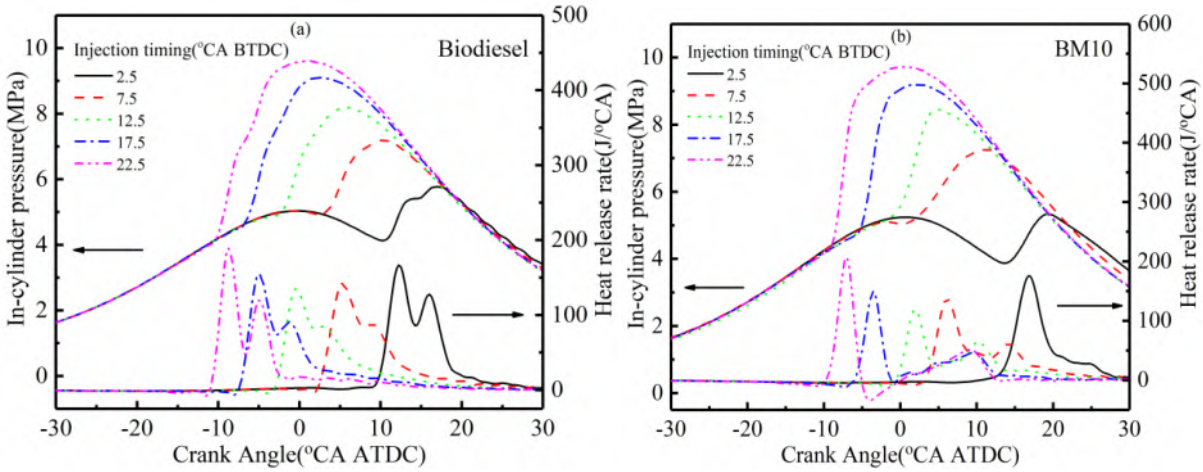


Figure 3: Effects of the EGR ratio on ignition delay and combustion time

Figure 3(a) shows the ignition delay as a result of EGR ratio. As the EGR ratio was increased, the ignition delay of the full test fuels increased. This pattern could be explained by reason.

The oxygen concentration in the cylinder decreased as the EGR ratio grew, making auto-ignition more difficult to obtain and ultimately in a prolonged ignition delay. Because the low cetane number of MF addition into plain biodiesel enhanced the auto-ignition temperature of the blends, both BM10 and BM20 experienced longer ignition delays than biodiesel at all EGR ratios.

Figure 3 depicts the differences in combustion time for various EGR ratios (b). As the EGR ratio increased, the combustion duration of all the test fuels increased. This tendency could be described in the following ways. On the one hand, as the EGR ratio rose, the premixed combustion ratio rose as well, but the diffusion combustion proportion fell, resulting in a shorter combustion duration. The oxygen content in the cylinder, on the other hand, decreased, resulting in a slower combustion rate. Furthermore, the inert gas from EGR sped up and slowed down the chemical reaction rate, extending the length of combustion.



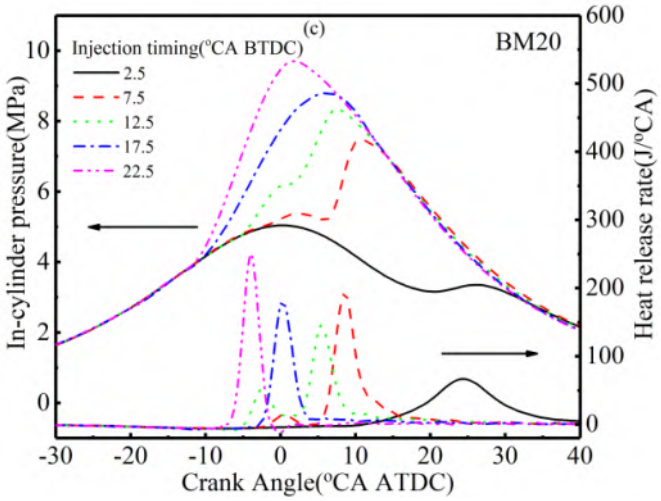


Figure 4 displays the in-cylinder pressure, HRR, and EGR ratios for three fuels at various injection timings. Peak in-cylinder pressure increased as injection timing was advanced from 2.5 to 22.5 oCA BTDC, as seen in fig.4. To create the injected fuel, the injection timing could be set ahead of time. Figure 4. Effects of injection timing on in-cylinder pressure and HRR of Biodiesel/BM10/BM20.As a result, when the condition of auto-ignition was attained, there were more premixed gases in the cylinder, resulting in an increase in the peak value of in-cylinder pressure due to a significant mixture burning together in the cylinder. When the injection timing was 2.5 ^{o}CA BTDC, the majority of the fuels burnt after TDC in the expansion stroke, resulting in a reduced proportion of constant volume combustion and a lower peak value of in-cylinder pressure. Liu et al. came to a similar finding in their experiment. With injection timing in advance, the maximum HRR first fell and subsequently increased. The advance of injection timing could result in more mixture burning in the premixed phase, resulting in a higher maximum HRR.Because most fuels burnt during the expansion stroke, in-cylinder combustion temperature was slightly lower when injection timing was set at 2.5 ^{o}CA BTDC. However, because of the very lengthy ignition delay, a large number of premixed gases burned together and produced a large amount of heat quickly. As a result, the maximum HRR was somewhat elevated in this situation. The peak value of in-cylinder pressure gradually reduced as the EGR ratio increased. At the same time, the peak in-cylinder pressure corresponding to the crank angle gradually drifted away from TDC (as shown in fig.5). The following things could explain the pattern. The oxygen concentration in the cylinder fell as the EGR ratio increased, leads to a longer ignition delay and a lower combustion rate. In the meantime, the EGR's inert gas became stronger, delaying the chemical reaction rate and decreasing the peak in-cylinder pressure. Secondly, the exhaust gases improved the specific heat capacity of the intake gas, diminishing the in-cylinder pressure peak value. In terms of maximum HRR, as the EGR ratio increased, the ignition delay was slightly extended and more premixed gases burnt, resulting in a progressive increase in maximum HRR. However, when the EGR ratio increased, the combustion rate decreased dramatically, resulting in a fall in the maximum HRR.

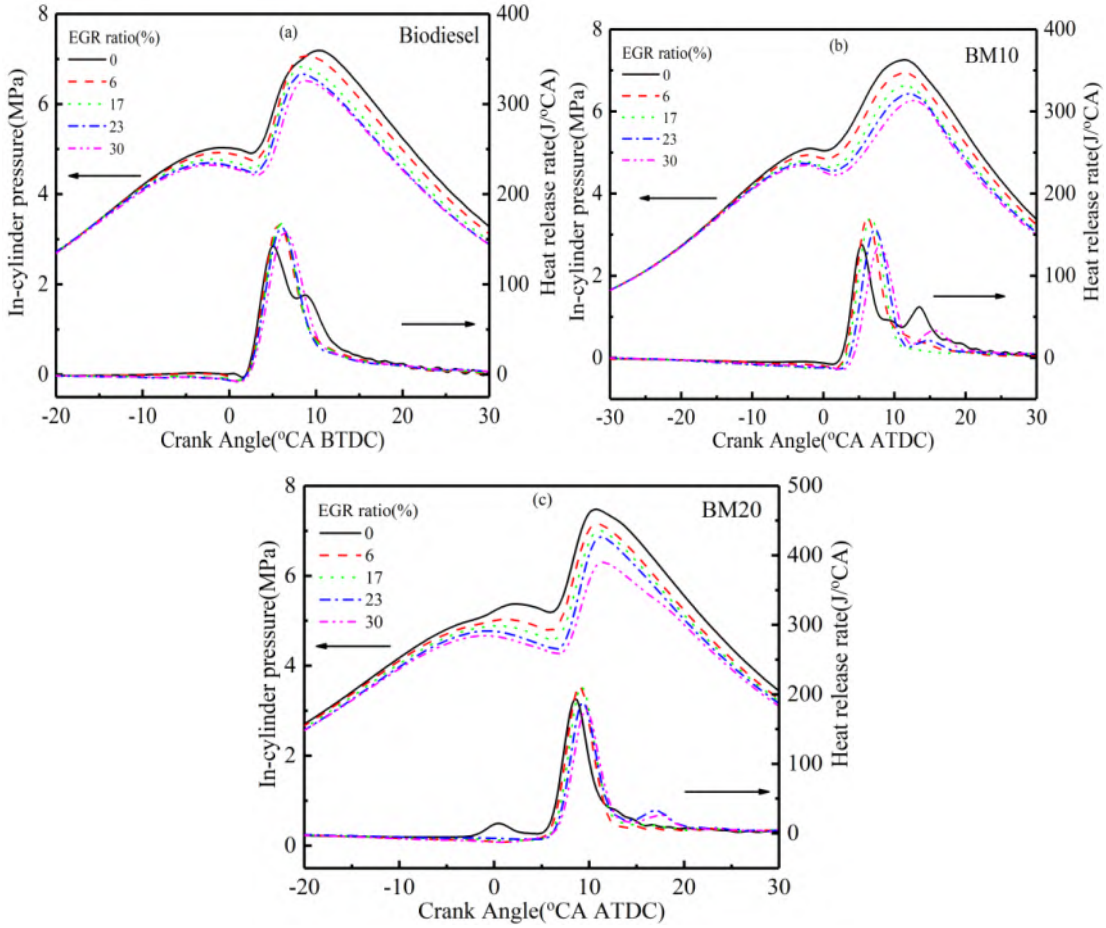


Fig. 5 Effects of EGR ratio on in-cylinder pressure and HRR of Biodiesel/BM10/BM20

3.2 Brake Specific Fuel Consumption (BSFC) and Brake Thermal Efficiency (BTE)

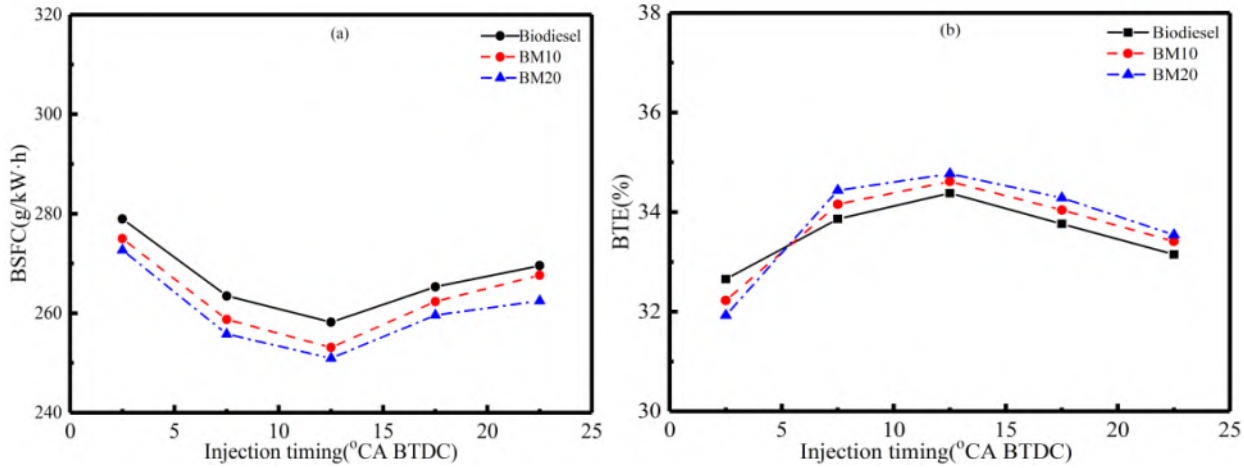


Fig. 6 Effects of injection timing on BSFC and BTE

For the entire test fuels, Fig. 6 depicted the impacts of injection timing on BSFC and BTE. The BSFC of the total fuels declined first, then climbed as injection timing was advanced, whereas the BTE trended in the other direction. When injecting at 2.5 °CA BTDC, most of the fuels burnt away from TDC, causing burning to deteriorate, increasing BSFC while lowering BTE. The combustion process was gradually enhanced by planning injection timing ahead of time. When injection timing was set at 22.5 °CA BTDC, most fuels burnt before TDC, resulting in higher compression negative work and a rise in BSFC and a decrease in BTE. Furthermore, the BSFC of biodiesel-MF blends was lower than that of biodiesel. The addition of MF to biodiesel increased the atomization impact of blends while increasing oxygen

concentration in fuels, potentially enhancing combustion and lowering fuel usage. Mean while, when the MF proportion increased, so did biodiesel-MF blends.

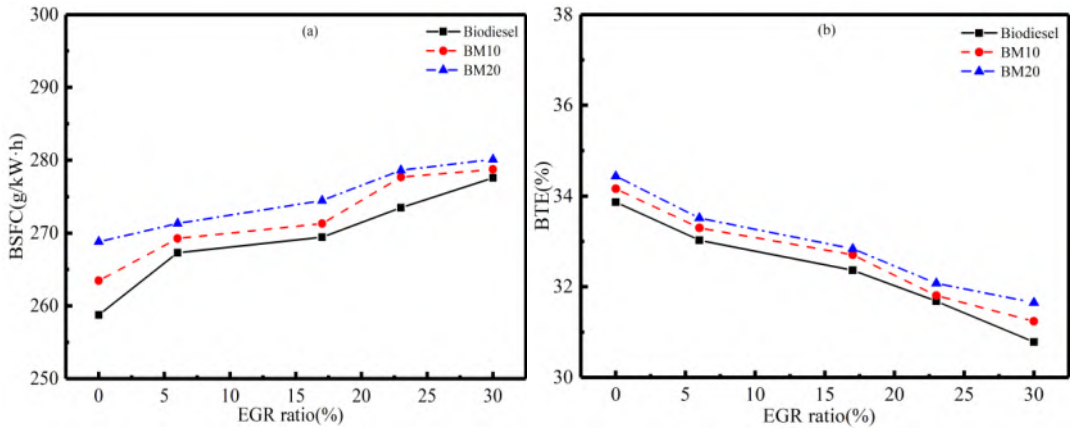


Fig. 7 Effects of EGR ratio on BSFC and BTE

Figure 7 displayed the impacts of EGR ratio on BSFC and BTE for all test fuels. For all four fuels, BSFC increased as the EGR ratio increased, although BTE decreased. The trend could be explained by reason. The oxygen concentration in the cylinder decreased as the EGR ratio grew, delaying the combustion process. BM10 and BM20 have a higher oxygen concentration than biodiesel, allowing for a more complete burning of the fuels, lowering the BSFC while raising the BTE.

3.3 Regulated and unregulated emissions characteristics

Figure 9 shows **N**OX emissions at various injection timings (a).All test fuels showed an increasing tendency for NOX emissions when injection timing was increased. Fernando et al. discovered that high in-cylinder temperature, oxygen concentration, and sufficient reaction time were all important factors in the generation of NOx emissions. The advancement of injection timing was able to raise the temperature inside the cylinder. Meanwhile, earlier fuel injection allowed for a longer reaction time in the cylinder, which aided in the increase in NOx production.

Furthermore, high oxygen content in fuels may encourage NOx formation. As a result, as the MF fraction rises, NOX emissions grow as well.

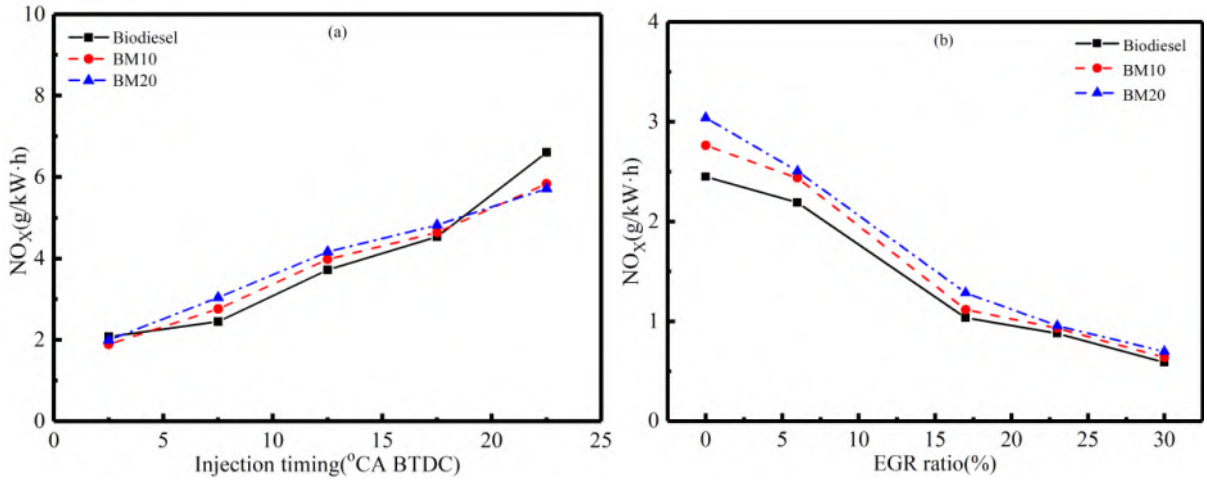


Fig. 8 Effects of injection timing and EGR ratio on NOX emissions

While the EGR's inert gas increased and absorbed more heat in the cylinder, the in-cylinder combustion rate reduced, resulting in a drop in in-cylinder temperature. Furthermore, the dilution of exhaust gas increased as the EGR ratio increased. For various injection

timings and EGR ratios, the result was a decrease in in-cylinder CO emissions, as shown in Fig. 9. When injection timing was advanced, CO emissions gradually decreased. Combustion deterioration is observed in BM20, particularly at 2.5 oCA BTDC, resulting in higher CO emissions. While CO emissions rose in tandem with EGR ratios. Because increased fuel-oxygen might promote CO oxidation, BM10 and BM20 produced lower CO emissions than biodiesel. oxygen concentration, obliterating the conditions for NOx generation. Furthermore, due to higher oxygen concentration, both BM10 and BM20 released more NOx emissions than biodiesel.

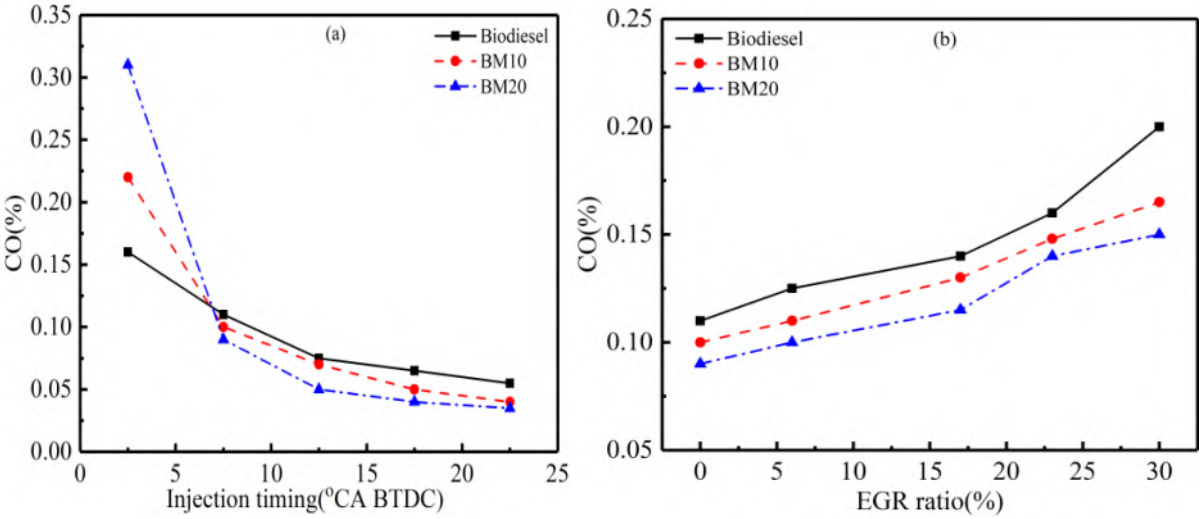


Fig. 9 Effects of injection timing and EGR ratio on CO emissions

HC emissions were shown in Fig. 10(a) for varied injection times. For all test fuels, HC emissions decreased first, then increased as injection timing advanced. Except with 2.5 °CA BTDC, HC emissions decreased as the MF proportion increased. The following seasons may help to explain it: Because biodiesel has a greater penetration distance than other fuels due to its higher kinematic viscosity, the injected biodiesel was sprayed into the squeezing zone. As a result, a wall oil film formed easily on the cylinder wall or the top surface of the piston, and a portion of the fuel was not entirely burned, resulting in an increase in oxidised HC. Second, high oxygen content in the blends may promote HC oxidation, resulting in lower HC emissions from BM10 and BM20.

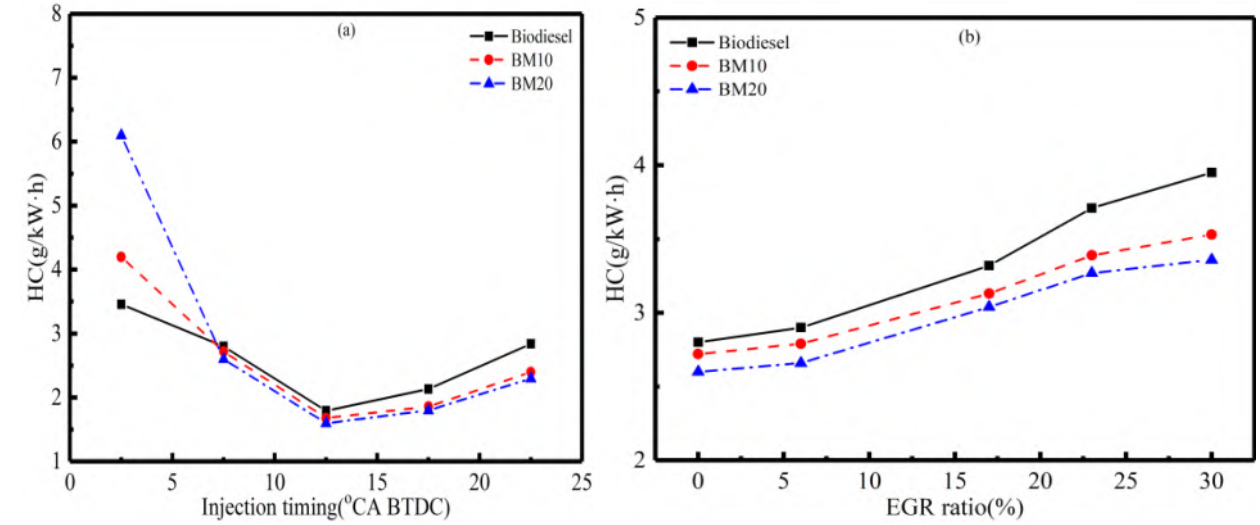


Fig. 10 Effects of injection timing and EGR ratio on HC emissions

Figure 10 (b) depicted HC emissions at various EGR levels.HC emissions gradually increased as the EGR ratio increased.The following factors could account for this.The ignition

delay of fuels was greatly lengthened as the EGR ratio increased, and the in-cylinder temperature was low, resulting in a reduction in combustion rate.Due to the expansion of the in-cylinder temperature and pressure before the flame reached the wall, the combustible mixture was quenched in a large volume, resulting in greater HC emissions.

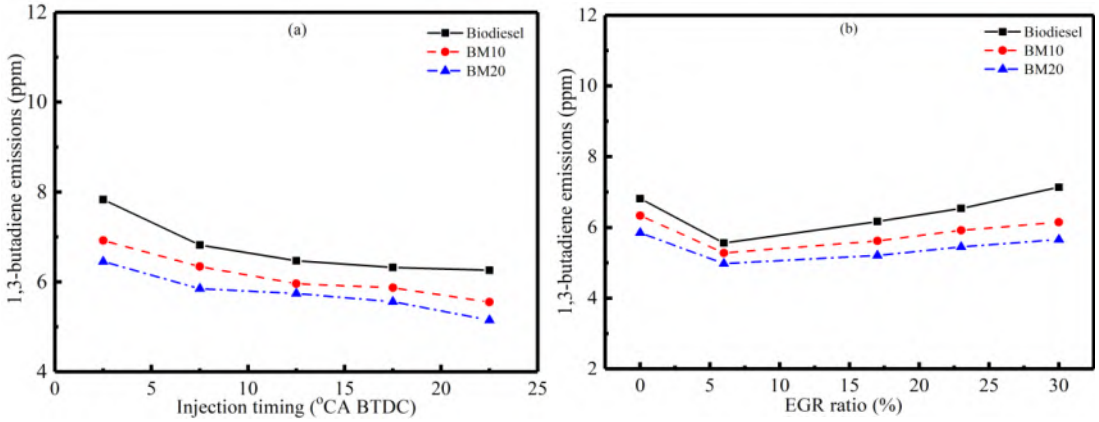


Fig. 11 Effects of injection timing and EGR ratio on 1,3-butadiene emissions

The increase in injection timing was linked to a rise in 1,3-butadiene emissions, as seen in Fig. 11. (a).1,3-butadiene emissions gradually decreased as injection timing was planned ahead of time.It could be ascribed to higher in-cylinder burning temperatures, which enhanced 1,3-butadiene post-oxidation and hence reduced 1,3-butadiene emissions. Zervas et al. investigated the production mechanism of 1,3-butadiene in depth. They discovered that fuels with more linear hydrocarbons were more susceptible to dehydrogenation and -cleavage reactions during burning, which was advantageous for producing more 1,3-butadiene emissions.In the meanwhile, a high-oxygen addition could help improve b. Because biodiesel has a low linear hydrocarbon structure, it emits less 1,3-butadiene.Furthermore, adding MF to biodiesel decreased linear hydrocarbon content while increasing oxygen content in the fuel. As a result, BM10 and BM20 emitted less 1,3-butadiene than biodiesel.

Furthermore, as the EGR ratio was increased, 1,3-butadiene emissions dropped at first, but steadily increased for all test fuels (see Fig. 11(b)).The result of incomplete fuel combustion is 1,3-butadiene.However, as the EGR ratio grew, the volume of exhaust gas delivered into the cylinder every cycle increased, and the dilution effect of exhaust gas caused oxygen concentration in the cylinder to drop, inhibiting complete fuel combustion and therefore increasing 1,3-butadiene emissions.

Figure 12(a) depicts acetaldehyde emissions at different injection times. Acetaldehyde emissions demonstrated a similar tendency to 1,3-butadiene emissions when injection timing was known ahead of time. Biodiesel produced a significant amount of acetaldehyde emissions. For starters, biodiesel comprised a high number of chemicals with short carbon chains and linear structures that burned easily into aldehyde fumes. Second, biodiesel was primarily produced by frying and refining waste animal and vegetable oils. As the EGR ratio increased, the ignition delay grew longer, and the fuel mixture generated during the deflagration period became more homogenous, promoting complete combustion and lowering 1,3-butadiene emissions. Many aldehyde fumes were created during the frying process, and these aldehyde gases were still present in the biodiesel. Furthermore, biodiesel's main component is fatty acid methyl ester, which contains a carbonyl group that is a major cause of acetaldehyde formation. Furthermore, adding oxygenated gasoline to biodiesel reduced the amount of biodiesel in the blends, lowering acetaldehyde emissions significantly. Meanwhile, the oxygen atoms in the fuel contributed to the complete oxidation of

acetaldehyde, lowering acetaldehyde emissions even more. Acetaldehyde emissions followed a similar pattern to 1,3-butadiene emissions as the EGR ratio increased (see Fig. 12(b)).It could be explained by EGR's effects, which are similar to those of 1,3-butadiene emissions.

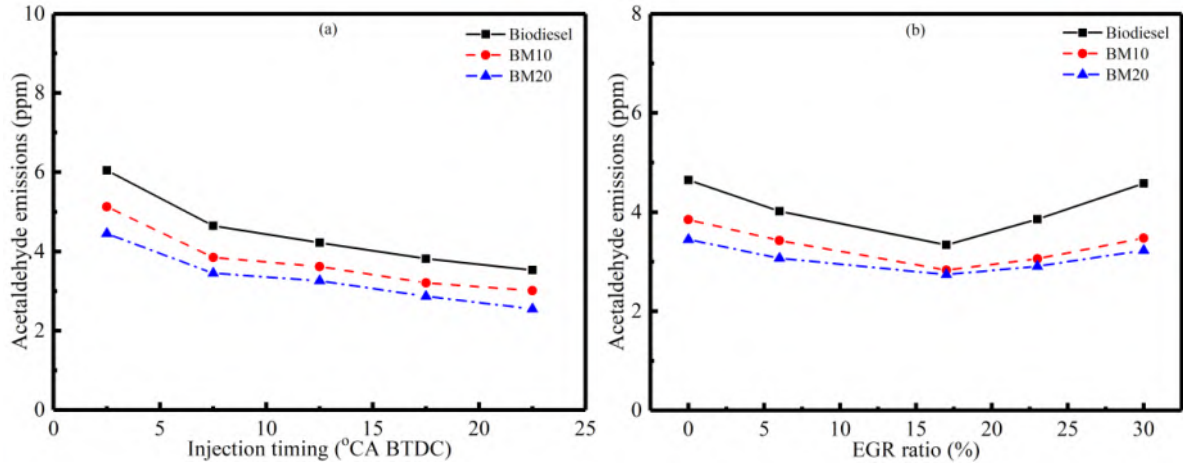


Fig. 12 Effects of injection timing and EGR ratio on acetaldehyde emissions

4. Conclusions

The effects of injection time and EGR on combustion performance and emissions characteristics for four fuels in a diesel engine under 0.38 MPa BMEP and constant engine speed of 1800 rpm were investigated.

1.When the injection time was altered to 2.5 oCA BTDC, both BM10 and BM20 showed a decrease in combustion.

2. The addition of MF to biodiesel improves combustion.BM10 and BM20 have lower BSFC and higher BTE than biodiesel. Meanwhile, BM20 has a greater BTE than BM10.

3. When injection timing was planned ahead of time, HC emissions reduced dramatically at first, then increased somewhat. NOx emissions increased with time, while 1,3-butadiene and acetaldehyde emissions decreased. When the injection timing was set to 7.5 or 12.5 oCA BTDC, the emissions were significantly reduced.

4. EGR effectively lowered NOx emissions while also reducing HC, 1,3-butadiene, and acetaldehyde emissions.

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A CASE REPORT OF FIBROUS DYSPLASIA OF THE FACIAL BONES – A RARE PRESENTATION

Dr. Sakthivel. V. S [1]*, Prof. Dr. Giri. G. V. V[2], Dr.Raj Prabhu[3], Dr.Gokulakrishnan. C[4], Dr.Manishaa. V[5], Dr.Mukesh. S[6], Dr.Sumithra. K[7]

[1]MDS (Oral and Maxillofacial Surgery), MFDS RCPS (Glasg), Velss Dental Care, Chennai, India
[2]Faculty of Dental Sciences, MDS (Oral and Maxillofacial Surgery), Sri Ramachandra Institute of Higher Education and Research, Porur, Chennai, India
[3,4]MDS (Oral and Maxillofacial Surgery), Velss Dental Care, Chennai, India
[5,6,7]Resident dentist, BDS, Institution: Velss Dental Care, Chennai, India

ABSTRACT

Fibrous dysplasia (FD) belongs to the group of benign fibro-osseous lesions (BFOL) of the jaw, facial and skull bones. FD is defined as the replacement of the bone with excessive proliferation of cellular fibrous connective tissue that are weak, expansive and sustain pathological fractures. It is classified according to the number of bones affected and its association with endocrine alterations into - monostotic (80-85%), polyostotic (20-30%) and McCune Albright's disease. Here, we report a rare case of FD involving facial bones in a 12- year-old female patient. The clinical diagnostic approach, different imaging modalities, and histological examination methods for definite diagnosis and treatment protocols have been elaborated.

Keywords: *Fibro-osseous lesion, Fibrous dysplasia, monostotic, polyostotic*

Introduction

In 1938, Lichtenstein first coined the term 'Fibrous Dysplasia'. FD is an uncommon, nonhereditary, skeletal developmental anomaly where normal bone is replaced by an excessive proliferation of cellular fibrous connective tissue intermixed with irregular bony trabeculae[1]. FD is a sporadic condition that occurs due to postzygotic mutation in GNAS1 gene. FD comprises 2-5% of all bone tumours and 7% of benign tumours. Monostotic FD is the most common form that is unilateral in nature and is most commonly observed in females. The bones commonly involved are maxilla(12%) and mandible(12%), while involvement of the ethmoid, sphenoid, frontal and temporal bones are infrequent[2]. The polyostotic variant is a rare form of FD that usually affects the facial bones, ribs, femur, pelvis, clavicle and cervical spine. Generally, the affected bones show expansion, thickening and sclerosis.

Case Report

A 12-year-old female patient reported to Velss Dental Care, Annanagar, Chennai, India with a chief complaint of pain in her right upper back tooth region for past one week. Patient gave us a history of pain which was continuous, mild, dull in nature, gradual in onset and progressive. The patient also had a history of a slow growing painless swelling in the right side of her face for past 5 years, which was smaller in size initially, but gradually increased and reached the current size. The medical, dental, family and personal histories of the patient were non-contributory {Figure 1}.

Figure 1: Clinical appearance of the patient

On general examination, patient was conscious, cooperative, well oriented, moderately nourished and built and showed no signs of pallor, icterus, cyanosis, clubbing, anaemia and lymphadenopathy. All vital signs were within normal limits. On extra oral examination, the patient presented with facial asymmetry due to a solitary, well-defined, hard swelling on the right side of the face and showed no signs of impaired vision and auditory functions. No pigmentations were observed on the skin or extraoral surfaces.

Movement of temporomandibular joints were within normal limits with non-tender muscles of mastication and no enlarged lymphnodes. The swelling involved maxilla, zygoma, frontal, ethmoidal and temporal bones on the right side. There wereprominences in zygomatic bone with flattening of cheek resulting in a shallow nasolabial fold. The swelling extended superiorly till temporal lobe and medially coincided with facial midline. No sign of inflammation wasobserved on the swelling and deviation of upper and lower lips was present {Figure 2}. On intraoral examination, there was enlargement of right side of the alveolar bone with expansion of alveolar buccal plate extending from the maxillary right first premolar to the maxillary tuberosity, which was hard in consistency, non-compressible, non-tender and palatally extended from the alveolar region of the teeth associated to the midpalatine area. The mucosa overlying the swelling was stretched. Teeth present in relation to the area of swelling were vital and malpositioned{Figure 3}. There was no swelling present elsewhere in the body and café-au-lait spots were absent

Figure 2:Facial photography showing asymmetry over right side of the face

Figure 3:Intraoral photography showing enlargement of right side of the palate and expanded alveolar ridge

After analysing the patient's data, we arrived at a provisional diagnosis of Fibrous Dysplasia with a differential diagnosis of Paget's disease, ossifying fibroma and cemento osseous dysplasia.

Furthermore, the patient was advised for investigations such as complete hemogram, serological investigations such as serum calcium and phosphorous, alkaline phosphatase level, orthopantomogram(OPG), Computed Tomography (CT) scan and incisional biopsy. All parameters were within normal limits. A testconducted to assess the Parathormone level of the patient, showed high levels of the hormone, indicating Hyperparathyroidism.

The CT scan showed a radio dense mass with ground-glass appearance involving right zygomatic region, right pterygoid plates, and wall of right nasal cavity, right frontal, parietal, temporal bone and maxillary region and its expansion causing facial asymmetry. Cortical bone was thinned. Thickening of frontal region with loss of anterior wall of frontal sinus and ossification of maxilla and its antrum was observed. Narrowing of the right supraorbital fissure wasobserved due to enlarged temporal and sphenoid bone {Figure 4}.

Figure 4:Computed tomography shows increased dimensions of zygoma and obliteration of right maxillary sinus with ground glass opacities

An incisional biopsy was done for histopathological analysis. Macroscopy revealed three pieces of bony hard-tissue, greyish white in colour measuring 1cm*0.5cm*0.5cm approximately, along with first molar tooth {Figure 5}. Microscopic examination showed irregular bony trabeculae in Chinese script pattern within fibrous stroma {Figure 6}. The bone appeared woven rather than lamellar.

Figure 5: Incisional biopsy specimen showing 3 bits of hard tissue with first molar

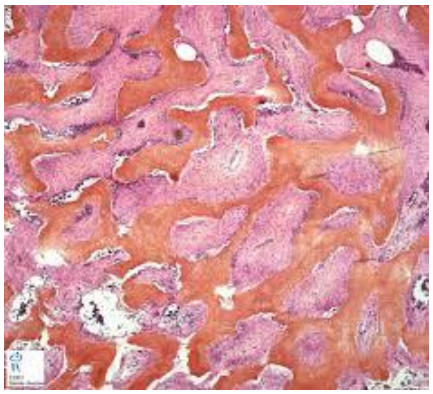

Figure 6:Decalcified section showing C shaped bony trabeculae with Chinese script pattern

In addition to the aboveinvestigations, a 99m Tc-MDP whole body Skeletal Scintigraphy and SPECT/CT was carried out to evaluate the extent of the lesion. The features suggested lesion involving right frontal, temporal bone, right orbit, right ethmoidal sinuses, right maxilla and right hemimandible, right second rib, T12-L5 vertebrae and sacrum {Figure 6}

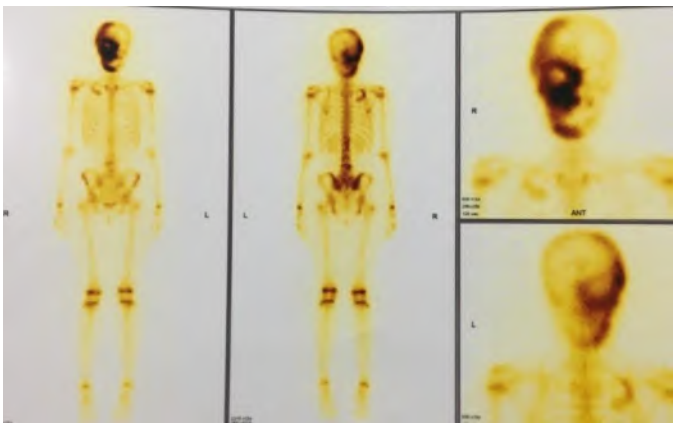

Figure 7:A 99m Tc-MDP whole body Skeletal Scintigraphy and SPECT/CT indicates involvement of the lesion at multiple sites

Based on the clinical history, radiographic assessment and histological features of the lesion, a diagnosis of **Polyostotic Fibrous dysplasia with Hyperparathyroidism** was deduced. Surgical recontouring was restricted only to maxilla. Contour correction of the alveolar bone was performed using vulcanite burs and soft tissue reduction was also performed under General Anesthesia (GA) {Figure 8}. There was recurrence of the growth within a month, which was confirmed by a CT scan that revealed the involvement of the floor of the orbit. Hence,a second phase of surgery was planned and hemimaxillectomy was performed on the right side under GA. Subsequently, post-operatively we also obtained opinion from an endocrinologist, upon whose advice, the patient was asked to take oral supplementation of Vitamin D and Calcium.

Figure 8:Surgical recontouring of maxilla under GA

Discussion

Fibrous Dysplasia (FD) is a benign disease of bone that has been classified as follows:

1. Monostotic FD
2. Polyostotic FD
3. Craniofacial form (CFD)
4. McCune Albright syndrome

Patient with FD usually exhibit bone deformity and facial asymmetry. Diagnosis of FD is challenging in 36.3% cases, as no characteristic symptoms are evident and 63.3% of patients complain of non-specific symptoms such as swelling and pain[3].

Monostotic FD affects the maxilla more commonly than the mandible. The less common polyostotic FD commonly affects the craniofacial region in more than 80% of the cases. The clinical manifestations and symptoms differ based on the type of FD and region involved. Involvement of sphenoid, nasoethmoid, frontal and maxillary bones may end in nasal obstruction, sinus obliteration mainly frontal sinus and subsequent sinusitis. Other common features related to CFD are dystopia, dysesthesias within the distribution of the trigeminal nerve, epiphora and also headaches. The McCune Albright variant is a classical triad of PolyostoticFD, café au lait pigmentation and endocrine abnormalities[4]. Latest researchers suggest that the activated G-protein Wnt/B-catenin signaling pathway is involved in modulation of bone formation. Patients with activating guanine nucleotide-binding protein, alpha stimulating mutations specifically showed activated Wnt/B-catenin signaling[5].

The typical radiographic feature of FD is a radiolucent, hazy or a ground-glass pattern[6]. The patterns are a result of defective mineralization of immature abnormal bone and it's usually different from the radiographic appearance of normal bone. FD can be categorized into three types based on the computerized tomography (CT) findings as ground glass (56%), homogeneous dense (sclerotic) (23%) and radiolucent (cystic) (21%). Bone scintigraphy is typically recommended to rule out the polyostotic variant of FD.

Magnetic resonance imaging (MRI) may also help in assessing nerve involvement and soft-tissue structures adjacent to the lesion. With MRI, FD shows homogenous, moderately low signal intensity on T1-weighted images. On T2-weighted images, the tissue usually exhibits very high signal intensity. After intravenous Gd-diethylenetriaminepentaacetic acid, lesions display moderate to significant central contrast enhancement with some rim enhancement. The degree of contrast enhancement on T1-weighted images depends on amount and degree of bone trabeculae and collagen present. Both CT and MRI are excellent imaging modalities in defining the compressive effect of FD on the orbit, optic canals and adjacent paranasal sinuses. Serum ALP is significantly high in this condition. Elevated Serum ALP is typically a reliable marker for predicting the prognosis of patients with FD.

The differential diagnosis of FD includes simple bone cyst, nonossifying fibroma, osteofibrous dysplasia, adamantinoma, low-grade intramedullary osteosarcoma, and Paget's disease.The current gold standard method for the diagnosis of FD may be a histologically-proven fibro-osseous lesion with poorly defined margins which are confirmed by radiographic investigations.

Aggressive lesions are treated by radicular resection except in pediatric patients with residual large defects, in which case it is often acceptable to resolve symptoms through bone shaving, reserving more aggressive treatments in cases of relapse or after skeletal maturity[7]. Second generation bisphosphonates are currently being considered for the treatment of FD, since FD is known to be caused by an increased rate of bone resorption due to excessive osteoclastic activity[8]. Several researches have shown that bisphosphonates help to improve function, lessen pain and prevent pathological fracture[9].However, the extent of the effect of medical therapy on skeletal changes is unclear. Radiotherapy is contraindicated due to sarcomatous transformation[10, 11]. To conclude, most of the cases of FD are often treated by conservative recontouring. Surgery is indicated only after active growth phase of bones and a follow-up should be done to ascertain for flare-ups.

Conclusion

FD is a benign bone lesion that is caused by fibrous tissue replacing the normal bone. The patient's age, extent of involvement, hindrance to normal function and esthetics and presence of facial asymmetry play an important role in treatment planning. Surgical treatment is undertaken in case of pain, pathological fracture or deformity. It is imperative to have periodic follow-ups done in order to detect any relapse or malignant transformation, if any at the earliest.

In this article, we have presented a case of Polyostotic Fibrous dysplasia, which is known to be the rarest type that has very low occurrence. Thus, it is our attempt to add further knowledge to literature regarding the pathology.

Figure Legends

Figure 1: Clinical appearance of the patient
Figure 2:Facial photography showing asymmetry over right side of the face
Figure 3:Intraoral photography showing enlargement of right side of the palate and expanded alveolar ridge
Figure 4: Computed tomography shows increased dimensions of zygoma and obliteration of right maxillary sinus with ground glass opacities
Figure 5: Incisional biopsy specimen showing 3 bits of hard tissue with first molar
Figure 6:Decalcified section showing C shaped bony trabeculae with Chinese script pattern
Figure 7:A 99m Tc-MDP whole body Skeletal Scintigraphy and SPECT/CT indicates involvement of the lesion at multiple sites
Figure 8:Surgical recontouring of maxilla under GA

Abbreviation

FD – Fibrous dysplasia
CT – Computed Tomography
MRI – Magnetic Resonance Imaging
CFD - Craniofacial form

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A PATIENT-DOCTOR PORTAL FOR MALARIA PARASITE PREDICTION

Gudapati Ramyasri[1], Kurra Upendra Chowdary[2], U Ramakrishna[3] and CH.Jayaram[4]

[1]School of Electronics, VFSTR, India

[2,3,4]School of Electronics, RVR&JC college of Engineering, India

ABSTRACT

Malaria is one of the significant general medical issues in India. Early expectation of a Malaria is the key for control of disease grimness, mortality just as decreasing the danger of transmission of disease in the network and can help policymakers, well-being suppliers, restorative officers, service of well-being and other well-being associations to all the more likely target therapeutic assets to regions of most prominent need. In this work, we have designed doctor-patient information portal with several parameters. Machine learning algorithms like random forest and support vector machine are used to train the data. Information of has been gathered from various resources. Parameters utilized are cold, rigor, fatigue, headache, bitter_tounge and etc. A substantial quantities of tests were gathered from various sources. It is seen that execution of the model created utilizing Random Forest is more precise than Support Vector Machine(SVM). The Random Forest model can foresee the episode 15 - 20 days ahead of time. Anyway precision of forecast can be expanded utilizing additionally preparing information. This model can be scaled-up at nation level.

Keywords: *Malaria, Machine learning, Random fores*

1 Introduction

Ailments brought about by the irresistible small scale living being which is transmitted to individuals by methods for parasitic anthropods are known as vector-borne ailment. In dispersion through the few anthropods, mosquitoes are the most widely recognized creepy crawlies which are in charge of causing a few sicknesses like malaria, dengue, and so on. Among the vector conceived infections, intestinal sickness is an extraordinary reason for dread for human wellbeing. Particularly in the creating nations like African nations and India, a large number of individuals experience the ill effects of this malady consistently. Regardless of numerous investigations on the malaria[6 - 8] still there were 243 million intestinal sickness cases detailed in 2008[9]. Intestinal sickness is still a noteworthy general medical issue as 109 nations are announced endemic to the ailment in 2008. Government specialists are causing gigantic expense to control/wipe out the episodes of jungle fever.

Because of a dangerous atmospheric devation, fast atmosphere modifications are happening which result in the expansion or lessening of disease spread rate bases on the particular small scale atmosphere of that specific district. Temperature variances influence the existence sequence of vector just as freeloader [10]. Further more, the procedure engaged with disease transmission is impulsive and is totally site explicit. In this manner, it is incredible challenge for the scientists to anticipate the malarial episodes in advance. Without information regarding probabilistic assault of these sicknesses, government neglects to give sufficient treatment office on schedule. In this manner, it is important to figure the event of these sicknesses ahead of time with the goal that its staggering effect on the society can be decreased.

We designed a doctor-patient interacting portal in order to predict the malaria disease based on various symptoms like cold, headache, fatigue and etc. Doctor and patient can login into the portal and enter the details of symptoms thereby depicting the disease. Based on the trained data, machine can be able to predict whether the particular patient

is suffering with the disease or not.

In section 2, we presented related work. Various studies exist for specific areas which suffer with malaria. Section 3, we explained the dataset and parameters that we have gathered for training the machine. Section 4 gives a clear cut idea about the machine learning algorithms that have been considered for processing data and predicting the disease. Section 5 discussed about the results followed by conclusion.

2 Existing Methods

VijetaSharma[1] et.al proposed a malaria outbreak prediction algorithm based on SVM and Artificial neural network(ANN) and shown that SVM outperforms with the given training data. They have collected data from different areas of Maharashtra with parameters such as average monthly rainfall, humidity, total number of positive cases, total number of pF cases and etc.

Contemporary sickness mapping endeavors have grasped measurable demonstrating ways to deal with appropriately recognize vulnerabilities in both the accessible estimations and their spatial introduction. The most widely recognized such approach is Gaussian procedure relapse, a numerical structure com- presented of two segments: a mean capacity tackling the prescient intensity of different free factors, and a covariance work yielding spatio-worldly shrinkage against lingering variety from the mean. Here, Samir Bhatt[2] et. al present a troupe approach dependent on stacked generalization that takes into account different nonlinear algorithmic mean capacities to be mutually implanted inside the Gaussian procedure structure. They apply this technique to mapping Plasmodium falciparum pervasiveness information in sub-Saharan Africa and demonstrate that the summed up outfit approach notably beats any individual technique.

DhanyaBibin[3] et al. propose a novel strategy to recognize the nearness of Malaria parasites in human fringe blood smear pictures utilizing a Deep Belief Networks(DBN). This work presents a prepared model dependent on a DBN to characterize 4100 fringe blood smear pictures into the parasite or non-parasite class. The proposed DBN is pre-prepared by stacking limited Boltzmann machines utilizing the contrastive difference technique for pre-preparing. To prepare the DBN, from the pictures highlights are extracted and instate the noticeable factors of the DBN. A linked component of shading and surface is utilized as an element vector in this investigation. At last, the DBN is distinctively fine- tuned utilizing a back propagation calculation that processes the likelihood of class names. The proposed strategy has performed altogether superior to the other best in class strategies with a F-score of 89.66%, an affectability of 97.60% and particularity of 95.92%. This work is the principal use of a DBN for intestinal sickness parasite location in human fringe blood smear pictures.

A novel strategy has been proposed by SudheerCh[4] et. al that depends on the coupling of Firefly Algorithm (FFA) and Support Vector Machines (SVM) which predicts the Malaria disease frequencies. The execution of SVM models relies on the proper arrangement of parameters of SVM. For this investigation FFA is being utilized toconfirm the SVM parameters. The intended SVM-FFA display is received in ancipating the malarial rates in Jodhpur and Bikaner zone point at which the jungle fever spread rate is unsteady. Month to month midpoints of precipitation, temperature, relative moistness also, malarial rates have been considered as info factors. The outcomes show that the proposed SVM-FFA display gives progressively precise estimates contrasted with the other customary methods.

Leila Malihi[5] et.al proposed an approach in which stained components of blood for

example, red platelets, parasites and white platelets are extricated. At the following stage, red platelet veil is situated on the extricated recolored components to isolate the conceivable parasites. At long last, shading histogram, granulometry, inclination and level surface highlights are separated and utilized as classifier inputs. Here, five classifiers were utilized: SVM, NM, KNN, 1-NN, and Fisher.

3 DATA COLLECTION

Data from various resources has been gathered to train the machine initially. Parameters such as, as shown in below figure, fever, cold, rigor, fatigue, headache, bitter_tongue, vomitting, diarrhea, convulsion, anemia, jundice, cocacola_urine, hypoglycemia, prostraction, hyperpyrexia are extracted to predict the disease.

Figure: Screenshot of dataset

Data is preprocessed by data mining tools and undergoes all the stages of mining such as collection, understanding, and feature extraction. Last stage of processing extracts the necessary features for training the machine and removes unnecessary ones.

Collection: It is the fundamental period of the preprocessing, and is incredibly vital.The idea of data accumulated whichinfluences livelily on the yield. The collection system should ensure that the data aggregated are both portrayed and aggregate, with the objective ofensuring decisions which subjects to the exposures which are authentic. This stage will ensure the providence of two factors like where to measure and what to improve.

Preparation: The proper structure for the control of data which is used for dealing with data and future examinations. It is impossible to arrange unrefined data and it is need to be checked for perfect accuracy. Game plan is connected to building up an enlightening list from any data source without any defined which is going to be used for dealing with and further examinations. Looking at data that has not been carefully screened for issues can make exceptionally beguiling results that are seriously dependent on the idea of data organized.

Input: It is the place affirmed data which is coded or changed over into a machine detectable structure. The main objective of implementing this is, it might be taken care of through an application. Data area is Finalized by utilizing data section, comfort, scanner, or from aavailable source. This monotonous strategy requires precision with more speed. Most data need to seek after a formal and extreme language since a ton of taking care of intensity is required to assort the astounding data at this stage. As a result of the costs, various associations are going to re-proper this stage.

Processing: is the point at which the information is exposed to different methods and strategies for amazing specialized controls utilizing Machine Learning and Artificial Intelligence calculations to produce a yield or elucidation about the information. The procedure might be comprised of different strings of execution that all the while execute guidelines, contingent upon the sort of information.

Output: **A**rranged information will get transmitted and can be displayed to the customers from this place. Yield is acquainted with customers. In various report positions like graphical reports, sound, video, or record watchers, yield will acquaints with the customers. The objective of providing significant information to control the future decisions of association using deciphered yield ought.

Storage: Dealing of data with cycles is the last stage of data storage, where data, and metadata (information about data) are held for at some point later. The hugeness of this cycle is that it licenses smart access and re-

cuperation of the readied information, empowering it to be passed on to the accompanying stage authentically, when required.

4 Proposed approach

This section explains about machine learning algorithms used for training and testing the data, doctor-patient interaction portal, programming language and framework used for designing the portal.

4.1 Random Forest Algorithm:

It has very nearly a comparative hyperparameters as a choice tree or a sacking classifier. We don't have to unite a choice tree with a sacking classifier and can just viably use the classifier-class of Random Forest. With Random Forest, you can oversee Regression endeavors by using the Random Forest repressor.

It adds additional haphazardness to the model, while building up the trees. Instead of searching for the most imperative segment while section a center, it checks for the best component among an unpredictable subset of features. This results in a wide varying assortment that generally results in a predominant model.

In this, only a sporadic subset of the features is pondered by the estimation for section a center. We can even make trees progressively discretionary, by likewise using unpredictable breaking points for every component instead of searching for the best edges (like a run of the mill choice tree does).

Pseudo Code:

1. Select the “k” features randomly from total “m” features.

Where k << m

2., calculate the node “d” among the “k” features, using the.

3. By using the best split point, split the node into daughter nodes.

4. Until the nodes has been reached to the count of “1” Repeat 1 to 3 steps.

5. To create “n” no of trees repeat the steps from 1 to 4 for “n” number of times which builds forest.

4.2 Python:

As a substitute of having most of its helpfulness joined with its center, Python was proposed to be significantly extensible. This littler withdrawal has made it particularly surely understood as a strategies to enumeratepreamble interfaces to the existing applications. Van Rossum's vision of a little center language with a generous standard library and successfully extensible go between. While offering choice in coding framework, the Python rationale rejects flooding semantic structure, (for instance, that of Perl) for a less mind boggling, less-cluttered punctuation.

4.3 Django

Despite having its own one of a kind arrangement, for instance, assignment of the redeemable articles making the HTTP responses "views",[6] the middle Django structure can be shown as a MVC architecture.[7] It contains a thing social mapper (ORM) that mediates betwixtdifferent data models (described as Python classes) and a social database ("Model"), a system for taking care of HTTP requests with a web templating structure ("View"), and a standard verbalization based URL dispatcher ("Controller").

Likewise incorporated into the frameworks are:

1. An autonomous and lightweight web server for planning and examination.

2. a structure serial arrangement and endorsement system which translatesamong HTML structures and characteristics proper for limit in the database

3. a format structure which resorts to the circumstance of acquisition procured from

article arranged programming

4. a saving framework that can use any of a couple of store procedures

5. Assist for middleware classes that can intercede at assorted periods of sales getting ready and complete custom limits

6. an inside dispatcher structure that empowers portions of an application to give events to each other by methods for predescribed sign

7. anglobalization structure, including interpretations of Django's own parts into a collection of lingos

8. a serialization structure that can make and scrutinize XML or conceivably JSON depictions of Django show events

9. a system for growing the limits of the configuration engine

10. an interface to Python's worked in unit test structure

4.4 Doctor-Patient Portal:

By making use of above explained technologies, we developed an information portal in which we incorporated all the features such as login by the doctor, selecting the symptoms of the disease, prediction result and diagnose for the disease based on the prediction.

Doctor Portal:

A doctor can login into his account by submitting the valid credentials. Main page has links to the following pages: Add Patient, Patient's history, Diagnose patient, training data. He/she can add a patient by filling the details(name, gender and date of birth) provided in the **add patient** page. In **patient's history** window, doctor can see the details of the particular patient details such as whether the patient is already diagnosed or not. If he wants to diagnose a patient, he can add the disease symptoms in the **diagnosis** page. Random forest algorithm reads all these features and predicts whether these details lead to disease or not. After predicting the disease, it gives the **result** whether is true or not. It the result is true, **prescribed drug** is shown along with the result. Then the **perform test** provides few questions regarding the medication to test the adherence. With these details, it will perform the test and decides whether the adherence true or false.

5 Results

Fig.1 Doctor Portal

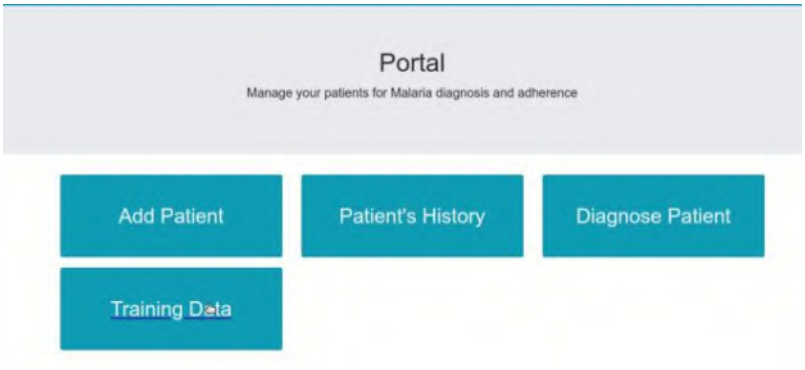

Figure Fig.2 Links to the various pages

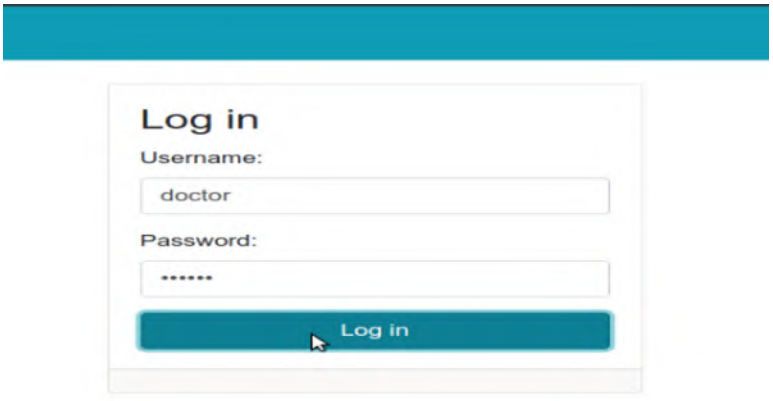

Fig.3 Login page

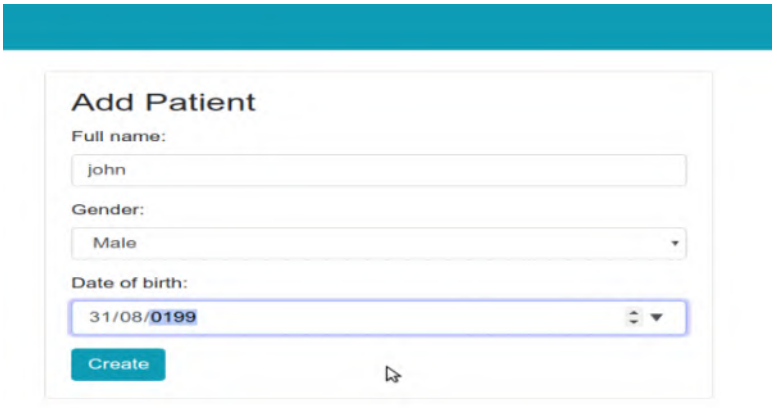

Fig.4 Adding a patient

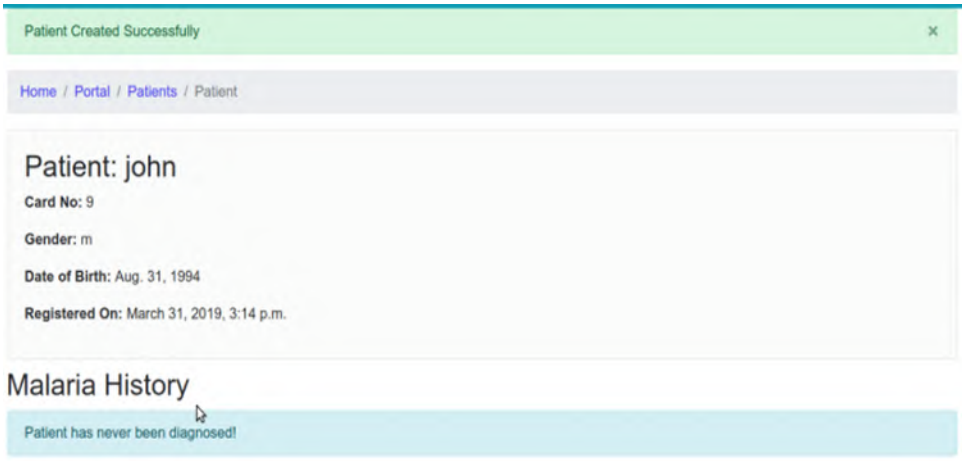

Figure Fig.5 Patient History

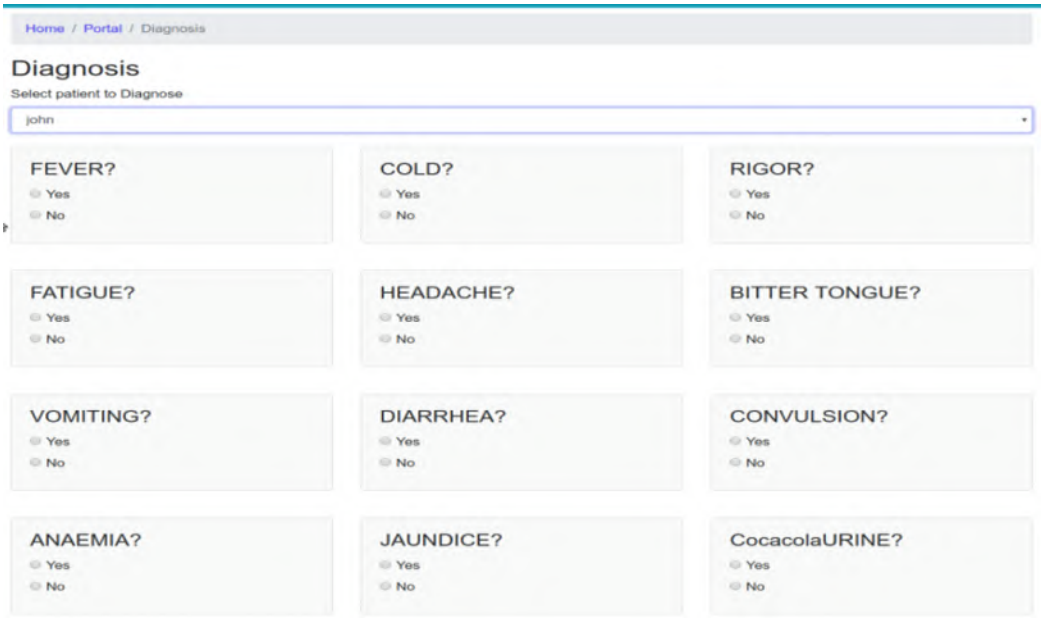

Figure: Diagnosis

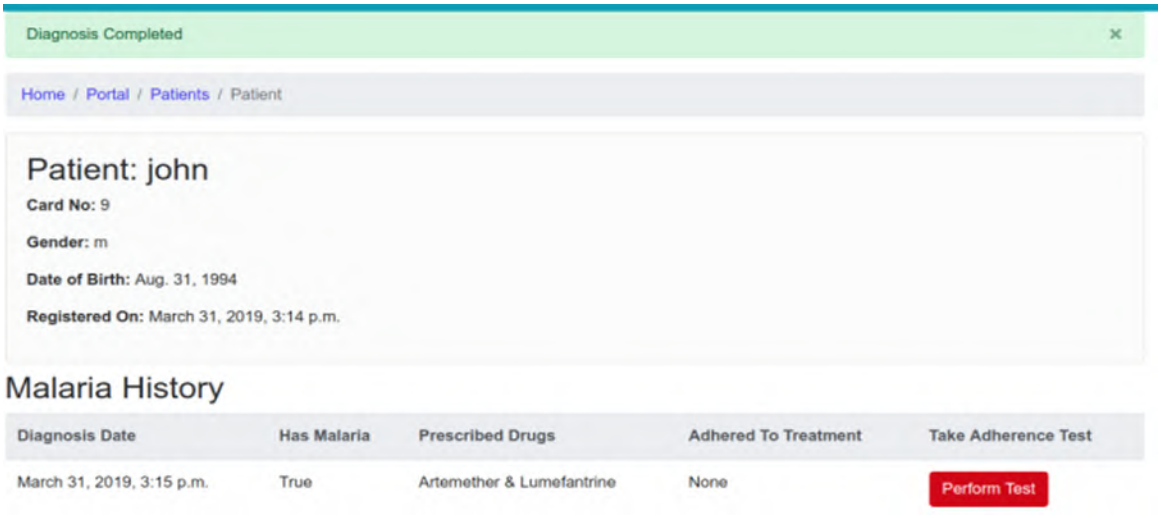

Fig.6 Diagnosis results

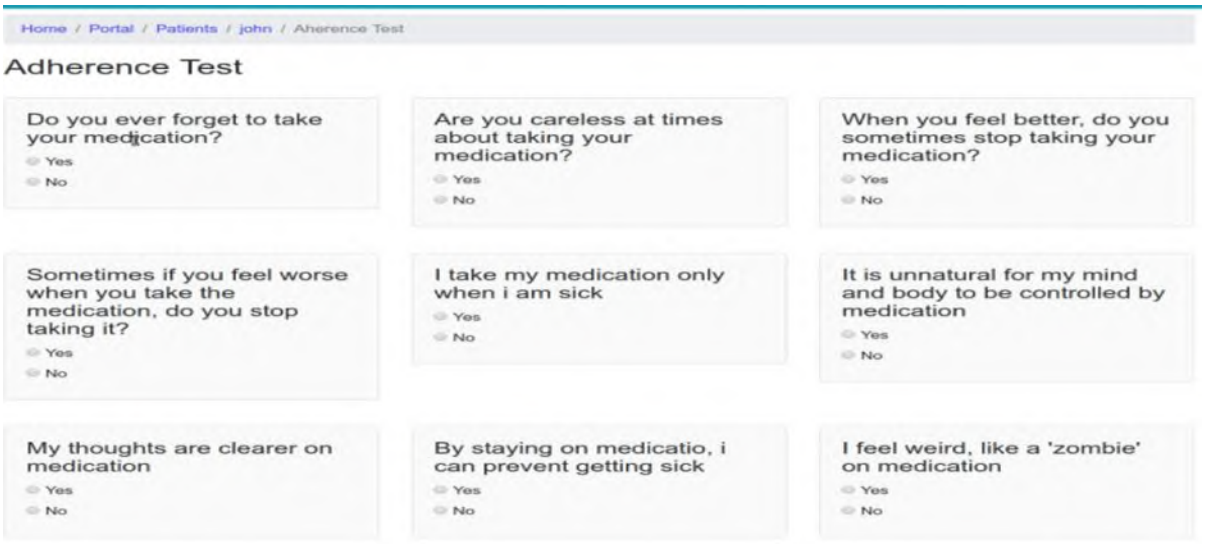

Fig.7 Adherence Test

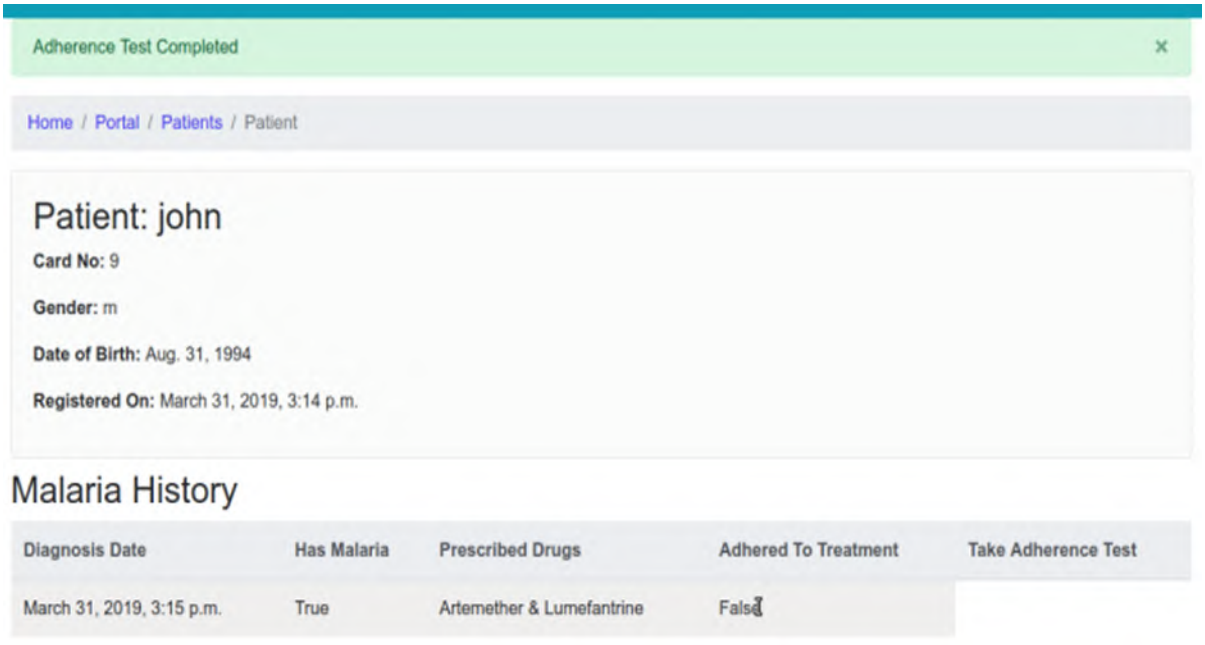

Fig.8 Adherence Test results

6 Conclusion And Future Work

In this work, we have designed a portal for Doctor to test a patient by different kinds of tests such as Diagnosis, Adherence test and predict whether that particular patient is diagnosed by Malaria or not. We are able to test the specific patient with specified symptoms with an accuracy of 95%. In future, we are planning to design a portal for various diseases and predict using machine learning algorithms by providing symptoms test for those diseases. Hence, a doctor can easily predict the disease and this in turn reduces the cost and time needed to diagnose a disease.

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COLLABORATIVE STRATEGY IN TEACHING CREATIVE WRITING TO SENIOR HIGH SCHOOL STUDENTS

Luiscel Teofi E. Cabico[1]& Ana Loraine H. Gealon[2]

[1] Cebu Technological University-Argao Campus
[2]Sibonga National High School

ABSTRACT

Teaching English in high schools, however, does not offer a sufficient proportion of writing skills. The study assessed the collaborative strategy in teaching Creative Writing to senior high students at Sibonga National High School for School Year 2019-2020. This study utilized the normative-correlational method of the research study. Correlational because it involved observing two variables in order to establish a statistically corresponding relationship between them. Statistical measures were used to interpret the data gathered, tabulated, and interpreted to arrive at findings, conclusions, and recommendations. The study found that the students' pre-test scores were very poor in knowledge on the three selected competencies in Creative Writing; the students' performance in competency 1 has significantly improved, the students' performance in competency 2 has also improved, the students' performance in competency 3 has also significantly improved, the student's academic performance has reached on the majority with satisfactory and very satisfactory and only very few fairly satisfactory grades by the use of collaborative strategy, and the hypothesis of no significant difference in students' pre-test and post-test of selected competencies in Creative Writing is rejected. Based on the findings mentioned above, it was concluded that collaborative strategy in teaching creative writing influences or immensely helped in the academic performance of the grade 11 students of Sibonga National High School-Senior High School. Anchored on the conclusion, it was recommended that varied learning exercises be pro, aligned with the competencies mandated by the Department of Education; that collaborative strategy be used in teaching creative writing; and that the proposed learning exercises be adopted to boost students' competence in Creative Writing.

Keywords: *English, Learning, performance, Sibonga high school, Teaching*

1. Introduction

Teaching English in high schools, however, does not offer a sufficient proportion of writing skills. Writing skills are taken less into account than the other skills in the teaching process (Latifah et al., 2020). Creative writing exercises improves students achievement in writing skills based on the results and let them to write more. In term of education, collaborative writing strategy was widely adopted to promote collaborative learning(Lai, Lei & Liu, 2016).

According to Hautemo (2016), collaborative learning is a process of peer interaction that is mediate and structured by the teacher. Moreover, people learn from one another via observation, imitation, and modeling.

Collaborative learning is based on the idea that learning is a naturally social act in which participants talk among themselves; it is through the talk that learning occurs. Consequently, learning exists throughout communication between the learners and teachers. Hence, collaborative learning has as its main feature a structure that allows students to talk and are supposed to talk to each other. Thus, it is in the talking the learning occurs (Amel, 2015).

Barkley et al. (2014) conceived also that learning is a social act and believed that an individual learns behaviors and attitudes through direct or indirect observation. Hence, learners watch another person who acts as a model and then imitates what they are watching. Through watching others, one adopts attitudes or forms an idea about how to perform new behaviors, and thus learning occurs by way of interaction between behavioral, cognitive, and environmental influences. Therefore, teachers have tried to organize different collaborative activities in their classroom teaching, to enhance student learning process (Hale, 2018).

Collaborative writing strategy is a teaching writing technique that allows students to work together in pairs or groups to produce a good writing. This technique helps the students to write with their peers a certain email (Sukirman, 2016).According to Pang et al., 2018 collaboration can create Positive social emotions and support active learning; these

situations can also evoke negative emotions and create novel interaction challenges for students in group work. Furthermore, collaboration processes such as levels of teamwork, multiple cognitive perspectives, or lack of common ground in shared conversations may also create learning obstacles. Students have reported that the challenges of collaborative learning are (1) teamwork, (2) communication, (3) personal priorities, and (4) external constraints. Based on the study ofUtami (2012) introducing collaborative writing in classroom activities, students were offered the opportunity to provide immediate feedback on vocabulary used in their writings that might be lacking while operating individually.

This study began to examine the collective writing reflections about the product, method and student. Furthermore, the research attempted to obtain reflections on the collective writing practice among the learners (Wulandari, 2017).The researcher therefore suggests that collaborative learning improved the writing process for students. So the students need a strong strategy to keep their focus in the lesson. Collaborative writing technique is an effective way to teach the writing. Teachers are allowed to use this technique to improve other practices. This study would like to give an overview on the Effectiveness of Collaborative Writing strategy toSenior High School students.

2. The Problem

This research assessed the status of collaborative strategies in teaching Creative Writing for Grade 11 Sibonga National High School- Senior High School during the School Year 2019-2020 as the basis for some learning exercises. It specifically answered the following sub problems:

1 What is the level of performance of the students in Creative Writing in the followingcompetencies?

1.1 identify the various elements, techniques, and literary devices in poetry;

1.2 use imagery, diction, figures of speech, and specific experiences; and

1.3 use selected elements of poetry in short exercises

2 After using collaborative strategies, what is the students' level of performance in the competencies mentioned above?

3 Is there a significant difference in the mean gain of the two performances?

4 Based on findings, what learning exercises can be crafted?

3. Rationale

The 21st century brings four critical challenges in which collaboration plays a central role: (1) a rapidly increasing global interdependence that will result in increasing local diversity as well as more frequent and intense conflicts, (2) the increasing number of democracies throughout the world, (3) the need for creative entrepreneurs, and (4) the growing importance of the interpersonal relationship that affect the development of personal identity (Johnson & Johnson, 2014).

According to Nelson (cited in Kumar, 2017), teaching and learning in a modern classroom is no longer an act of transferring knowledge. The art of teaching has become a multidisciplinary enterprise to develop critical thinking, interaction, and collaboration among learners. Moreover, given these multidisciplinary changes in curriculum and its relative learning objectives, the need to collaborate to create a learning environment has gained momentum in this decade or so. Gone are the days where traditional teacher-centered approaches dominate the entire system; the focus has gradually shifted to learner-centered and learning-centered strategies.

In the past years, the Philippines initiated a significant curriculum reform leading to implementing the Enhanced Basic Education curriculum (K to 12) in 2013. The new curriculum envisions the development of scientifically, technologically, and environmentally literate and productive members of society who are critical problem solvers, responsible stewards of nature, innovative and creative citizens, informed decision-makers, and effective communicators

(Official Gazette of the Republic of the Philippines, n.d, p.2)

With the K to 12, students will develop competencies and higher-order thinking skills through one of the program's key features: the provision of time for independent/ collaborative learning. It aims to develop student capacity for self-directed learning, teamwork, goal-orientation, a sense of responsibility, and accountability for results. (DepEd Order 31, s. 2012).

Hence, this study assesses the status of collaborative strategies in teaching Creative Writing for Grade 11 students of Sibonga National High School- Senior High School.

4. Methodology

4.1 Design

This study utilized the normative-correlational method of the research study. Normative because the target was not only to gather facts but also to point out which aspects of the study can be improved. Correlational because it involved observing two variables in order to establish a statistically corresponding relationship between them. Statistical measures are used to interpret the data gathered, tabulated, and interpreted to arrive at findings, conclusions, and recommendations.

4.2 Environment

This study was conducted in Sibonga National High School, located at the the southern part of Cebu, Province, about 50 kilometers away from Cebu City. It has a land area of 9,781 square meters. Its operation started in the year 1947. It is the school's vision and mission to produce graduates that are globally competitive and competent. Thus, competencies in the curriculum are carefully crafted to align and be ONE with the Department of Education in realizing its goals and aspirations.

The school aims to turn out graduates who can realize their full potential and contribute meaningfully to building the nation. Many students from the different barangay of Sibonga are sent to study because of its accessibility and, of course, its excellence when it comes to quality education. Sibonga National High School offers five strands of the Senior High, namely, HUMSS, STEM, ABM, BREAD AND PASTRY, and EIM Strand.

4.3 Respondents

The study respondents were the 233 Grade 11 HUMSS students of Sibonga National High School of the School Year 2019- 2020. HUMSS (Humanities and Social Sciences) strand under Academic Track were distributed into 4 sections: HUMSS 1- Descartes, HUMSS 2- Homer, HUMSS 3- Dewey, and HUMSS 4- Lincoln. The researcher used a purposive sampling technique, which automatically considers the bottom 36 of each class to come up with the 144 respondents. The researcher believed that this technique is the most appropriate tool since grade 11 are the current recipient of the subject Creative Writing, thus representing the population needed for the study.

Table 1 .Distribution of Respondents of the Study

Respondents	N	Sample Size	Percentage
HUMSS 1	58	36	25%
HUMSS 2	58	36	25%
HUMSS 3	57	36	25%
HUMSS 4	60	36	25%
Total	**233**	**144**	**100%**

4.4 Instrument

The instrument used in the study is an assessment test adapted and modified from the "Wording of World: The Art of Creative Writing" by Augusto Antonio Aguila, Ph.D., Ralph Semino Galan, M.A., and John Jack G. Wigley, Ph.D. It was subdivided into 3 categories. The first part was for the students to determine the different elements present in poetry. The second part was for the students to identify what figures of speech was used in the sample lines taken from famous poems. The third part was for the students to use and apply these elements in a selected poem.

5.5 Data Gathering Procedure

The procedure of data collection was divided into two phases: the preparation phase and implementing phase.

Preparation Phase Included:

In the preparation phase, the researcher sought approval from the principal of Sibonga National High School to grant permission to conduct the study. Thus, it is included in writing a formal letter to utilize the grade 11 HUMSS students for the study. Furthermore, lastly, the formulation of the instrument employed in the study by the researcher.

Implementing Phase included:

In the implementing phase, the researcher gave the first set of tests to HUMSS 1- Descartes students, then to HUMSS 2- Homer class, followed by HUMSS 3- Dewey, and lastly to HUMSS 4- Lincoln class.

The second was the conduct of the actual instruction using collaborative strategies like Small Group Discussion and Think-Pair-Share to enhance the performance level of the students. A careful and thorough assessment of the materials and activities to be used was considered by the researcher based on the result of the pre-test.

Lastly was the administering of the post-test to all HUMSS students. The researcher carefully examined the results, notably the selected respondents of the study.

4.6 Treatment of Data

In the analysis of data gathered, the researcher used:

(1) Z-test. This was used to determine the level of performance of the respondents on the identified competencies.

(2) T-test. This was utilized to determine whether there is a significant difference between the two performances' mean gain.

5. Results and Discussion

Pre-test Level of Students' Performance in Creative Writing- Competency No.1

The pre-test consists of 30 items, which was then subdivided into 10 items per competency. The competencies are generated form the Curriculum Guide in Creative Writing for Senior High School students. The 3 identified competencies are identifying the various elements, techniques, and literary devices in poetry, using imagery, diction, figures of speech, and specific experiences, and using selected poetry elements in short exercises.

The teacher administered the pre-test at the start of the grading period. The objective of the test was for the facilitator to determine whether they have prior knowledge of the various elements, techniques, and literary devices in poetry, use imagery, diction, figures of speech, and specific experiences, and use selected elements of poetry in short exercises. The test result was for the teacher to know what specific strategy to use for these competencies.

As shown in Table 2, students lack proficiency in competency no.1, which is to identify the various elements, techniques, and literary devices in Poetry with an actual mean performance score of only 6.08. It can be inferred that students, when given individual tasks, are hardly not paying much attention to the activity given to them. They are more concerned with merely just completing the task without really having mastered the competency.

This finding accords with Saula's(2015) study that learning does not happen in isolation. It

requires the association of learners and teachers at the same time learners with each other. Although it becomes widely believed that one can learn alone, for instance, using the Internet or a CD, it is not equivalent to classroom learning; thus, collaboration is significant for better understanding thus better learning. The result further signifies that the teaching-learning experiences of the students were not meaningful, motivating, and challenging. Hence, it is a big challenge for the teacher to better think of a strategy that would engage students and acquire knowledge and skills through working with others.

Table 2. Pre-test Level of Students' Performance in Creative Writing- Competency No.1

Competency1	**No.of Items**	**hm**	**am**	**s**	Computed z	Critical z	Description
Identify the various elements, techniques and literary devices in Poetry	10	7.5	6.08	1.36	12.51	1.96	Below Average

Pre-test Level of Students' Performance in Creative Writing- Competency No.2

As presented in Table 3, the students were having difficulty with this particular competency. As it shows, the mean performance score of the students was only 5.89, which is way too low from the passing level. It can be inferred that this competency needs to be given appropriate strategy to allow the learners not just to get the necessary knowledge of the content but also the needed skills to help them identify the different figures of speech and the use of imagery in poetry.

Students were having a hard time understanding and comparing the different figures of speech. They were only exposed to the primary figures of speech like metaphor, simile, and personification. The finding resembles Ramadhanti's (2018) study on Understanding Poetry Through the use of the Cooperative Learning Method when she found out that in the learning process, the teacher has the task to help students improve reading skills and instill reading habits in students. Thus, the vital role in the success of learning this particular strategy lies in the teacher.

It can be implied further that the teacher needs to carefully pre-determine the learners' different learning styles and skills not to create division among learners instead of collaboration as the primary focus. Hence, students need to develop other skills needed in the 21st century, like teamwork in study groups that will be increasingly encouraged in thinking in solving problems under the subject matter. Moreover, student's interaction in groups affected by group composition strongly affects the accountability of each individual in performing the task, especially understanding Poetry.

Table 3. Pre-test Level of Students' Performance in Creative Writing- Competency No.2

Competency2	**No.of Items**	**hm**	**am**	**s**	Computed z	Critical z	Description
use imagery, diction, figures of speech and specific experiences	10	7.5	5.89	2.10	9.19	1.96	Below Average

Pre-test Level of Students' Performance in Creative Writing- Competency No.3

The facilitator has used the poem "The Road Not Taken" by Robert Frost as a springboard to elicit their insights on the elements used and reflected in the poem. Thus, they used these elements to short exercises that would enhance and deepen their understanding of the difficulty and circumstances in making choices in life.

As displayed in Table 4, the students got 6. 53 mean performance score in the 3rd competency, which uses selected elements in short exercises. It is notably a bit higher than the 2nd competency but still could not reach the passing level. It can be deduced that the students tend to be more expressive when they are asked to discuss some things that ignite their inner thoughts and by sharing their individual experiences.

Hence, the learners are more productive and participative if they feel listened to and can tell their side of the story openly. However, in adherence to the competency, the teacher as the facilitator of learning must successfully bring out individual capability and strengths to produce sound and quality results among learners, whether an individual or group task.

Table 4. Pre-test Level of Students' Performance in Creative Writing- Competency No.3

Competency3	No. of Items	hm	am	s	Computed z	Critical z	Description
Use selected elements in short exercises.	10	7.5	6.53	1.93	6.03	1.96	Below Average

Post-test Level of Students' Performance in Creative Writing- Competency No.1

There was an increase in the students' mean performance scores from 6.08 to 7.42, which says that the strategy/technique used in this particular competency was effective.As reflected in Table 5, the students now got an actual mean of 7.42, which significantly increased compared to the previous results of only 6.08. The increase of 1.34 was a good sign that the strategy used and employed in this particular competency was well-founded.

The teacher has paired the student first with someone they were comfortable being with. Someone they can freely express their views and opinions. They were then asked to help each other in understanding the hidden meaning behind a specific picture. After which, they were tasked to give their insights as to what has transpired beyond the picture. With the "Think-Pair-Share" activity, the students are welcoming thoughts and ideas other than their own.

Moreover, Saoula (2015) affirms that the use of Collaborative Learning strategy was not just an adopted technique to accomplish a given task in the classroom; it was instead a philosophy or a theory that can be applied in any context in which a group of people was working together to achieve a particular goal or to solve a problem.

Furthermore, learning and understanding were not merely individual processes supported by the social context; instead, they were the result of a continuous, dynamic negotiation between the individual and the social setting in which the individual's activity takes place. The teacher had given varied and differentiated activities that would cater to all the needs of the learners. Through collaborative strategy, learning activities were made fun and accessible, connecting individual differences into a common goal.

Hence, the grade 11 students were not only able to master the competency, but they also have somehow helped their fellow students who were having difficulty with this competency. Through collaboration, they accomplished the task given to them by the teacher.

Table 5. Post-test Level of Students' Performance in Creative Writing- Competency No.1

Competency 1	**No. of Items**	**hm**	**am**	**s**	Computed z	Critical z	Description
Identify the various elements, techniques and literary devices in Poetry	10	7.5	7.42	1.29	0.766	1.96	Average

Post-test Level of Students' Performance in Creative Writing- Competency No.2

The findings suggest a significant improvement in the mean performance scores of the students as to competency no.2 is concerned. There was an evident good result as it leaps a 2.5 difference of the mean from 5.89 to a passing level of 8. 39. Thus, the strategy employed in this competency is commendable. Table 6 demonstrates the students' mean performance score for competency no.2. The data revealed that the student's performance has significantly improved in using imagery, diction, figures of speech, and specific experiences with 2.5 differences in the mean.

The students worked together as a team in unlocking complex activities. They used their knowledge in the different elements of poetry in helping their group come up with the correct figures of speech used in the poem. The lines were thoroughly examined individually, then took turns expressing their observations and findings of the tasks given.

As Ramandhati (2018) concluded in her study, teachers who apply collaborative learning in the classroom make learning more mediated. Moreover, with teachers implementing group work to make the class more disciplined, students also showed a positive interaction in their group. Hence, collaborative learning enhances students' understanding of poetry's physical and inner structure, requiring critical reading skills. Even students with low performance in school find it very motivated in learning because cooperation and collaboration are strongly evident.

Furthermore, in Collaborative Learning, two or more learners are placed together in one group to allow each learner to grasp an idea and help each other find a solution to a particular problem. It also gives the group a sense of pride to come up with a very productive result, giving credit to each member who has given their best to the group.

Table 6. Post-test Level of Students' Performance in Creative Writing- Competency No.2

Competency2	**No. of Items**	**hm**	**am**	**s**	Computed z	Critical z	Description
use imagery, diction, figures of speech and specific experiences	10	7.5	8.39	1.57	6.79	1.96	Average

Post-test Level of Students' Performance in Creative Writing- Competency No.3

Table 7 demonstrates the students' mean performance score for competency no. 3. The data revealed that the student's performance has significantly improved in using selected elements in short exercise with 2.27 difference in the mean. Notably higher from 6.53 to 8.80, which was higher in percentage compared to other competencies.

Indeed, meaningful learning can truly be achieved if the students were engaged when their emotional well-being is considered and given importance. From what they have learned from their group, they go back confidently to their tasks and prepare to relate

and link one's story to that of the material. Thus, the collaboration of young minds can achieve great ideas.

Hence, Pushpa and Savaeda (2014) assert that when learning exercises were properly selected according to the level and demands of the students, these can aid their language enrichment, cultural enrichment, literary enjoyment, and personal involvement. Moreover, by moving away from the traditional approaches of teaching poetry, students should be guided to experience, feel, create and share what they understand.

Furthermore, the finding signifies that if students were given a chance and opportunity to freely express themselves in a healthy environment where they are not afraid to be judged or ashamed, good results can be evident. Collaboration, therefore, will allow teamwork and, more importantly, it allows growth among learners as part of the team since they contribute meaningfully to the whole group's success.

Table 7. Post-test Level of Students' Performance in Creative Writing- Competency No.3

Competency 3	No. of Items	hm	am	s	Computed z	Critical z	Description
Use selected elements in short exercises.	10	7.5	8.80	1.29	12.10	1.96	Above Average

Significant Difference of the Mean Gain of the Two Performances after using Collaborative Strategies

For competency in identifying the various elements, techniques, and literary devices in poetry, the mean gain between the pre-test and post-test was 1.34. It has a computed t-value of 11.34, which was greater than the critical t-value of 1.97. This leads to a decision to reject the null hypothesis, which means a significant difference in the mean gain from the pre-test to the post-test after using collaborative strategies. This implies that collaborative strategies were effective in dealing with the identified competency since it had increased in the respondents' performance.

The group component of collaborative learning consists of communication and the sharing of information within the partnership and group cohesion and commitment. Communication sets a foundation for students to use critical argumentation to build group and individual success (Kolikant&Pallack, 2015). Students must believe that their outcomes were linked to success (Laal & Laal, 2012); therefore, the success will increase the success of the others (Laal &Ghodsi, 2012). As communication within groups increases in a meaningful and constructive way, the students' knowledge begins to converge, and a shared understanding was developed (Balasooriya, Hawkins, &Corpo, 2010).

For competency on the use of imagery, diction, figures of speech, and specific experiences, the mean gain between the pre-test and post-test was 2.50. It has a computed t-value of 15.21, which was greater than the critical t-value of 1.97. This leads to a decision to reject the null hypothesis, which means a significant difference in the mean gain from the pre-test to the post-test after using collaborative strategies. This implies that collaborative strategies were effective in dealing with the identified competency since it had increased in the respondents' performance. It clearly showed that the students could achieve better outputs when given a chance to work together in teams. It also has helped that they were first paired with someone they were comfortable with to establish comfort and trust in expressing their thoughts and opinions. Then, when they were now grouped together, they were physically and emotionally ready to share.

For competency on using selected elements of poetry in short exercises, the mean gain between the pre-test and post-test was 2.27. It has a computed t-value of 15.97, which was greater than the critical t-value of 1.97. This leads to a decision to reject the null hypothesis,

which means a significant difference in the mean gain from the pre-test to the post-test after using collaborative strategies. It was very safe to say that collaboration among the group members has dramatically helped the learners. Individual insights that have turned into meaningful output. The students have used their knowledge with their real-life experiences in achieving success in their tasks.

In totality, the mean gain between the pre-test and post-test was 6.10, with a computed t-value of 20.58, which was far greater than the critical t-value of 1.97. This leads to a decision to reject the null hypothesis, which means a significant difference in the mean gain between the two performances. This implies further that collaborative strategies effectively dealt with the identified competencies since they had increased the students' level of performance.

This was the result of engaging the learners in a deeper understanding of the poem. They were also allowed to explore their own experiences and find meaning in the situations they were in. They were also made to discover together with their groupmates the good and bad effects of decision making and how they should accept whatever choices they have in life.

Hence, for students to develop their passion for learning, the teacher must first set the right atmosphere for her learners. The need to belong and not be humiliated regardless of whatever level the students were currently in should be given greater weight. The learning exercises crafted by the teacher should enable the learners to grow and develop their full potential. In addition, the teacher should be very keen in determining the multiple intelligences of learners inside her classroom to address their different needs appropriately. Thus, students learn best when they were given the opportunity to engage, share, express, and learn from one another.

Table 8. Significant Difference of the Mean Gain of the Two Performances after using Collaborative Strategies

Competencies	Tests	Mean	Mean Gain	Computed t-value	Critical t-value	Decision	Interpretation
Identify the various elements, techniques, and literary devices in poetry	Pretest	6.08	1.34	11.34	1.97	Re-ject Ho	Significant
	Posttest	7.42					
Use imagery, diction, figures of speech, and specific experiences	Pre-test	5.89	2.50	15.21	1.97	Re-ject Ho	Significant
	Posttest	8.39					
Use selected elements of poetry in short exercises	Pre-test	6.53	2.27	15.97	1.97	Re-ject Ho	Significant
	Posttest	8.80					
TOTALITY	Pre-test	18.50	6.10	20.58	1.97	Re-ject Ho	Significant
	Posttest	24.60					

6. Conclusion

The utilization of the Collaborative Learning strategy in teaching Creative Writing among grade 11 students of Sibonga National High School-Senior High School has been proven effective and beneficial to teachers. Collaborative learning has helped learners interact with peers to develop conceptual connections and alternative methods of understanding. It has also boosted their confidence in expressing their insights and ideas and somehow linked them to real-life situations. Moreover, it enhanced their

interpersonal relationships with peers, classmates, and friends. Thus, Collaborative learning incorporated in Creative writing has prepared individual work, then generated in preparation for small group interactions and weave together individual contributions to solve a more significant problem.

7. Acknowledgment

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DESIGN AND CONTROL OF SINGLE-STAGE GRID CONNECTED SOLAR PV WITH BES SYSTEM

Pavankumar D S[1] and T B Dayananda[2]
[1]Power Electronics, Dr.Ambedkar Institute of Technology, Mallathally,Bengaluru
[2]Electrical and Electronics Engineering, Dr.Ambedkar Institute of Technology Mallathally,Bengaluru

ABSTRACT

A synchronized control of a single-stage grid-connected SPV-BES system with energy management control is proposed in this paper. The synchronized control regulates the inverter and bidirectional DC-DC converter based on the battery's State of Charge (SoC), allowing MPPT and real-power injection to happen simultaneously. The control technique also compensates the output reactive power and reduces the unbalanced neutral current. Simulation work is carried out in MATLAB/Simulink software.

Keywords: *Photovoltaic source, dc-dc converters, artificial neural network, VSI, PQ Control.*

I. Introduction

Traditional energy sources such as fossil fuels are going scarce compared to the growing demands and also it leads to more pollution. The renewable energy sources such as PV is adapted due to low operating cost and as the power generation process is free of any pollution. But it is less efficient and non-reliable due to frequent changes in weather conditions. Incremental conductance algorithms are being developed for single PV panel systems to make MPPT approaches like Perturb and Observe (P&O) more efficient. These algorithms track the maximum PV power and corresponding voltage, so that it makes the converter operates on that particular voltage and extracts the maximum power.SPV (Solar Photovoltaic) energy is the mostly useable renewable energy source in the distributed generation (DG)units. The quick development of the SPV methods and usage of SPVs in the grid-interfaced applications denotes that the SPVs are beneficial to generate eco-friendly electrical power generation [1]. The maximum power is given to the grid system by the grid interfaced SPV unit at MPP (Maximum Power Point)[2]. The traditional VSC(Voltage Source Converter) associated with smoothening inductoris the highly used synchronizing unit in grid-interfaced SPV system [3].In three phase systems, single and two stage grid linked PV units are often employed. A DC-DC converter stage with MPP tracking and voltage boost, as well as a DC-AC inverter stage for connecting the PV system to the grid system, make up the two-stage conversion system.[4], [5]. A synchronized methodology of two stage grid interfaced PV and BESS(Battery Energy Management System) with ANFIS for voltage control [6] is proposed. Two-stage PV and battery energy storage system which operates by usage time for cost [7] is proposed for residential usage. The above mentioned systems suffer with lesser efficiency and higher cost, hence, for efficient grid-interfaced system it is not applicable. But, the single-stage methods provide higher efficiency compared to two stage topologies. Various single stage methods are proposed, and a comparison between them are made [8], [9]. A grid interfaced single stage PV unit with better performance is analyzed [10-12]. However, the compensation of neutral current is not provided, which leads to the higher harmonic contents in grid current.

In this, a single stage PV and battery energy storage system with synchronized control is proposed. It has multiple operations such as,

injecting the real power into the grid, active rectification and compensating the reactive power. The VSC and DC-DC converter based is operating under synchronized control based on SOC (State of Charge) of the battery. Based on the power generated by PV, the proposed control is classified into three modes 1) Power generation > Power Demand and 2) Power generation < Power Demand. During the time when PV is not generating power, the battery operates and provide power to the loads.

II. MODELLING OF PHOTOVOLTAIC CELL

The equivalent circuit of a PV cell is shown in Fig. 2

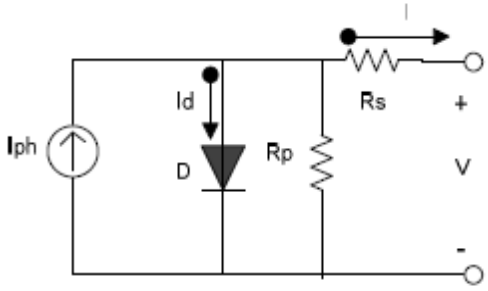

Fig. 1. Equivalent circuit of single diode model of PV cell

In various literatures it is also termed as a five parameter model (I_{ph}, I_o, n, R_s and R_p).
Where
I_{ph}- Photocurrent (A)
I_o -Diode saturation current (A)
N -Diode factor (1 <=n<=2)
R_s-Series resistance (Ω)
R_p- Shunt resistance (Ω)

•R_s is used to represent internal current flow losses and voltage drops.
•$R_p$is used to measure the internal leakage current flow due to reverse biasing of diode.

$$I = I_{ph} - I_o\left(e^{\frac{V+IR_s}{n_s v_T}} - 1\right) - \frac{V+IR_s}{R_p} \quad (1)$$

III. PV FED BATTERY CHARGING UNIT

The proposed PV fueled battery charging unit is provided in Fig. 3.

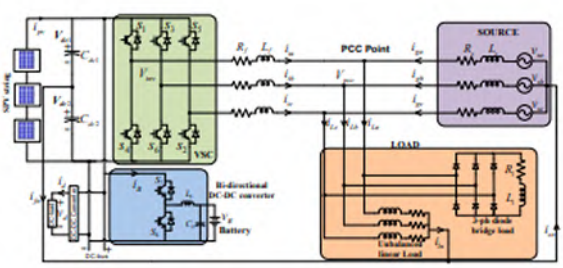

Fig. 2. Proposed PV fed battery charging unit

The PV power is provided to boost converter which steps up the PV voltage according to the duty ratio generated by the FLC or ANN based MPPT controller and the boosted voltage is reduced to battery voltage or the reference voltage provided for PI controller based voltage control circuit by the buck converter.
The circuit for boost converter is provided in Fig. 4.

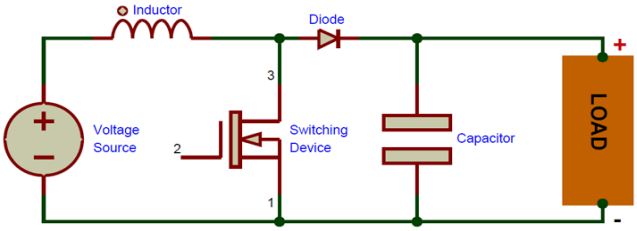

Fig. 3. Boost Converter circuit

The boost converter is used to step-up the dc voltage according to the duty ratio of the switching pulse provided. It comprises of inductor, power electronic switch, diode and capacitor. The load voltage will be higher than that of input voltage. The operational modes of the boost converter are provided as follows:

Mode 1:

The mode1 operational circuit is provided in Fig. 5. Here, the gate pulse provided for switch S is HIGH and the inductor gets charged during this time period. The capacitor, will maintain the load voltage at designed value during this time period.
The inductor voltage and load voltage are provided in the following equations:

$$V_L = V_{in}$$

$$V_{Co} = V_o$$

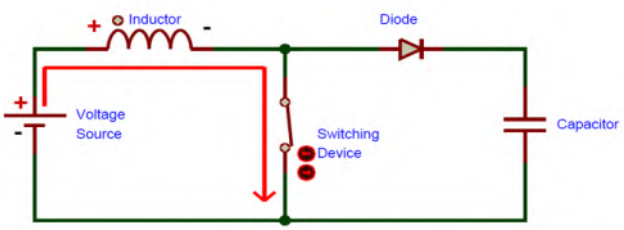

Fig. 4. Mode 1 Equivalent circuit of boost converter, V_L=Vin

Mode 2:

The mode2 operational circuit is provided in Fig. 6. Here, the gate pulse provided for switch S is LOW and the inductor gets discharged during this time period. The inductor voltage and source voltage gets added and provided to the load. The load voltage is provided in the following equation:

$$V_o = V_L + V_{in}$$

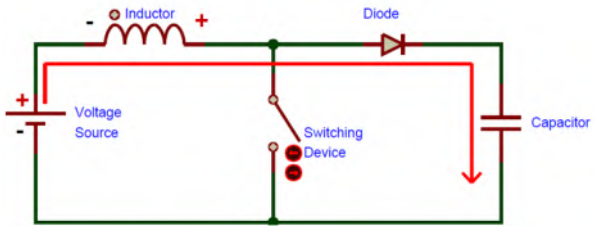

Fig. 5. Mode 2 Equivalent circuit of boost converter, Vo=Vin+V_L

IV. DESIGN OF INVERTER CONTROL

A. MPPT CONTROL:

The Perturb and Observe algorithm based MPPT controller will provide the change in duty ratio(ΔD) which will be added with initial duty ratio and provided for pwm pulse generation unit. The pulse generated is given to the gate terminal of the boost converter switch. The P&O mppt operates under the following conditions:

1. If ΔP/ΔV > 0, ΔD is +ve,
2. If ΔP/ΔV < 0, ΔD is –ve.

The flowchart of the P&O algorithm based mppt is provided below in Fig 6:

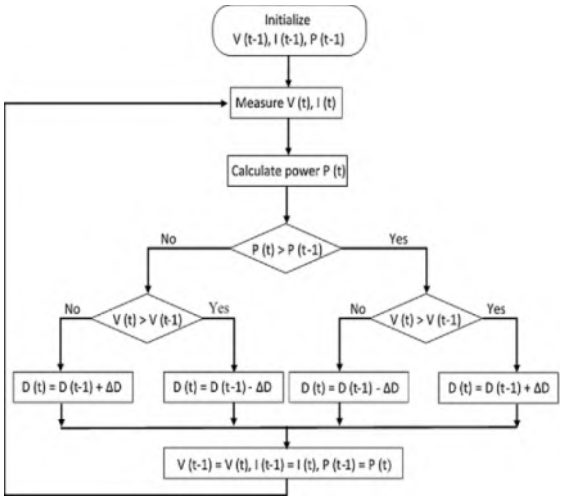

Fig 6 P&O Algorithm based MPPT control

B. *PQ* THEORY ALGORITHM

The steps to extract the harmonics is based on the *PQ* strategy is shown in Fig 7. Generally, the harmonic reduction process is denoted using a series of mathematical relations and calculations of Instantaneous Power in three phase system with balanced operation. The calculations are provided in *α-β* coordinates in which the three-phase parameters are initially transformed translated to *α-β* domain using the following matrix as

$$[M] = \sqrt{\frac{2}{3}}\begin{bmatrix} \cos\theta_1(t) & \cos\theta_2(t) & \cos\theta_3(t) \\ \sin\theta_1(t) & \sin\theta_2(t) & \sin\theta_3(t) \end{bmatrix}$$

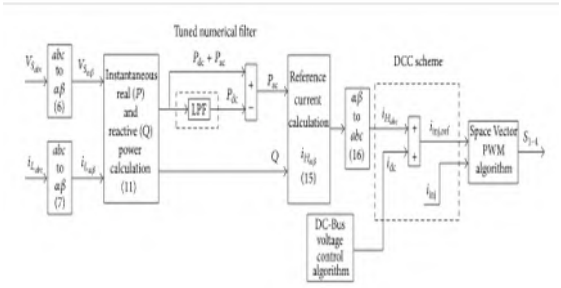

Fig 7. Controller block diagram for Series Active Power Filter

The transformation of three phase currents and voltages in terms of *α-β* coordinates by Clarke-transformation which is provided below in the following matrix:

$$\begin{bmatrix} v_\alpha \\ v_\beta \end{bmatrix} = \sqrt{\frac{2}{3}}\begin{bmatrix} 1 & -\frac{1}{2} & -\frac{1}{2} \\ 0 & \frac{\sqrt{3}}{2} & -\frac{\sqrt{3}}{2} \end{bmatrix}\begin{bmatrix} v_a \\ v_b \\ v_c \end{bmatrix},$$

$$\begin{bmatrix} i_\alpha \\ i_\beta \end{bmatrix} = \sqrt{\frac{2}{3}}\begin{bmatrix} 1 & -\frac{1}{2} & -\frac{1}{2} \\ 0 & \frac{\sqrt{3}}{2} & -\frac{\sqrt{3}}{2} \end{bmatrix}\begin{bmatrix} i_a \\ i_b \\ i_c \end{bmatrix},$$

The instantaneous power is provided below in terms of In *α-β* coordinates

$$\begin{bmatrix} P \\ Q \end{bmatrix} = \begin{bmatrix} v_\alpha & v_\beta \\ -v_\beta & v_\alpha \end{bmatrix} \begin{bmatrix} i_\alpha \\ i_\beta \end{bmatrix}.$$

The current harmonics are generated in order to remove the harmonics present in the system by removing the calculated or transformed values from the measured values which is shown below:

$$P_{ac} = P - P_{dc}.$$

Once the component is subtracted from the original value, the equations for real and reactive power can be rewritten as

$$\begin{bmatrix} P_{ac} \\ Q \end{bmatrix} = \begin{bmatrix} v_\alpha & v_\beta \\ -v_\beta & v_\alpha \end{bmatrix} \begin{bmatrix} i_{H_\alpha} \\ i_{H_\beta} \end{bmatrix}$$

The reference current required for reducing the harmonics are generated by transforming α-β coordinates of current to three-phase coordinates which is shown below:

$$\begin{bmatrix} i_{H_a} \\ i_{H_b} \\ i_{H_c} \end{bmatrix} = \sqrt{\frac{2}{3}} \begin{bmatrix} 1 & 0 \\ -\frac{1}{2} & \frac{\sqrt{3}}{2} \\ -\frac{1}{2} & -\frac{\sqrt{3}}{2} \end{bmatrix} \begin{bmatrix} i_{H_\alpha} \\ i_{H_\beta} \end{bmatrix}.$$

This reference current is provided to hysteresis control which generates the pulses accordingly. The hysteresis band is calculated using the following relation:

$$\text{SHB} = \frac{1}{8\Omega_c}\left(V_{dc} - \frac{4v_s^2(t)}{V_{dc}}\right)$$

In this, Vdc=400V, Vg_max=400V and F=5000Hz. Hence from above formula, we get the SHB value as 0.03.

V. Design Of Ann Control

The ANN senses the change in voltage and power and generates the duty ratios as per the equations (2) and (3). Hence if there is change in irradiation, the ANN control is accurate and quicker in response than any other control and provides the appropriate duty ratio in order to extract maximum PV power. The training was done with the help of data taken from the base system. The Levenberg-Marquardt algorithm used for training the neural network. This algorithm requires more memory but minimum time. Training will stop when improvement of generalization stops, as indicated by an increase in the mean square error of the validation samples.

The fitting curve of the training of ANN controller is provided in the following graphs (Fig. 8):

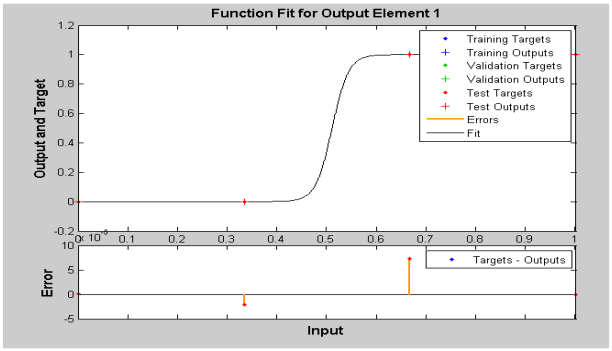

Fig 8 Fitting curves from neural network training

The regression value obtained from the training of neural network control is 0.99953. The regression curve is provided in the following graphs (Fig 9):

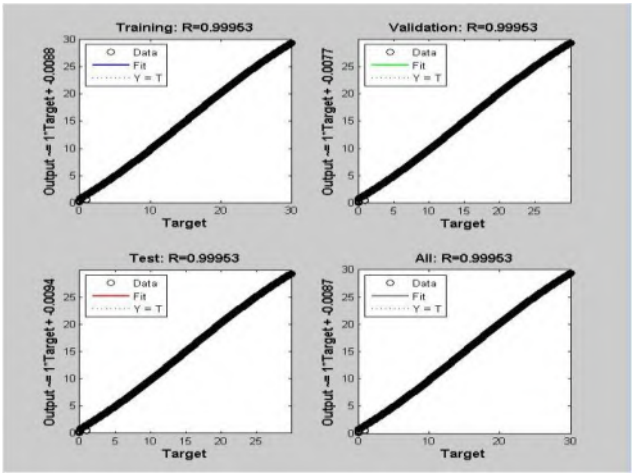

Fig 9 Regression curves from neural network training

VI. Constant Voltage Control Loop

The reference voltage compared with the measured voltage and the error voltage generated is provided to PI controller. The PI controller provides the duty ratio for buck converter so that the error voltage is to be reduced and reached zero.

The transfer function of PI controller is provided below:

$$Gpi(s) = K_p + K_i/S$$

VII. Boost Converter Design Equations

The design of boost converter circuit is provided by following equations:

The Duty ratio (D) of the boost converter circuit is provided below:

$$D = \frac{Vo}{Vo - Vin}$$

The inductor value of the boost converter circuit is calculated by the following equation:

$$L/2 = \frac{Vin * D}{\Delta Io * Fsw}$$

The inductor ripple current is selected using the following equation:

$$\Delta I_L = 0.2 * \frac{Vo}{V_{in}} * I_o$$

The output capacitance of the boost converter circuit is given by the following equation:

$$Co = \frac{\Delta Ioc}{8 * Fsw * \Delta Vo}$$

The capacitor ripple voltage is selected from the following equation:

$$\Delta Voc = 2\% \, ofVo$$

V. Simulation Setup & Results

The Table I consist of the values of the parameters used in simulation which is shown below:

TABLE-I SIMULATION PARAMETERS

Parameters		Values
Load Voltage (in volts)		400 V
Battery Voltage (in Volts)		48V
Proposed Bidirectional Converter	L	0.18mH
	C	110µF
	Fs	5 KHz
PV Power		12 KW
PV Voltage		300V

The simulation circuit for Hybrid converter with dab converter for battery charging is provided in Fig. 10, which is shown below:

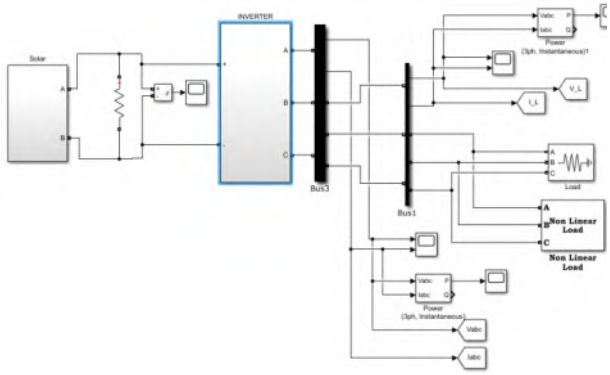

Fig 10. Simulation circuit of proposed Hybrid Converter System

In this, the PV power is reduced at t=1s when the irradiation reduced from 1000W/m2 to 500W/m2 which is the connected to battery with dab converter and to grid with hybrid converter. The PV voltage, current and power are provided below in Fig 11:

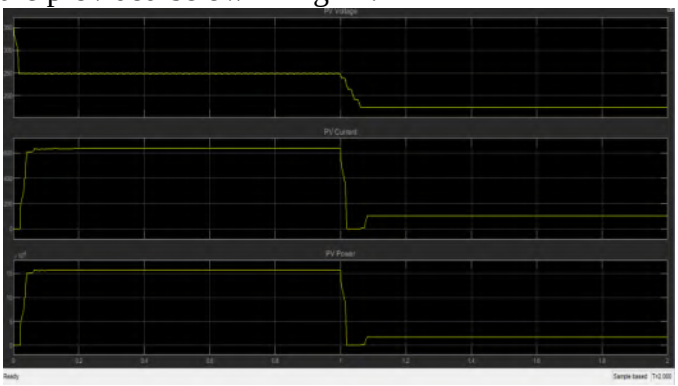

Fig 11 PV voltage, current and power

In this, the PV voltage are around 250V and reduced to 180V at t= 1s due to change in irradiation across the PV modules.

The dc bus current and voltage are provided below in Fig 12:

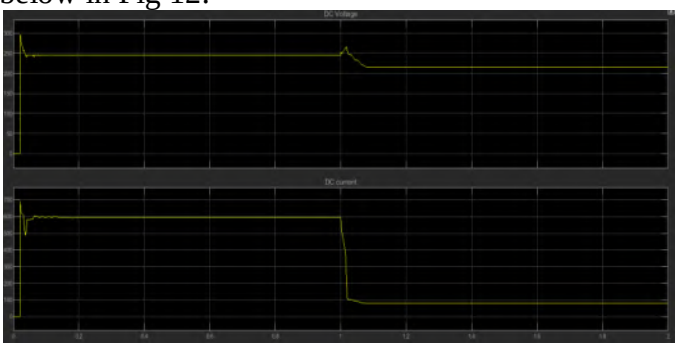

Fig 12 DC link current and voltage

The dc link voltage is around 250V and current is around 30A. It is provided to the battery load through the dab converter.

The grid current and voltage are provided below in Fig 13:

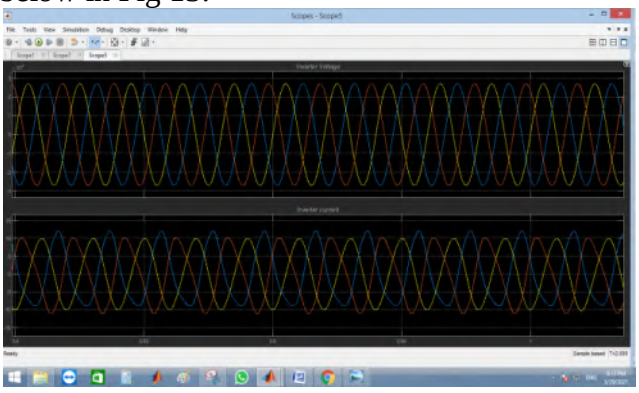

Fig 13Load current and voltage (with Boost Converter)

In this, the voltage is around 400V and current is around 30A.

The battery voltage, current and %SOC is provided in Fig 14:

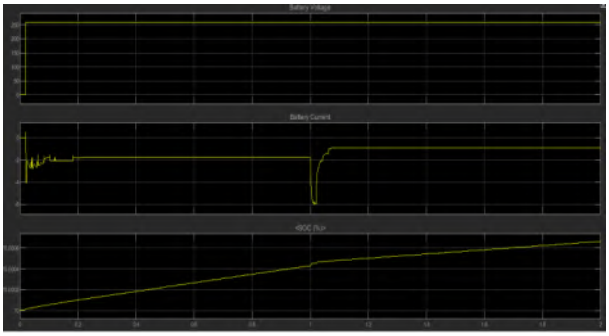

Fig 14 Battery Voltage, current and %SOC waveforms

The %SOC of the battery is increased at higher rate when irradiation is high and hen the irradiation reduced at t=1s, the rate of charging of the battery also gets reduced.

VI.Conclusion

In this paper, a hybrid source of PV and battery energy storage system is proposed along with bidirectional boost converter for three phase application. The controller for converter is the combination of mppt control with inverter control. The performance of the proposed converter under varying solar irradiation is noted with simulation results. The ANN control is trained and replaced the PI controller and the performance are noted.

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DESIGN OF BLDC DRIVE BASED ELECTRIC VEHICLE WITH POWER GENERATION FOR LOW VOLTAGE VEHICLE LOADS

Shreedhar Rao N R, Ms. Arpitha Raju B
[1]Power Electronics, Dr. Ambedkar Institute of Technology, Malathahalli, Bengaluru
[2]Electrical and Electronics Engineering, Dr. Ambedkar Institute of Technology, Malathahalli, Bengaluru

ABSTRACT

In this work, a BLDC motor drive based Electric Vehicle (EV) with Battery as source is proposed along with aDC - DC converter for boosting up the source voltage to rated load voltage. A speed control technique based on DC voltage control is also provided in this paper.When the EV is in charging station, the battery source is charged with the help of a1ϕ rectifier from the grid supply. A hardware prototype is developed with regenerative braking for charging the battery during braking mode.

Keywords: *Electric Vehicle, BLDC drive, Boost Converter, Voltage mode controller, Regenerative Braking.*

I. Introduction

In past years, there are numerous drive based applications wherever the induction motor drives (IMD)is ideally used attributable to its various featuressuch aswide speed management strategies, robustness, value effective, convenience in markets, less maintenance and repair value, convenient to all power ratings and can be operated inhazard areas. However there are some shortcomings in it. They are not suitable for a few specific conditions like, when the supply voltage is too low heating in motor is high, this condition also affects speed control and variation in torque. The BLDCmotors have the options like higher potency, high responsibility, rugged operating, lower magnetic force interference, they have high torque and efficient to achieve better rotor speed variations [1].The conventional BLDC motor drive comprises of uncontrolled AC - DC converter and voltage source inverter shown in Fig1. In this, high frequency (PWM) pulses is provided to VSI that is connected to BLDC motor. Due to this, switching losses gets higher in voltage source inverterdevices. Also, this leads to harmonic current flow from the grid supply and ends up with increased harmonic contents ingrid side with reduced power factor [2]. The international power quality (PQ) standards such as

IEC61000-3-2 don't accept PQ issues at grid supply terminals. The losses across the power electronic switches and PQ issues at grid terminals areprevailed overusing thecontrol strategy for BLDC drive with varying DC voltage according to the speed reference for VSI [4].

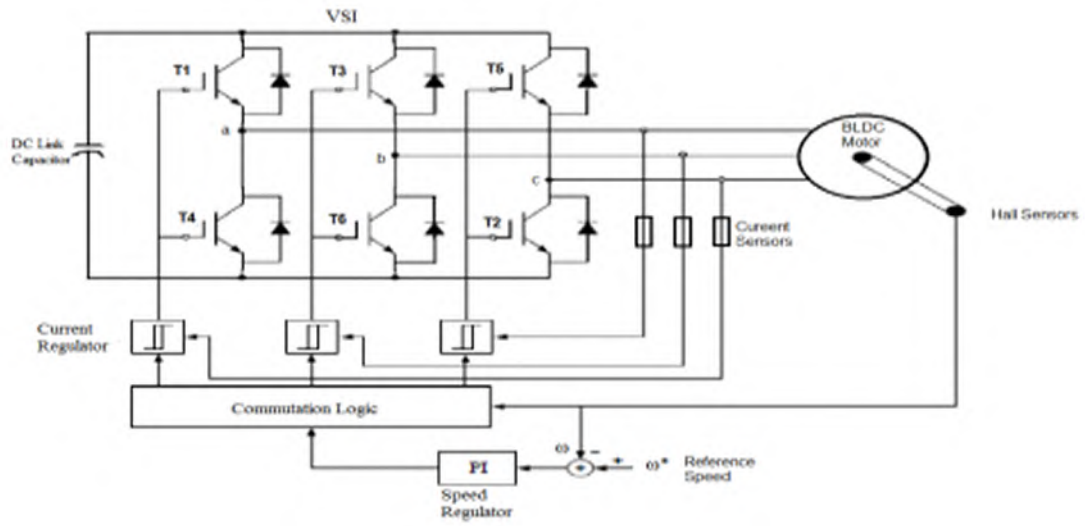

Fig.1: Conventional BLDC drive system

This provides the function of electrical converter just for setup of electronic commutation that is required for operating the BLDC drive at system frequency. ABLDC drive associated with boost converter using controlled dc voltage requires a voltage sensor and speed sensor. BLDC driveis associated with modifiedZeta and Luo converter used respectively[5,6].However, it needs higher filtering to reduce the EMI issues.

In this paper, a battery sourced boost converter provides supply to theBLDC drive is formulated for electric vehicles along with speed controllerusingcontrol loop for DCoutput voltage of the DC - DC (boost) converter. The reference DC voltage value is provided byPI controller based rotor speed control loopwhich usesdc voltage for controllingthe rotor speed of the motor. A hardware prototype is developed for the BLDC motor drive.

II.Proposed Bldc Drive System

The proposed BLDC drive based electric vehicle system is given below in Fig. 2.

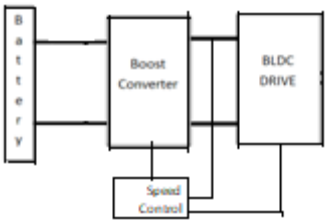

Fig.2: Proposed BLDC drive based Electric Vehicle

Here for BLDC motor, input source is from battery, then it is connected to Boost converter, the output voltage of Boost converter is given to VSI. The three phase AC from inverter is provided to stator winding of BLDC. A single voltage sensor is used in order to obtain actual dc voltage to control it with discontinuous operatingmode. The boost converter provides the controlled output voltage whichin turn controls the BLDC motor speed. The inverter operates in lower frequencybased on only electronic commutation.Thisminimizes the switching and conducting losses in voltage source inverter devices. The performance of theproposed system is gauged at various speed values, torsion and in operation settings.

A. Bridge Rectifier

The rectifier converts the ac supply voltage to DC voltage which is provided to battery in idle state of electric vehicle operation.

B. Boost converter

The boost converter steps up the input voltage from battery to the required output voltage to attain the reference speed provided to the control circuit.

C. Inverter and BLDC motor

For controlling the speed of the BLDC motor is from threephase AC which is provided by three leg voltage source inverter, inverter provides required power for the load. To know the EMF and direction of motor hall effect sensors are used in simulation.

III. Boost Converter& Operational Modes

The circuit configuration for the boost converter is given in Fig. 3 shown below:

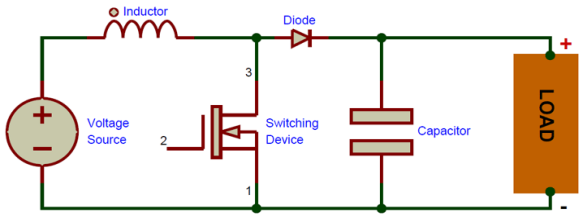

Fig.3: Boost converter Circuit

In boost converter, the input voltage is lesser than that of the output voltage provides that the output voltage is relied on the duty ratio. It comprises of a switch, inductor, diode and capacitor.

Mode 1:

The mode 1 operational circuit of boost converter is given in Fig. 4. When the power electronic switching device S is turned ON and therefore the inductance starts to get charged.

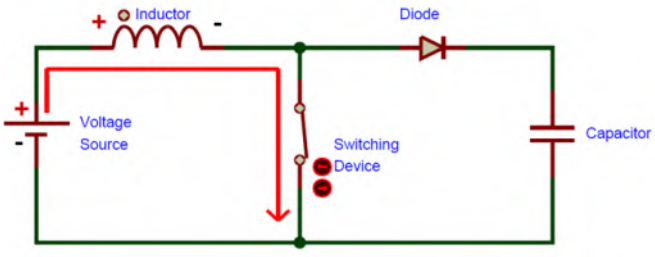

Fig.4: Mode 1 operational circuit of boost converter, VL=Vin

Mode 2:

The mode 2 operational circuit of boost converter is given in Fig. 5. Here, the power electronic switching device S is turned OFF and hence the inductance starts to discharge. In order to provide boosted voltage to VSI, inductor voltage adds up with the Vin.The output voltage equation for boost conversion is shown below:

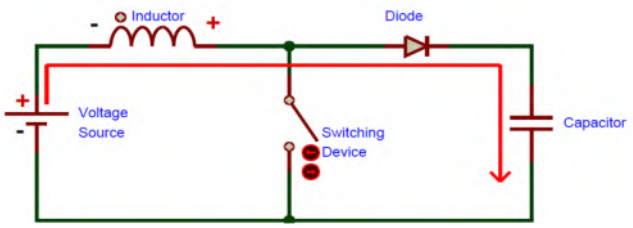

Fig.5: Mode 2 operational circuit for boost converter, Vo=Vin+VL

Design Equation of Boost Converter:

The boost converter duty ratio equation is provided as

$$D = \frac{V_o - V_{in}}{V_o}$$

The inductance equation of the boost convertor is shown below:

$$L = \frac{V_{in} * D}{\Delta I_o * F_s}$$

The boost converter inductance ripple current is shown below:

$$\Delta I_L = 0.2 \; to \; 0.4 * \frac{V_o}{V_{in}} * I_o$$

The equation for output capacitor of the boost convertor is shown below:

$$C = \frac{I_o * D}{\Delta V_c * F_s}$$

The output ripple voltage is shown below:

$$\Delta V_c = 0.1 * V_o$$

IV. Control Strategy For Converter And Motor

The control strategy for BLDC drive with a DC - DC converter involvestwo parts like controlcircuit for DC voltage regulation and BLDC motor control.

A. Control of boost converter

Here, the reference speed is provided to the controller and need to find the difference between reference speed and actual speed and the erroris provided to PI controller from which DC reference voltage is obtained.Again the difference between reference voltage generated by PI controller and measured boost converter voltageerror is provided to PI controller which providespulse width which is given for pulse generation.

If MC <VC then Q is ON

If MC ≥VC then Q is OFF

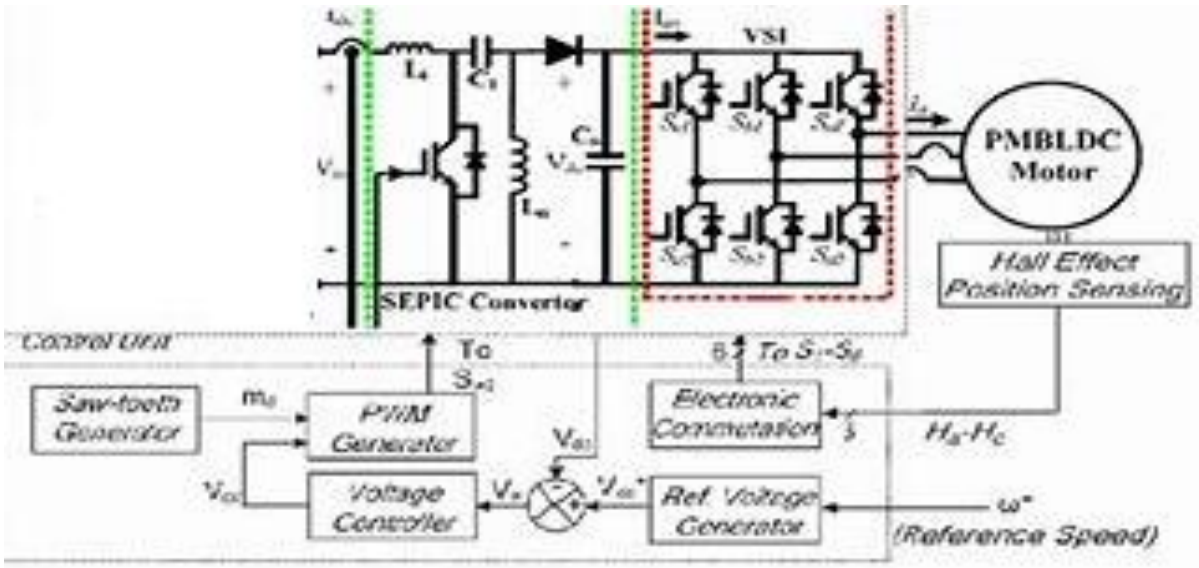

Fig 6:Control strategy for DC - DC converter and BLDC drive

B. Control System of BLDC motor

The BLDC operates in few particular switching sequences and hence in order to provide such switching sequences, hall sensors are utilized.The hall sensor output signals are converted into back EMF which is used for pulse generation. The hall signals desires decipherment and following truth table as shown in Table Iso that a correct sequence of switching is done.

TABLE I: Truth Table for BLDC drive

Ha	Hb	Hc	Emf_A	Emf_B	Emf_C	Q1	Q2	Q3	Q4	Q5	Q6
0	0	0	0	0	0	0	0	0	0	0	0
0	0	1	0	-Vb	+Vb	0	0	0	1	1	0
0	1	0	-Va	+Vb	0	0	1	1	0	0	0
0	1	1	-Va	0	+Vb	0	1	0	0	1	0
1	0	0	+Va	0	-Vb	1	0	0	0	0	1
1	0	1	+Va	-Vb	0	1	0	0	1	0	0
1	1	0	0	+Vb	-Vb	0	0	1	0	0	1
1	1	1	0	0	0	0	0	0	0	0	0

V. Simulation Setup & Results

The values of proposed system ratings and components used in simulation are provided in the Table II:

Table Ii: Simulation Components & Ratings

Parameters			Values
DC-DC CONVERTER	Output Voltage		400 V
	Power		1.5 kW
	BOOST CONVERTER	Inductor	0.2mH
		Capacitor	110µF
		Switching Frequency	5 kHz
Battery	Voltage		48 V
	Capacity		10.5 Ah

The simulation circuit of BLDC motor drive is given below in Fig.7.

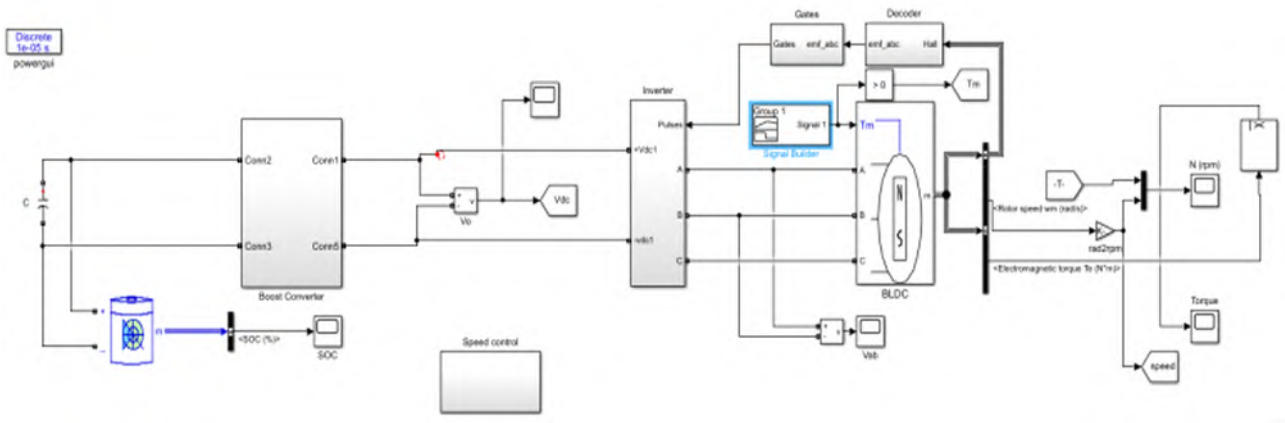

Fig. 7: Simulation circuit of BLDC motor drive

In this, the back EMF is used for generation of pulses which is derived from the output signals of hall sensors mounted on the motor. TheBLDC drive control loop is shown below in Fig.8.

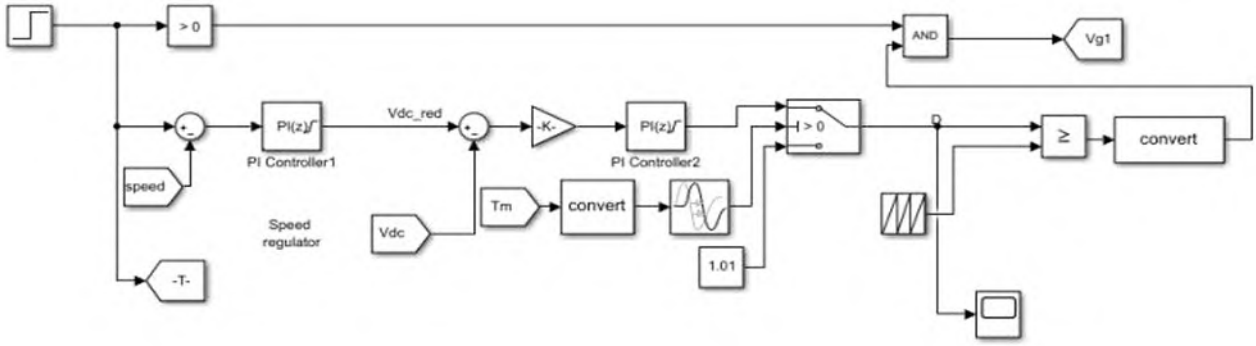

Fig. 8: Simulation control circuit for BLDC motor drive

Here, the reference speed is provided to the controller and need to find the difference between reference speed and actual speed and the error is provided to PI controller from which dc reference voltage is obtained. Again the difference between reference voltage generated by PI controller and measured boost converter voltage error is given to PI controller.This provides pulse width which is given for pulse generation.

When the vehicle starts operating, thegate pulses are generated and providedto the converter.

In this, the motor runs in traction mode from t=0s to t=0.8s and braking occurs at t=0.8s. The battery will be discharged during the traction mode. The battery will provide supply to the motor during traction mode through Bi - Directional converter (boost mode) and inverter. During braking mode, the battery gets charged through rectifier and bidirectional converter (buck mode). The boost converter output voltage is provided belowin Fig 9.

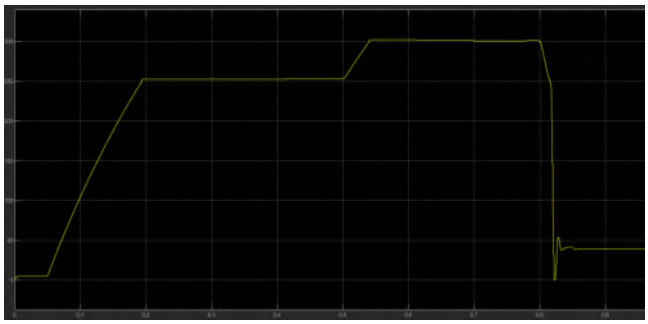

Fig. 9: Boost converter output voltage

In this, the DC voltage is around 300V during traction mode and during braking mode, it is reduced to 48V.

The inverter voltage of phase A is provided belowin Fig 10.

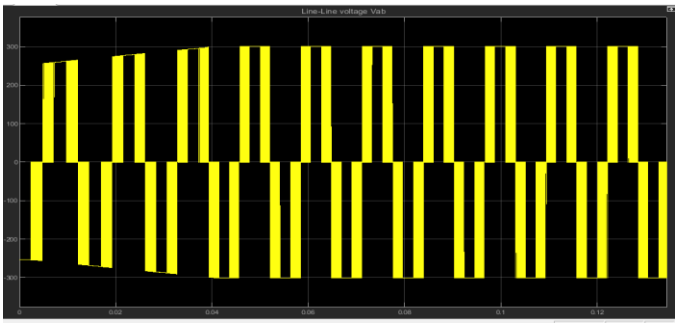

Fig 10 Phase A voltage of inverter

In this, the amplitude of the inverter voltage is around 300V. The rotor speed reference and measured is provided in Fig. 11.

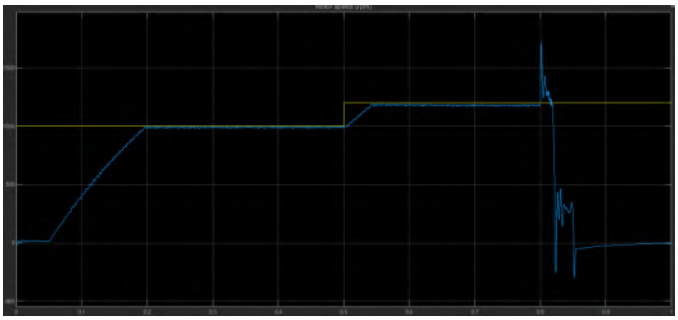

Fig. 11: Rotor speed of BLDC motor

The rotor speed reaches the reference speed at t=0.18s and during regenerative braking, the speed reduces below 25% of reference speed and rotor speed reaches zero at t=0.85s

The %SOC of the battery is provided below in Fig. 12.

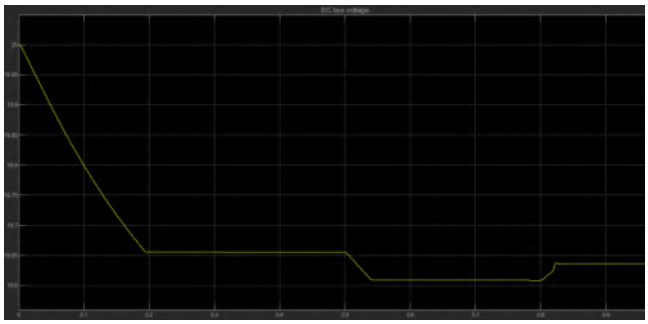

Fig. 12: %SOC of Battery

In this, the %SOC reduces as the battery discharges and after t=0.8s, it slightly gets increased due to the regenerative braking and voltage will be constant when the speed of the rotor reaches zero.

VI. Hardware Results

The hardware circuit is given below in Fig. 13.

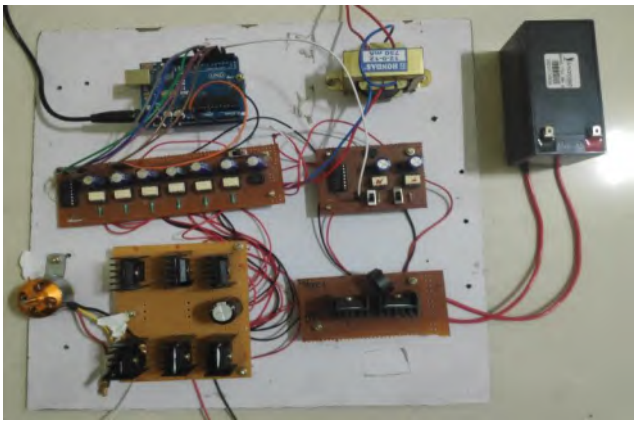

Fig.13 Hardware prototype circuit for BLDC motor drive

In this, 12V battery is provided as source to BLDC motor. As the power and voltage requirement of BLDC motors are high, we are just designing the prototype model of the BLDC drive with boost converter. The battery connected to the circuit is provided to boost converter which boost up the voltage to 18V and provided to the inverter. The inverter will convert the DC voltage to three phase voltage and provides to the motor. Arduino UNO controller is used for generating the switching pulses for both the Bi - Directional DC - DC converter and the inverter switches. The boost converter voltage is provided below in Fig. 13.

Fig. 14 Boost Converter output voltage waveforms

The inverter voltage for phase A is provided below in Fig. 15.

Fig. 15 Inverter voltage waveforms for phase A

The inverter operates during traction mode and when the braking occurs, the inverter switches will be turned OFF and the energy from the motor windings is fed back to battery through the body diodes and the Bi - Directional boost converter and the battery is charged.

VII. Conclusion

In this paper, a BLDC motor drive based Electric Vehicle (EV) with Battery as source is proposed along with a DC - DC converter for boosting up the source voltage to rated load voltage. A speed control technique based on DC voltage control is also designed and simulated.A hardware prototype was also designed for BLDC motor drive with regenerative braking so that the battery was charged during braking mode.

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ELECTRIC VEHICLE CHARGING STATION USING RENEWABLE ENERGY SOURCES-HARDWARE STUDIES

Nalini S.[1] and Pooja G[2],

[1,2]Dept of Electrical & Electronics Engineering, Dr Ambedkar Institute of Technology, Bengaluru

ABSTRACT

The adaptation of electric vehicles worldwide is accelerating and gradual in India, in particular due to the absence of development of the infrastructure. There are few standard EV charging facilities in retail malls, and there aren't enough hotels in the nation to get people the charging facility for their customers. However, the charge waiting time might be some 5 to 6 hours longer, making India steadily fall short of the EV trend. The hybrid energy storage system may improve the battery life by enhancing its operating conditions and also decrease charging time. This research paper provides a framework to charge the car in real-time with battery, solar and wind to overcome these challenges. The Arduino microcontroller can control the charging time, source diversions between battery, solar and wind, billing based on charging time. An additional feature to improve battery life is an overcharging safeguard. The hardware configuration successfully addresses the car charge problem.

Keywords— *Electric Vehicle, Charging, Hybrid charging, Microcontroller, Over charging protection.*

I. Introduction

In recent decades, electric vehicles (EVs) have become a major concern, largely because of the huge effects of global warming. Many governments promised and desired a solution in terms of reducing carbon footprint and integration of renewable energy [1]. The rationale for using energy and being able to locate new energy resources has been examined and applied to the electricity grid so that energy from

conventional sources may be compensated for. This issue is particularly essential if the Energy Management System (EMS) is to be used; to control the entire energy system framework termed the intelligent grid system as illustrated in Fig. 1. [2].

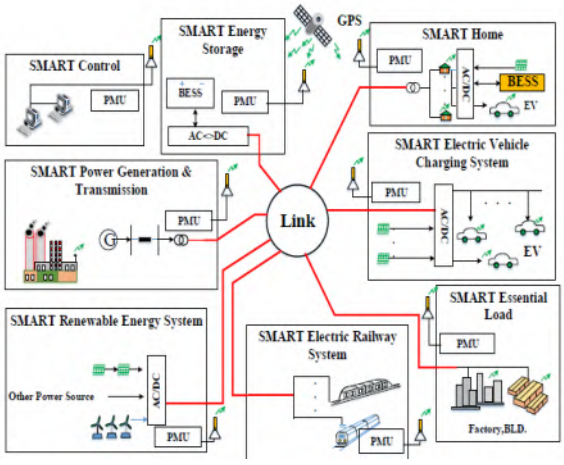

Figure 1: Smart Grid Energy System.

Environmental problems and increased costs of non-renewable crude oil have prompted scientists to seek a gas combustion engine substitute. Electric vehicles (EVs) have a good probability of becoming widespread owing to improvements in energy density, internal resistance, battery size, and battery costs. Furthermore, in terms of operating costs, environmental pollution and energy efficiency EVs are superior than traditional internal combustion engine (ICE) cars. One of the most popular EVs, Nissan Leaf, can drive around 250 km depending on the NEDC [3] with a full 30 kWh charge [3]. NEDC is a driving cycle designed to measure passenger vehicle emission levels and fuel savings. Most customers may profit from this range from and to the office, where about 78 percent of individuals travel on average 64 km or fewer per week as per the US Transportation Department [4]. Refill the battery with 3.3- or 6.6-kW on-board charger in 240VAC power supplies takes approximately 4 to 7 hours on the basis of Nissan Leav [3] and i-MiEV [5] EVs. The allowed power for the on-board charger is 240VAC which is only for the single-phase supply of current (called the Level 2 charging method) and SAE hybrid committee has fixed the power ratings of 19.2 kilo watts [6]. To obtain high power, the rate of charging is related to the charging power, which may be attained more quickly [7]. Our goal is to

develop a better onboard electric vehicle loader that allows the user to choose a charging solution as required. With this computer-based integrated management system (IMS), it enables the user to charge depending on how much current they need. When the input signal width changes, the power supply mode switches and controls the voltage and current accordingly (PWM). This results in battery voltage, input current, and vehicle temperature feedback being sent to the IMS to assess charge power for safety.

The battery charges for the Electric vehicle can be divided based on the power rating and it as shown in the table 1.

Power level	Charger location	Typical use	Typical power	Charging time	Connector
Level 1	On-board	Home	2 kW	4–11 h	SAE J1772
Level 2	On-board	Public	20 kW	1–4 h	SAE J1772
Level 3	Off-board	DC Fast	100 kW	<30 min	CHAdeMO/ CCS COMBO 2

Table 1: Power Charging Levels

A. Worldwide Adaptation of EVs

- The planned ban on fossil fuel cars in Norway was made public in 2016. Petrol and diesel-powered vehicles will be illegal to buy by 2025. The data showed that, of the new cars sold in Norway in January 2017, over half were electric or hybrid. Norway is among the first countries to allow the sale of vehicles that emit zero or minimal levels of emissions. As of December 2018, more than 135,000 electric vehicles have been registered in the nation. With laws requiring the nation to have more than 4 lakh battery-powered cars on the road by 2020, the organisation of EV's in the country is preparing by 2030 the Federal Council of the Bundesrat agreed to prohibit vehicles based on fossil fuels. The European Commission announced an EU ban on petrol and diesel automobiles in October 2016. The country wants to reduce its CO2 emissions by 95% by 2050, with the hope that EVs can contribute to achieving this goal.
- France has set the date for phasing out gasoline and diesel cars by 2040 and halting oil and gas production. It will be a critical factor in helping the nation reach carbon neutrality by the year 2050. By 2030, Paris plans to eradicate all fossil fuel vehicles from the city. A city-wide provisional ban on air pollution reduction is now in place. On 2018 registrations, approximately 150,000 electric cars were registered in France, with a 1.98% contribution to new registrations in 2017.
- New petrol and diesel cars cannot be sold in the UK from 2040 on the explicit instruction of the UK government.
- While plug-in vehicles, which account for less than 1% of total vehicle sales, were part of the original strategy, plug-in automobiles, which represent a minuscule percentage of overall sales, did not significantly contribute to it. Throughout the first half of 2018, about 2.2% of UK total vehicle sales are projected to rise.
- By the end of the year 2030 all around the globe the people will fully used shift from petrol to electric cars

B. India's EV Global Market Growth

- According to forecasts in 2013, electric vehicle (EV) growth would have a major impact on electric vehicle (EV) adoption in 2030 to deal with national energy safety, vehicle emissions, and capacity development issues. EV commitments to the Paris Convention would therefore be upheld. (https://beeindia.gov.in/content/e-mobility). Numerous car manufacturers, including Nissan, TATA, Mahindra, and Maruti Suzuki, are expected to launch their electric vehicles in 2020. According to Taumar (2019), Most motorcycles and scooters would be electrified over the next six to eight years according to the draught plan of Niti Aayog, headed by Indian Prime Minister Narendra Modi. not only sought to electrify the three-wheel autos haws of the nation, but insisted on doing so (Shah 2019). The motorbike and scooter industry in India had over 21 million sales in 2018-2019, making it one of the world's largest double-drive markets.

I. For electric vehicle's charging station

Better battery technology and electronic power management are required to integrate electric

vehicles in a larger power grid in the near future. Depending on the kind of EV and the charging level, EV energy usage may have a wide range of impacts. To sum up, it was concluded that for the purpose of power system energy support, EVs may be categorized based on the fact that they exist in a variety of shapes, sizes, and weights.

Among all renewable resources, wind and solar energy have been widely involved in renewable energy initiatives from all countries. But it also has severe problems, given that the wind speed is inconsistent and regularly fluctuates, which would significantly affect the system stability. The panels must be rotated or changed such that the rays are. Integrating the energy storage system into the wind power system can improve the overall power system stability and dependability.

A. Different types available to charge the Electrical Vehicle.

Many types of electric motors can also be represented by combining motors and motors named for pure electric motors. The engine type may be used to convert energy from the energy-storage system which can be characterized in EVs with different types in the four following categories,

1. Hybrid Electric Vehicles (HEVs) The internal combustion engine, which powers the primary propulsion system, gets electricity from an electric propulsion system, which may transmit power to the traction drive by means of an electric motor. Torque and speed are responsible for determining the automated power control.

2. Plugs-in-hybrid electric cars (PHEVs) Other than when they can be recharged by plugging them into power outlets or charging stations, HEV vehicles may be manufactured using all-electric processes. Reducing fuel consumption in the internal combustion engine helps the environment. Since, electricity is an alternative energy source for PHEVs, and it is initially utilized, then electricity is an alternative energy source for PHEVs.

3. Battery Electric Vehicle (BEV) A kind of electric vehicle uses an internal combustion engine, motor control, and a battery to store chemical energy instead of an electric motor. The electricity they receive is either from the charger at home or the charging station, which is situated where the battery packs are located.

4. Fuel Cell Electric Vehicle (FCEV) is an electric vehicle type that uses a fuel cell rather than a battery. It is possible for the FCEV to convert energy from one kind to another to power the control system. To make the fuel cell, you must utilize air and compressed hydrogen. Yet, FCEV was costly and new technologies that were of interest but not yet ready for commercialization, all working along with the internal combustion engine.

II. Implementation

The proposed framework has the block diagram as showed in the Figure2.

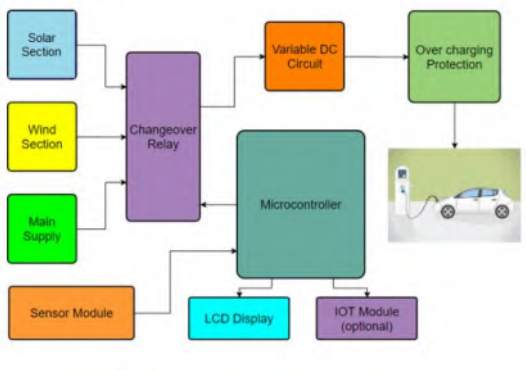

Figure 2: Block Diagram of the Proposed System.

The blocks which are available in the proposed framework are as follows,

1. Solar Sub-section: The model used 10 watts of solar panels for implementation and prototyping, which has thirty-six silicon cells to convert electricity from light. It has the power ratings shown in the table below

Wattage (Wp) Voltage rating	10 Watt 12 Volt
Voltage at Max Power,(V)	16.85 Volt
Current at Max Power, Imp (A)	0.59 Volt
Open Circuit Voltage, (V)	20.9 Volt
Short Circuit Current (A)	0.65 Amp
number of cells	36 Number

Table 2: Power Ratings for the Solar Panel.

2. Convertors: The IC is used to convert the DC to DC with high power levels. The frequency of operation of the IC is 150 kilo hertz. The voltage input is transformed to the required voltage

output. The IC pin arrangement is depicted in the image below

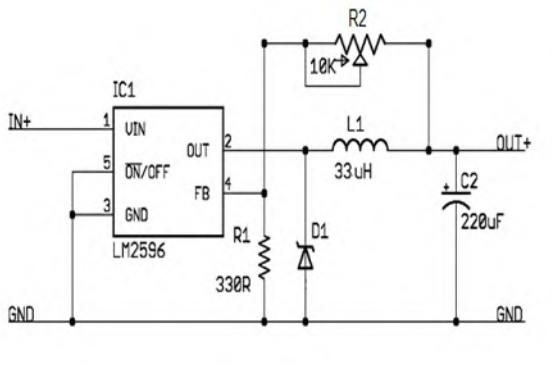

Figure 3: Pin Configuration of the Convertor IC.

The hardware specification of the convertor IC is as shown in the below table.

Input voltage:	4.5V-35V
Output Voltage: (Less than input)	1.3V-30V
Output current:	3A
Conversion efficiency:	92%
Switching frequency:	150KHz
Output ripple:	50mV (maximum) 20M-bandwidth
Load regulation:	± 0.5%
Voltage regulation:	± 2.5%
Operating temperature:	-40 °C to +85 °C

Table 3: Power Specification of the Convertor IC.

3. Discrete components: Liquid Crystal Display of dimension 16x2, Diode- 1N4007, Capacitors with 470 Micro Farad.
4. The voltage and current sensors are placed to accurately sense the required voltage and current.

Solar and Wind Modelling

Designing the wind model based on wind speed

Based on the speed of the moving vehicle the wind accumulation in the turbine varies. The Weibull distribution provides the relationship for this speed with respect time. [17]

$$f^t(P) = \frac{\beta^t}{\alpha^t}\left(\frac{p^t}{\alpha^t}\right)^{\beta^t-1} exp\left(-\left(\frac{p^t}{\alpha^t}\right)^{\beta^t-1}\right), for\ \alpha^t > 1; \beta^t > 1$$

The shape of the wind blades are designed using the below equation

$$\beta^t = \left(\frac{\sigma^t}{\mu_p^t}\right)^{-1.086}$$

$$\alpha^t = \frac{\mu_p^t}{\Gamma(1+1/\beta^t)}$$

Where alpha and muo are the standard deviation and mean of the model's speed with respect to the time.

The wind blade has the following specifications, Pitch of the blade is 5.5 inches, diameter of the propeller is ten inches, having a hub diameter of 0.65 inches with thickness of 0.35 inches. Overall weight of the blade is 0.53 grams.

Solar modelling

The solar power generation is based on the irradiance value and it is calculated by using the below equation,

$$f^t(R) = \frac{\Gamma(a^t+b^t)}{\Gamma(a^t)\,\Gamma(b^t)}(R^t)^{a^t-1}(1-R^t)^{b^t-1}, \quad for\ a^t > 0; b^t > 0 \quad [18]$$

Where, Γrepresents the gamma function for the shape parameters a and b.

III. PROTOTYPE OF THE MODEL

The prototype of the execution model for charging the Electric Vehicles are showed in the below figure,

Figure 4: Prototype of the Proposed Framework.

The voltage supply to the vehicle is sufficient or not is determined at first using the voltage sensos. All the reading are provided to the microcontroller. The microcontroller decides to choose one among the three sources. The DC-

DC convertors are employed to provide the higher current which helps in reducing the charging time of vehicle. The overcharging avoidance system is provided as the added advantage which in-turn increases the battery's life. Once the vehicle is charged, the consumption charges is sent to the customer using the Internet of Things technology and the same is displayed in Liquid Crystal Display.

IV. Result and Discussion

The implementation results are discussed in this section which provides the information about the various conditions such as, when to select the one among the three power sources. The instance of customer bill uploaded in the Cloud (think speak) serve will be provided.

The charging performance is formulated in the chart.

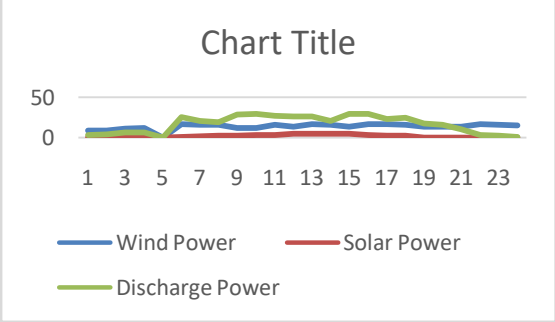

Fig 5: Generation of power using solar and wind based on hours.

In the figure 5 the x axis holds the hours of the day and y axis hold the electricity in kilowatts.

Once the charging is completed the cost need to be paid by the customer is sent to them using Internet of Things technology.

The instance of Think speak with cost is as shown in the figure 7.

Figure 7: Charges are updated Using Think Speak.

V. Conclusion and Future Scope

Electric based cars are going to reduce the usage of the non-conventional fuels which in turn reduces the pollution as per the pollution board surveys. As the developing country like India these technologies can provide the more employment opportunity. The existing systems are not able to provide the overcharging breaking facility in their charging unit this reduces the life of the battery. The paper successfully formulated the prototype of the model to serve as the real time charging unit. The results snapshots shows that the model can be applied to real world scenario. The future work can be extended to introduced a fast-charging facility for the electric vehicles.

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EFFECT OF HIGH AND LOW VELOCITY BALLISTIC TRAINING ON EXPLOSIVE POWER AMONG NOVICE COLLEGE ATHLETES

M. Nadeem[1],P. Kulothungan[2] and S. Bupesh Moorthy[3]
[1,2,3]Department of physical education, Annamalai University Tamil Nadu,
[1]nadeemdar543@gmail.com, [2]pkuloth@gmail.com

ABSTRACT

The purpose of the study was to find out the effect of high velocity and low velocity ballistic training on explosive power (vertical jump) among novice college athletes. To achieve this purpose,forty five male students studying in department of physical education, Annamalai University, Chidambaram, Tamil Nadu, India, were randomly selected and divided into three groups of fifteen each. The age of the subjects, ranged from 18 to 24 years. This study consisted of two experimental variables (high velocityballistic training(HVBTG) and low velocityballistic training (LVBTG)). The allotment of groups was done at random, thus Group-I underwent high velocityballistic training, Group-II underwent low velocityballistic trainingfor three days per week for twelve weeks, Group-III acted as control. All the subjects were tested prior to and after the experimentation period. The collected data were statistically treated by using ANCOVA, and 0.05 level of confidence was fixed to test the significance. When the obtained 'F' ratio was significant, Scheffe's post hoc test was used to find out the paired mean difference. The results of the study revealed that there was a significant difference among high velocity ballistic training group, low velocityballistic training group as compared to control group on explosive power. And also, it was found that there was a significant improvement on explosive power due to high velocityballistic trainingas compared tolow velocityballistic training among novice college athletes.

Keywords: *High velocity ballistic training, Low velocity ballistic training, Vertical jump*

1. Introduction

Ballistic training is commonly used to target improvements in explosive power output and athletic performance. This training modality involves exercises that require the athlete to exert as much force as possible in short periods of time as in the ballistic movements (Winchester et al., 2008). Ballistic performances, notably jumping, can be definedas the ability to accelerate body mass, both as much as possible and within the shortest time possible (Samozino et al., 2012). From a mechanical point of view, ballistic push-off performance is thus directly related to the net mechanical impulse produced onto the ground (Winter, 2005). The capability to develop a high net impulse during one lower limb push-off has been associated with muscular mechanical power output capabilities (McBride et al., 2010). Numerous studies have highlighted neuromuscular power as the primary variable related to ballistic performance, yet this analysis only provides a partial representation of the athlete's true maximal mechanical capabilities (Cronin and Sleivert, 2005). Specifically, in the recent years, a new paradigm supports the fact that although ballistic performance such as jumping height is largely determined by maximal power output that lower limbs can generate (Yamauchi and Ishii, 2007), it is also influenced
by the individual combination of the underlying force and velocity mechanical outputs, known as force-velocity profile (Morin and Samozino, 2016). Thus, the inclusion of force-velocity relationship and their contribution to ballistic performance may provide a more accurate and integrative mechanical representation of the athlete's maximal capabilities, since they encompass the entire force- velocity spectrum, from the theoretical maximal force to the theoretical velocity capabilities**.**

Velocity specificity is an important consideration when designing resistance training programs. It indicates that training adaptations (e.g., increased strength/power) are greatest at or near the training velocity However, there exists a conflicting hypothesis that the intention to move a barbell, one's own body, or any other object explosively is more important than the actual movement velocity in determining velocity-specific responses of the neuromuscular system to resistance training (Behm and Sale, 1993).

The relative difference between actual and optimal force-velocity profiles for a given individual represents the magnitude and the

direction of the unfavorable balance between force and velocity qualities i.e., force-velocity imbalance, in %, which makes possible the individual determination of force or velocity deficit. The actual individual force-velocity profile and Pmax can be easily determined from a series of loaded vertical jumps (Giroux et al., 2016), while the optimal force-velocity profile can be computed using previously proposed equations based on a biomechanical model (Samozino et al., 2014). For a given Pmax, vertical jump performance has been shown to be negatively correlated to force-velocity imbalance, which supports the importance of considering this individual characteristic in addition to Pmax when designing training programs to improve ballistic performance.

Power is one of the most important characteristics of muscle function and one of the most important capabilities for any athlete in competitive sports (Kraemer and Looney,2012). From an exercise perspective, the ability to perform high-intensity to maximum exercises in less than one to a few seconds is called power. According to this subject, any increase in power should be obtained from progress in strength, speed, or a combination of both. Therefore, it can be used from strength training, and especially from the resistance-power training method for this purpose. The main stimulus in these exercises is the dynamics of movement, which is associated with the magnitude of the force exerted in the same effort (Harris et al., 2008) and it must be performed quickly and explosively to apply the most motor units with the highest contraction rate and create the most neuromuscular compatibility. The main purpose of strength training in high-level competitive sports is the specific progress of players and the relationship between athletes activities and the type of specific strength training that is done in that sport (Zagatto et al., 2008). Thus the present study was undertaken to explore the effect of high and low velocity ballistic training on explosive power among novice College athletes.

2. Methodology

The purpose of the study was to explore the effect of high velocity and low velocity ballistic training on explosive power (vertical jump) among novice college athletes.To achieve this purpose forty five male students studying bachelor's degree in the Department of Physical Education, Annamalai University, Chidambaram, Tamil Nadu, India, were selected as subjects at random. The selected subjects were randomly divided into three groups and each group consisted of fifteen subjects. The groups were randomly segregated as high velocity ballistic training group, low velocity ballistic training group and control group. Group-I underwent high velocity ballistic training programme, group –II underwent low velocity ballistic training programme for three days per week for twelve weeks. Group-III acted as control and they did not participate in any special training programme.Explosive power (vertical jump)was selected as criterion variable andwas measured by explosive power with vertical jump in nearest centimeters. The subjects of all three groups were tested on explosive power, prior to and immediately after the training programme.

2.1 Training load

The experimental group-I underwent high velocity ballistic training and group-II underwent low velocity ballistic training regimen for a period of twelve weeks. The training regimen for high and low velocity ballistic training consisted three sets eight exercises per day, three days per week. After selecting the exercise 1 RM was found for each exercise separately. 1RM is the maximum amount of weight a person can successfully lift one time only through the full range of motion. High velocity ballistic group started with 60% of intensity and it was increased once in two weeks by 5% and 3 sets x 12 repetitions was given for twelve weeks. Low velocity ballistic groupstarted with 60% of intensity and it was increased once in two weeks by 5% and 3 sets x 6 repetitions was given for twelve weeks and rest interval of two minutes between repetition and five minutes between set was given. The control group did not participate in any special training during this period.

2.2 Statistical Technique

All the subjects of three groups were tested on dependent variables prior to and immediately

after the training programme. The analysis of covariance (ANCOVA) was used to analyze the significant difference, if any among the groups. Since, three groups were compared, whenever the obtained 'F' ratio for adjusted post- test was found to be significant, the Scheffe's test was applied to find out the paired mean differences, if any. The 0.05 level of confidence was fixed as the level of significance to test the 'F' ratio obtained by the analysis of covariance, which was considered as appropriate and the results are presented below.

3. Result of study

The influence of low and high velocity ballistic training on each criterion variables were analyzed separately and the results are presented below.

Table-I
Anacova For Before Training And After Training On Explosive Power Of Experimental And Control Groups

	HVBTG	LVBTG	CG	SOV	SS	df	MS	'F' ratio
Before Training Mean	42.13	40.53	41.33	B	19.20	2	9.60	1.46
SD	2.28	3.04	2.26	W	274.8	42	6.54	
After training Mean	51.86	47.86	42.40	B	677.51	2	338.76	52.48*
SD	2.74	2.66	2.74	W	271.06	42	6.45	
Adjusted Posttest Mean	51.61	48.12	42.40	B	642.97	2	321.46	54.17*
				W	243.31	41	5.93	

*Significant F = (df 2,42) (0.05) = 3.22 ; (P ≤ 0.05) and F = (df 2,41) (0.05) = 3.23 ; (P ≤ 0.05)

It is clear from Table- I that before experimental intervention the mean values on explosive power for HVBTG is 42.13, LVBTG is 40.53 and CG is 41.33. The obtained 'F' ratio 1.46 is less than the table value of 3.22 required for df 2 and 42 at 0.05 level of significance. It is inferred that there is statistically no significant variation on explosive power among HVBTG, LVBTG and CG before the commencement of training programme. The mean scores secured by the HVBTG, LVBTG and CG after experimental interventions are 51.86, 47.86 and 42.40 respectively. The 'F' ratio of 52.48 arrived at by the statistical calculation is higher than the table value of 3.22 required for df 2 and 42 at 0.05 level of significance. It reveals that all the three groups have demonstrated significant variations on explosive power at the end of the training programme.

Table -I further shows that the adjusted post-test mean values for HVBTG is 51.61, LVBTG is 48.12 and CG is 42.40, which resulted with an 'F' ratio of 54.17 and it is higher than the table value of 3.23 required for df 2 and 41 at 0.05 level of significance. It is found that significant differences exist among the three groups on explosive power after adjusting the initial mean differences on the post-test means.

In order to determine which of the paired means have significant differences, Scheffe's test was computed and the result is presented in table - II.

Table – II Scheffe's Post Hoc Test For The Adjusted Post-Test Paired Mean Differences On Explosive Power

ADJUSTED POST TEST MEANS				Confidence Interval
HVBTG	LVBTG	CG	Mean Difference	
51.86	48.12		3.74*	2.25
51.86		42.40	9.46*	2.25
	48.12	42.40	5.72*	2.25

*Significant, (p ≤ 0.05)

The table II shows that the adjusted post- test paired mean difference between HVBTG and LVBTG, HVBTG and CG and LVBTG and CG are 3.74, 9.46 and 5.72 for explosive power respectively. All the three mean differences are higher than the confidence interval of 2.25 required for significance at 0.05 level of confidence. It is inferred that the twelve weeks of training for HVBTG and LVBTG have significantly increased the explosive power as compared to the CG. The result also reveals that the increase in explosive power is significantly more for HVBTG as compared to LVBTG.

4. Discussion of Study

The result of present study was that explosive power has increased significantly for high velocity ballistic training group and low velocity ballistic training group as compared to control group. However the result of the present study also reveals thatincrease in explosive power significantly more for high velocity ballistic training group than low velocity ballistic training group among novice college athletes. It is inferred that high velocity ballistic training has produced statistically significant effect on explosive power. However, explosive power also improved significantly after high velocity ballistic training protocol.

The important point to be discussed is why there is a significant increase in explosive power for low velocity ballistics training group as compared to control group. The reason could be attributed to the fact that the increase in maximum strength will also lead to increase in power and ability to generate more force at fast speed, since strength is strongly correlated with power, especially in less trained athletes. The reason for greater increase in explosive power for ballistic group than the resistance training group may be attributed to the reason that the improvement of power is greater in ballistic training since it involves sequence of throwing and these actions recruit fast twitch muscle fibers and in addition it induces central nervous system to co-ordinate a sequence for throwing so that larger quantizes of force is generated in the shortest possible time. In addition to this, ballistic training uses higher velocity with lower force.

The result of these studies are conformed with the finding of (Newton et al.,1999) optimal load ballistic resistance training at the end of season attenuates declining jump performance on women volley ball players. The ballistic training significantly produced more effect in improving vertical jump and performance. (Hoffman et al.,2005)have showed that the greater level of significance in vertical jump and standing board jump performance when compared to the control group. (Kraemer and Others, 2001)have also found an increase in these characteristics. Besides some others have also found an increase in vertical jump and standing board jump when compared to the performance as to the control group (Sivakumar and Kulothughan2011) results of the study reveal that there was a significant improvement after the 12 week of conventional resistance training and ballistic training in vertical jump performance. Improvements in both CMJ and SJ were evident after the entire power training period in EXP, and these findings were similar to previous studies involving explosive weight/power strength training or in combination with heavy strength training (Lamas et al., 2012; Lyttle et al., 1996; Smilios et al., 2013; Wilson et al., 1993). In the present study, the magnitude of improvements in CMJ was 10 % and in SJ 16 % after pre- to mid-training (4 weeks) and during the next training period no further significant improvements were observed (i.e. improvement plateau). Interestingly, percentage improvements in CMJ and SJ were 18 % and 15 % from pre- to post training (10 weeks) in a study by Wilson et al. (1993). Thereafter, a plateau in SJ performance was observed after mid-training (5weeks) but significant improvements in CMJ continued throughout the jump squat training period.

In contrast to vertical jump performance, improvements in isometric maximal force production (Fmax) were significant from pre- to mid-training and also from mid- to post-training. The magnitude of improvements from pre- to mid-training was ~14 % and ~5 % from mid- to post-testing. Short-term jump squat training has been observed to improve maximum strength (either dynamic or isometric testing) (Lamas et al., 2012; McBride et al., 2002; Smilios et al., 2013) however,

some studies using light load (0-30% 1-RM) jump squats have not observed improved maximum strength performance (Cormie et al., 2010; Wilson et al., 1993). Furthermore, in studies comparing heavy strength training to jump squat training greater improvements in maximum strength occurred using higher loads (Cormie et al., 2010; Smilios et al., 2013; Wilson et al., 1993). In addition to the positive association between Fmax and SJ improvements, there were also negative associations between Fmax and 50 m sprint time. These findings suggest that improving maximum strength favorably influences some elements of explosive athletic performance. Thus, one possible training strategy for athletes with limited time to improve athletic performance (e.g. team sports) would be to perform jump squats with Pmax loads until a plateau is reached (e.g. approx. 4 weeks and/or 12 sessions) and then use lighter and heavier loads periodically to further increase specific performance. (Marian et al.,2016) Eight weeks of jump squat training resulted in significant improvements in countermovement jump, squat jump, maximum isometric squat force and average force over 100 ms, as well as 50 m sprint time. Only the improvement in vertical jumps plateaued after 4 weeks of training, with further improvements observed from week 4 to 8 in isometric force and sprint performances. The present study suggests that short-term jump squat training can improve several different athletic performance tasks simultaneously. This may be important, for example, where training duration is limited such as in team sports.The result of these studies support and prove that high and low velocity ballistic training has significant effect on explosive power (vertical jump) among novice college athletes.

5. Conclusion

There will be significant difference for high velocity ballistic training group and low velocity ballistic training group when compared to control group. However, the result of the present study also reveals that increase in explosive power significantly more for high velocity ballistic training group than low velocity ballistic training group among novice college athletes.

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ANALYSIS OF VITAL CAPACITY AMONG SCHOOL BOYS AND GIRLS WITH DIFFERENT AGE GROUPS

Reyaz. A.R[1], P. Kulothungan[2], S. Bupesh Moorthy[3]
[1,2,3]Department of physical education, Annamalai University, Tamil Nadu
[1]reyazphd600@gmai.com, [2]pkuloth@gmail.com

ABSTRACT

The aim of the study was to investigate the vital capacity among players of school boys and girls of three different age groups studying at various schools of Cuddalore district, Tamil Nadu. To achieve the purpose of the study one hundred and eighty (180) players were selected comprised of ninety boys and ninety girlsfrom among the three age categories of U-14, U-17, and U-19. Thus, the study comprised of ninety players under the category of boys with thirty players in each of the age group of U-14, U-17 and U-19. Similarly, ninety players were in the category of girls with thirty players in each of the age group of U-14, U-17 and U-19. The data collected from U-14, U-17, U-19 players of both gender (boys and girls) on vital capacity was measured by using wet spirometer, were statistically analysed by using 2 x 3 factorial ANOVA (gender x age categories). When the obtained 'F' ratio for interaction was significant, the simple effect test was applied as a follow up test. In all cases, the 0.05 level of confidence was fixed to test the level of significance which was considered as more appropriate. The result of the study showed that the players under boys category were significantly better in vital capacity. The result also revealed that the vital capacity was significantly better for BU- 19 players as compared to BU- 17 and BU-14 players. Further GU-19 players and GU- 17 players have showed significantly better vital capacity as compared to the GU- 14 players. The result also reveals that the increase in vital capacity is significantly more for GU-19 players as compared to GU-17 players.

Keywords: *-Vital capacity, boys and girls*

1. Introduction

Vital capacity is the overall air capacity that can be inhaled or exhaled from the lungs. This is one of the measurements taken by the spirometer or pulmonary function test. Vital capacity is calculated by the use of spirometer. Ronald et al.,(2005). Spirometry being the mostcommonly performed lung function test, is consideredas first choice in diagnosis of lung pathology.Spirometry is a technique used to measure amount andflow of air inhaled and exhaled. Itmeasures amount of air that can be moved in and out ofone's lungs.Vital capacity is the maximum amount of air that a person can remove from the lungs after a deepest inhalation. It is equivalent to any inspirational reserve volume, tidal volume and expiratory reserve volume. Individual vital capacity can be measured by a wet or normal spirometer.MacIntyre& Neil. R. (2012)

Most measured entity of lung function is vital capacity. Change in volume of lungs after taking maximal inhalation followed by maximal exhalation is called vital capacity of lungs. It is the sum of tidal volume, inspiratory reserve volume and expiratory reserve volume. Vital capacity of normal adults ranges between 3 to 5 litres. A human's vital capacity depends on the age, sex, height, weight and ethnicity. Lung volume and lung function is related to air volume associated with various phases of the respiratory cycle. The lung volume is determined directly, while the lung capacity is inferred from the volumes. Muhammad et al., (2006).

The average of an adult human male is around 6 liters of air, although only a small amount of this capacity is used for normal breathing. Tidal breathing is natural resting breathing, the volume of tidal breathing is the volume of air that is inhaled or exhaled in a single breath. The average of human respiratory rate is 30-60 breaths per minute at birth which falls to 12-20 breaths per minute in adults. Vital capacity is a concept that refers to the full volume of the human breathing in the lungs. It depends on several factors, such as how fit some of them and other factors which influence are smoking, obesity, height, weight, sex, body size and posture.Marieb & Hoehn, (2010)

It is generally accepted that the ratio of forced expiratory volume is 1 s (FEV1) to forced vital capacity (FVC), the established index for diagnosing airway obstruction, decreases from childhood to old age Quanjer et al., (2010).Indeed, it has been shown that infants have larger middle and peripheral airway sizes they are obtained from the proportional

downscaling of the adult lung and that lung volumes increase more rapidly than airway calibre in early life. It has also been suggested that the FEV1/FVC ratio falls with both increasing age and body height. Stanojevic et al., (2009)

Unlike adulthood, childhood and adolescence represent a period of growth of lung volumes and forced ventilatory flows rather than decay. This growth phase is associated with significant changes in alveolar number and size, the shape and stiffness of the thorax, and muscular strength (Tomalak et al., 2002). This potentially affects the total lung capacity (TLC) as well as the FVC, whereas the development of flows, and hence FEV1, is determined by airway calibre and the elastic properties of lungs and airways. Thus, airway properties, thoracic growth, changes in the mechanical properties of the chest age and muscular strength interact from birth to early adulthood. During the adolescent growth spurt, this is associated with differences in the timing and rate of growth of lung volumes, flows and body dimensions**.** It, therefore, seems counter-intuitive that the FEV1/FVC ratio should fall linearly with age or height during childhood and adolescence as it does in adults, or that the ratio of residual volume (RV) to TLC should remain constant**.**Quanjer P, H. et al., (1995)Thus, the present study was undertaken to analysis of vital capacity among school boys and girls with different age groups.

2. Methodology

The study was undertaken to investigate the vital capacity among players of school boys and girls of three age groups studying at various schools of Cuddalore district, Tamil Nadu. To achieve the purpose of the study one hundred and eighty (180) players were selected comprised of ninety boys and ninety girlsfrom among the three age categories of U-14, U-17, and U-19. Thus, the study comprised of ninety players under the category of boys with thirty players in each of the age group of U-14, U-17 and U-19. Similarly, ninety players were in the category of girls with thirty players in each of the age group of U-14, U-17 and U-19.The age of the subjects ranged between 12 to 19 yearsand the data collected from U-14, U-17, U-19 players of both gender (boys and girls) on vital capacity was measured by using wet spirometer, were statistically analysed by using 2 x 3 factorial ANOVA (gender x age categories). When the obtained 'F' ratio for interaction was significant, the simple effect test was applied as a follow up test. In all cases, the 0.05 level of confidence was fixed to test the level of significance which was considered as more appropriate**.**

3. Result Of The Study

Table – I: Mean And Standard Deviation Of Vital Capacity Among Gender (B & G) And Different Age Categories (U-14, U-17, U-19 Players)

Gender / Ages		Under- 14	Under- 17	Under- 19	Combined
Boys	Mean	3507.66	3794.00	3965.00	3755.55
	SD	213.97	280.61	262.66	
Girls	Mean	3373.66	3545.00	3602.33	3507.00
	SD	189.01	211.01	170.30	
Combined	Mean	3440.66	3669.50	3783.66	3631.27

Table – I indicates that the mean and standard deviation value of vital capacity between U-14 boys and U-14 girls were 3507.66 ± 213.97 and 3373.66 ± 189.01 with combined mean value of 3440.66. The U-17 boys and U-17 girls mean and standard deviation values on vital capacity were 3794 ± 280.61 and 3545 ± 211.01 with combined mean value of 3669.50. The U-19 boys and U-19 girls mean and standard deviation values on vital capacity were 3965 ± 262.66 and 3602.33 ± 170.30 with combined mean value of 3783.66. The combined mean value on vital capacity of boys U-14, U-17, U-19 players was 3755.55. The combined mean values on Vital capacity of girls U-14, U-17, U-19 players was 3507.

Table –Ia: Two Factor Anova For Vital Capacity Of Gender (B & G) And Different Age Categories (U-14, U-17, U-19 Players)

Source of Variance	Sum of squares	Df	Mean squares	'F' ratio
Factor A (Gender)	2780093.88	1	2780093.88	55.09
Factor B (Age categories)	3660954.44	2	1830477.22	36.27
Factor A & B (Interaction)	392167.77	2	196083.88	3.88
Residual	8780590	174	50463.16	

*Significant at 0.05 level of confidence.

The required table value for significant at .05 level of confidence with df 1, 2 and 174 is 3.05. Table I-A shows that the obtained 'F' ratio value on vital capacity was 55.09 for factor-A (Gender- B and G players) irrespective of their different age categories (U-14, U-17, U-19 players) which was greater than the table value of 3.05 with df 1 and 174 required for significance at .05 level of confidence. The results shows that significant difference exist between boys and girls irrespective of different age categories players on vital capacity. The obtained 'F' ratio value on vital capacity was 36.27 for factor-B different age categories (U-14, U-17, U-19 players) irrespective of genders boys and girls players which was greater than the table value of 3.05 with df 2 and 174 required for significance at .05 level of confidence. The results shows that significant difference exist among different age categories (U-14, U-17, U-19 players) irrespective of gender (boys and girls) on vital capacity. The obtained 'F' ratio value on vital capacity3.88 for interaction [AB factor - (Gender × Age categories) was also greater than the table value of 3.05 with df 2 and 174 required for significance at .05 level of confidence. Since, the obtained 'F' ratio for the interaction effect was found significant, the simple effect test was applied as follow up test and it is presented in Table I-B.

Table –Ib: Simple Effect For Gender (Boys & Girls) And Different Age Categories (U-14, U-17, U-19 Players) On Vital Capacity

Source of variance	Boys	Girls	Sum of squares	Df	Mean Square	F- ratio
Gender and Under 14	3507.66	3373.66	269340	1	269340	5.33*
Gender and under 17	3794.00	3545.00	930015	1	930015	18.42*
Gender and under 19	3965.00	3602.33	1972943	1	1972943	39.09*
Error			8780590	174	50463.16	

*Significant at .05 level of confidence.

The table value required for significance at .05 level of confidence with df 1 and 174 was 3.06. Table I-B shows that the obtained 'F' ratio values on vital capacity is5.33, 18.42 and 39.09 for (gender and under 14 players),(gender and under 17 players) and (gender and under 19 players) which are greater than the table value of 3.05 with df 1 and 174 required for significance at .05 level of confidence.The results show that difference significant exist between U-14, U- 17, U- 19 age categories of boys and girls on vital capacity.

Table-Ic: Simple Effect On Vital Capacity Among Three Age Categories Of (U-14, U-17, U-19 Players Of Boys And Girls

Sourceof Variance	**Mean**			**Sum of Squares**	**Df**	**Mean Squares**	**F-ratio**
	Under -14	**Under 17**	**Under 19**				
Different age categories and Boys	3507.66	3794.00	3965.00	3203915	2	1601951	31.74*
Different age categories and Girls	3373.66	3545.00	3602.33	849340.9	2	424670.5	8.41*
Error				8780590	174	50463.16	

***** Significant at .05 level of confidence.
(The table value required for significance at .05 level of confidence with df 2 and 174 were 3.05 respectively).

Table I-C also revealed that the obtained 'F' ratio value on vital capacitywas 31.74 and 8.41for different age (U-14, U-17 and U-19) categories of boys and girls playerswhich was greater than the table value of 3.05 with df 2 and 174 required for significance at .05 level of confidence. The vital capacity performance differ among different age (U-14, U-17 and U-19) categories of boys as well as different age categories of girls. To find out the mean differences Scheffe's test was applied. Table I-D

Table– Id: Scheffĕ *S* Test For The Difference On Mean Values Of Vital Capacity Among Gender (Boys & Girls) Different Age Categories (U-14, U-17, U-19 Players)

Gender	DIFFERENT AGE CATEGORIES				
	U-14	U-17	U-19	MD	C.I
Boys	3507.66	3794.00		286.34	47.13
	3507.66		3965.00	457.34	47.13
		3794.00	3965.00	171	47.13
Girls	3373.66	3545.00		171.34	47.13
	3373.66		3602.33	228.67	47.13
		3545.00	3602.33	57.33	47.13

* Significant at 0.05 level of confidence

Table – I-D shows that the mean difference between boys U-14 and boys U- 17 players, boys U-14 and boys U- 19 players, boys U-17 and boys U- 19 players are286.34, 457.34 and 171, respectively on vital capacity of gender boys and different age categories which are greater than the confidence interval value of 47.13 at .05 level of confidence. Girls U-14 and girls U- 17 players, girls U-14 and girls U-19 players and girls U-17 and girls U- 19 players are 171.34, 228.67 and 57.33 respectively on vital capacity of gender girls and different age categories which is greater than the confidence interval value of 47.13 at .05 level of confidence. The results of the study shows that the (boys U-19 and boys U-17 players) had significant increase in vital capacity as compared to the (boys U- 14 players). The result also reveals that the increase in vital capacity is significantly more for (boys U- 19 players) as compared to (boys U- 17 players). Also, (girls U-19 and girls U-17 players) had significant increase in vital capacity as compared to the (girls U- 14 players). The result also reveals that the increase in vital capacity is significantly more for (girls U- 19 players) as compared to (girls U- 17 players).

The data on vital capacity is graphically represented in figure- 1.

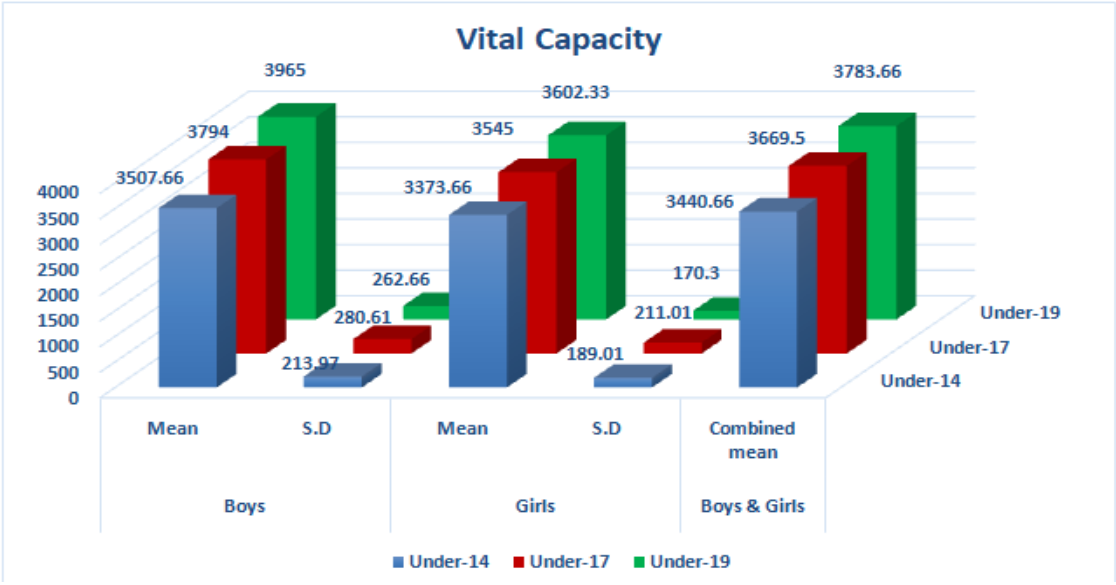

Figure -1:Showsthe mean, S.D and combined mean values of vital capacity among boys and girls with three age categories under-14, under-17,and under-19.

4. Discussion Of The Study

The result of the study showed that the players under boys category were significantly better in vital capacity. The result also revealed that the vital capacity was significantly better for BU- 19 players as compared to BU- 17 and BU-14 players. Further GU-19 players and GU- 17 players have showed significantly better vital capacity as compared to the GU- 14 players.The result also reveals that the increase in vital capacity is significantly more for GU-19 players as compared to GU-17 players.There are many studies in support of findings of the present study If ethnic differences in FEV1 and FVC are proportional, the FEV1/FVC ratio should be the same for different ethnic groups. However, children from India, Iran, Mexico and Oman were systematically shorter than Caucasians and yet had the highest FEV1/FVC ratios. This may well reflect differences in developmental age between populations Wu et al. (2002). Venkata Venu Gopala Raju (2013) have provedpulmonary function test values of children and adolescents, a marked increase was observed in all the five parameters (FVC, FEV1, ERV, FEF 25-75%, and PEFR), from childhood to adolescence as per the body needs of oxygen. It is important to understand the improvement of Pulmonary function test values with age among adolescents, in interpretation of PFT variations in different clinical settings. Schoenberg et al. (1978), have found interpreting lung function test results, the changing pattern in FEV1/FVC and RV/TLC should be considered. Prediction equations for children and adolescents should take into account sex, height, age, ethnic group, and, ideally, also SH. Quanjer et al. (2010) have studied white and black population from USA over age 7 years. We compared our data for age group 7-9 and 10-14 years. FVC and FEV1 in our study was significantly lower ($p < 0.005$) than white population for both sexes and age groups. However, they do not reveal any significant difference when compared with black population. Peak flow rate (PEFR) is comparable with our values for both sexes and races except for boys in age group 10-14 years where our study shows significantly higher values for PEFR than an earlier report (10). Mid expiratory flow rate (FEF 50%) in our study is significantly lower than white and black population. Knudson et al. (1983) have studied American population over age 6 years for flow volume curve. We compared our data for boys between age 6-12 years and girls between age 6-11 years. Our values for FVC and *FEV*1 in this age range are significantly lower ($p < 0.005$) than Knudson study for both boys and girls. However, mid expiratory flow rates FEF 50% and FEF 25-75 did not reveal any significant difference.

The simplest explanation for these findings is that young children lack the coordination to deliver a full vital capacity, and so they inhale insufficiently or terminate the expiratoryeffort prematurely. However, children have been shown to be capable of performing acceptable FVC man oeuvres Vilozni et al. (2009),Thus the FEV1/FVC and RV/TLC ratio fall in early childhood. Maximum respiratory pressures increase with age in schoolchildren's Tomalak et al., (2002),The increasing inspiratory and expiratory pressures increase vital capacity at the expense of RV. In addition, the greater pressure generated by males explains, at least in part, the difference in vital capacity, and hence in FEV1/FVC and RV/TLC ratio, between males and females.Sandeep Budhiraja et al., (2010),The present study shows, all the three independent variables (age, weight and height) have linear positive correlation with lung function parameters, both for boys and girls Lung function values in boys were significantly higher as compared to that of girls. Urban children had higher lung function parameters than rural children except IRV, FEF25%. Among all anthropometric parameters, height was the most independent variable with maximum coefficient of correlation.

Vijayan et al., (2000)have proved correlations of forced vital capacity (FVC) and forced expiratory volume in one second (FEV1) were, in general highest with height followed by weight and age. Peak expiratory flow rate (PEFR), forced mid-expiratory flow (FMF) and forced expiratory flow rates at 25%, 50% and 75% of FVC (FEF25% FVC, FEF50%FVC and FEF75%FVC) were also significantly correlated with physical characteristics (age, height and weight). With a view to find out regression equations to predict spirometric

functions based on physical characteristics (age, height and/or weight), the functions were regressed over all possible combinations of regressor variables, i.e., age, height and weight separately for boys and girls. Nair et al., (1997), have found the results show an increase in "lung volumes" and "flow rates" with increase in age, height and weight. FMFT and MVV(IND) also increase with increase in anthropometric measurements. All the lung functions except FEF75-85% and the ratio between different lung volumes show significant positive correlation with age, height and weight. Regression equations were derived for predicting normal lung functions for healthy South Indian boys. Sitarama Raju et al., (2004), have examined the regression equations to predict the pulmonary functions were presented using the independent variables like height, fat free mass and chest circumference or age, since these variables have shown very strong predictability for FEV1, FVC and PEFR. The equations presented in this study can be considered as referral standards for Indian girls. Tahera et al., (2010) have found to be statistically significant in the study groups. For FVC and FEV (1), highest correlation was found with age in girls and height in boys. For FEV(1)%, significant negative correlation was found with age and height in both sexes, but positive correlation was found with surface area. Similarly, PEFR showed highest correlation with surface area in boys and girls. Variables such as FVC, FEV(1) and PEFR show good positive correlation with height, age and body surface area in both sexes. There is a need to have regional values for the prediction of normal spirometric parameters in a country like India with considerable diversity. Chatterjee& Mandal (1991), have proved prediction equations were derived on the basis of age and height for all the pulmonary function measurements except FEV1% and FET. The prediction equations for FVC, FEV1, MVVF, and PEFR were reliable, but relative variability of predicted FEF25-75% and FEF75-85% was very large. A comparative study of FVC, FEV1, and PEFR values of our subjects, standardized for age and height, was much closer to the boys of Delhi in FVC but higher than South Indian boys in FEV1, North and South Indian boys in PEFR. Kundan et al. (2014), have found mean values of all pulmonary function measurements were higher in boys as compared to girls but statistically significant difference ($p<0.001$) was found for FVC and FEV1.

5. Conclusion

The result of the study showed that the players under boys category were significantly better in vital capacity. The result also revealed that the vital capacity was significantly better for BU- 19 players as compared to BU- 17 and BU-14 players. Further GU-19 players and GU- 17 players have showed significantly better vital capacity as compared to the GU- 14 players. The result also reveals that the increase in vital capacity is significantly more for GU-19 players as compared to GU-17 players.

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