A Review On Calophyllum Methyl Ester As A Possible Source Of Fuel In CI Engine

[1]Vibha P.Pode
[1] Assistant Professor,
[1] Mechanical Engineering Deparment,
[1]D.Y.Patil Institute Of Engineering & Technology, Pune, India

Abstract : Global warming and environmental pollution are the major concern today. Fossil fuel will face a serious shortage in the near future and become rare. So there is a high priority to find alternative energy as their sustainable energy sources. Besides having various sources of alternative fuels, Biodiesel is considered as a cleaner renewable fuel and best substitution for diesel fuel due to it being used in any compression ignition engine without any modification. The main advantages of using biodiesel are its renewability, availability, and better quality of exhaust gas emissions. This paper reviews performance and emission of Calophylluminophyllum biodiesel and its blends when tested on the diesel engine with varied compression ratios, injection pressure. It is understood that the performance characteristics are more over similar for the biodiesel blend and diesel. The emission like CO, HC, and smoke opacity showed reduction with increase in compression ratio, NOx emission slightly high for Biodiesel blends when compared to diesel.

IndexTerms - **Alternate fuel; CalophyllumInophyllum Biodiesel; Compression ratio; diesel engine; Emission; Injection pressure; Performance.**

I. INTRODUCTION

Energy is a major need for the development of country and the increase in population needs more energy for both economic and social development. The petroleum products and fossil fuels are a predominant source of energy. Increase in petroleum prices and environmental pollution necessitated exploring some renewable alternatives to conventional petroleum fuels. Also depleting fossil fuels, vehicular population, increasing industrialization, environmental pollution, and stringent emission norms emphasis on the need of alternative fuels Diesel engines are the prime source of transportation, power generation, marine applications, agriculture applications etc. hence diesel is being used largely, but due to gradual depletion of world petroleum reserves and the impact of environmental pollution of increasing exhaust emissions, there is an urgent need for suitable alternative fuels for use in diesel engines. In view of this, rigorous efforts are being made throughout the world to reduce the consumption of liquid petroleum fuels. Two general approaches are in use. The first is to enhance the efficiency of combustion devices. This can be achieved by AllmanuscriptsmustbeinEnglish.Theseguidelinesincludecompletedescriptionsofthefonts,spacing,andrelatedinformationforproducingyourproceedingsmanuscripts.Pleasefollowthem. understanding the physicochemical processes involved during the combustion. Second is to switch over the energy consumption devices on alternative energy source which are either abundant or are reproducible

Biodiesel is one of these promising alternative sources for diesel engines. It is defined as the mono-alkyl esters of long chain fatty acids derived from vegetable oils or animal fats and alcohol with or without a catalyst. It is environmentally friendly, renewable, biodegradable, non-toxic, portable, and readily available and eco friendly fuel. There are a variety of potential feed stocks for biodiesel production. There are basically two type's edible and non edible oils.

The utilization of edible vegetable oils or the first generation feed stocks has been of great concern recently; this is because they raise many concerns such as food versus fuel debate that might cause starvation especially in the developing countries and other environmental problems caused by utilizing much of the available land. In view producing the biodiesel oil deforestation is giving the ecological imbalance and damage to the wildlife. Therefore, non-edible vegetable oils have become more attractive for biodiesel production and highly accepted in view of there advantage.

1.1Non Edible oils:

To name a few non-edible oil seed crops are Jatrophacurcas, Calophylluminophyllum, Sterculiafeotida, Madhucaindica (mahua), Pongamiaglabra (koroch seed), Linseed, Pongamiapinnata (karanja), Heveabrasiliensis (Rubber seed), Cerberaodollam (Sea mango),Coriander(CoriandrumsativumL.), Croton megalocarpus, Salmon oil, Pilu, Crambe, syringa, Scheleicheratriguga (kusum), Stillingia, Shorearobusta (sal), Terminaliabelericaroxb, Cuphea, Camellia, Champaca, Simaroubaglauca, Garciniaindica, Ricebran, Hingan (balanites), Desert date, Cardoon, Asclepiassyriaca (Milkweed), Guizotiaabyssinica, Radish Ethiopianmustard, Syagrus, Tung, Idesiapolycarpa var. vestita, Alagae, Argemonemexicana L. (Mexican pricklypoppy, Putranjivaroxburghii (Lucky bean tree), Sapindusmukorossi (Soapnut), M. azedarach (syringe), Thevettiaperuviana

1.2. Advantages of biodiesel

The advantages of these oils are eco-friendly and can be produced easily in rural areas, where there is an acute need for modern forms of energy. Production of biodiesel within the country reduces expenditure on oil imports. Biodiesel benefits include bio-degradable, non-toxic, free from sulphur(< 0.001 %) and 60% less net carbon dioxide emissions. In addition, it has high flash point (greater than 160 0C) which helps biodiesel by transportation and storage. The important quality that biodiesel posses is that it decomposes more easily when they expose to environment and most importantly they can be produced easily compared to petrol and diesel. The most important feature for using biodiesel is it can be used without modification in diesel engines. Another advantage of using biodiesel is that it eliminates the compound such as polycyclic aromatic hydrocarbons (PAH) and nitrated PAH that causes cancer in humans. The lubrication property of biodiesel dominates more when compared to the diesel fuel and increases the engine life. Biodiesel causes less emission of carbon dioxide (CO2), hydrocarbon (HC) and particulate matter (PM), which are the dominant factors with diesel.

1.3.Disadvantage of biodiesel

The disadvantages that biodiesel has to overcome was deposit formation in engine which results in clogging of fuel filters. So better refining techniques has to be followed in order to remove more fatty acids and glycerin completely. The disadvantages that biodiesel posses were emission of high percentage of NOx emission. So reduction of NOx in biodiesel will results in commercial usages in engines.[1]

Keeping in view of the above discussion over the advantages and disadvantages of biodiesel more non edible crops have to be encouraged for production of biodiesel than considering the edible crops. Biodiesel plants have to be planted around the country in order to produce more biodiesel. Simultaneously environmental factors have to be considered to prevent from pollution.

2.CALOPHYLLUM INOPHYLLUM OIL

After referring all the investigation on various biodiesel oils, Honne oil (CalophyllumInophyllum) is a promising for further studies since this oil is not much explored as an alternative biofuel for CI engine application. One of the non edible oil abundantly available in India is Honne Oil. The scientific name is CalophyllumInophyllum Linn where. Calophylluminophyllumlinn is a species of family Guttifereae (Clusiaceae), native to India, East Africa, Southest Asia, Australia and South Pacific. Commonly it is called as 'Indian laurel', Alexandrian Laurel, Beach calophyllum, Beauty leaf, Pannay tree, Sweet Scented Calophyllum (in English), Pongnyet, Burmese, Hawaii, Kokani, Nagachampa, (in Marathi), Sultan Champa, Surpan (in Hindi), Nagam, Pinmai, Punnagam, Punnai, Pinnay, Namere (in Tamil). It grows near the sea coast throughout India. It is a broad leaved evergreen tree occurring as a littoral species along the beach crests, although sometimes occurring inland .The tree grows slow but grows well in direct sun light. Annual yield of 20-100 kg/tree of whole fruits. Trees begin to bear significantly after 4-5 years. The nut kernel contains 50-70% oil and the mature tree may produce 1-10 kg of oil per year depending upon the productivity of the tree and the efficiency of extraction process. The Calophyllum oil which is also very commonly called as " Honne Oil" serves as a healing agent with skin healing, anti-inflammatory and antimicrobial properties. Tree grow to height of 8-20m (25-65ft), sometimes reaching up to 35cm (11ft).The total Calophylluminohyllumlinn tree has got excellent medicinal properties. The greenish yellow oil obtained from the calophyllum seeds was used as alternative to candlenut oil in lamps. It may be used for hair oil. It was also used to furnish wooden bowls and for cosmetic and topical applications for healing of burns and skin diseases. The oil can also used for soap making.

II. 1.PERFORMANCE AND EMISSION REVIEW

S V Channapattanaa et al(2015):

A study has been conducted on the CalophyllumInophyllumlinn oil in emission and thermal performance on DI CI VCR engine. Tests were conducted on blends of biodiesel and standard diesel as a fuel at compression ratios of 15, 16, 17 and 18.the experiments are conducted on kirloskar model and TVmodel1witha single cylinder four stroke operation. At a constant speed of 1500 rpm the load was varied from 25% to 100% with a difference of 25.They tried to measure the Brake Thermal efficiency, Specific fuel consumption, Brake power, Indicated mean effective pressure, Exhaust gas temperature and mechanical efficiency when the compression ratios are varied from 15:1to 18:1.

The observations after conducting test were found that as the CR increase BTE increases for increased Honne bio diesel blends But at highest CR BTE of the engine is 8.9%less for Honne biodiesel compared to diesel .As CR increased BSFC decreased for all biodiesel blends. At maximum CR BSFC is found to be least. The impact of CR was found to increase in biodiesel content and that EGT decreased with increase in CR.

Emission Characteristics: At high CR was found that CO, HC, Smoke are reduced because of the better combustion of the fuel at higher CR due to high temperature in the cylinder. The emission of CO2 initially decreased and then increased as the blends increased. NOx emission increases for blends while it decreases for Diesel. At higher CR NOxemisson is high. Overall performance of Honne biodiesel approached that of Diesel fuel at higher CR and it can be included that the Honne oil can be alternate fuel at higher CR expect of the NOx emission

R. Bhaskar Reddy et al (2014):

Effect of injection pressures on a blend of B50 honne biodiesel was compared with pure diesel on performance and emission characteristics evaluated at constant speed and variable loads. Experiments were conducted on a single cylinder four strokes engine at varied injection pressure from 180 bar to 220 bar. BSFC decreases with increase in injection pressure this is because of the good atomization at high injection pressure .The BTE and mechanical efficiencies were found to be maximum at 200 bar injection pressure and the BSFC minimum at maximum pressure. BMEP is almost same for B50 and diesel for all the injection pressure.
The EGT of B50 is less for all injection pressure. HC emission of B50 is less than the diesel fuel at 180 bar fuel injection pressure. CO emission decreased and CO2 increased for honne oil-at high fuel injection pressures. At high injection pressure Honne oil blend are suitable substitute for diesel produce lesser emission and better performance then diesel.

C. Srinidhi et al(2014):
The main objective was to prepare the Honne oil methyl ester and then conduct the performance and emission test on the Diesel engine with biodiesel and its blends and compare with diesel. So extraction oil from seeds and later convert the Honne oil to biodiesel by reacting the oil with alcohol in the presence of the catalyst NaOH and KOH, this process is called trasesterification. In the work sodium methoxide is used and conducted an endothermic reaction for a temperature range of 60º-65ºC and constant stirring for 2 hours. Studied the performance parameter (such as BP, BSFC, BTE, EGT) and emission characteristics (NOx , HC, CO. etc.) of the blend of B20, B40, B60, B80, B100 and diesel on VCR at 18 and at injection pressure 200bar in CI engine and injection timing of 27 before Top Dead Centre (bTDC) The performance aspects: As the load increases BSFC decreases for the fuels and the blends. The BSFC of B 100 is increased 24% to that of diesel fuel.
As the load increases the Brake thermal efficiency also increases is what is observed. It was also observed that as the load increased and as the Honne oil methyl ester increased content increased in diesel the BMEP also increased. The BMEP of Diesel has increased by 53% on average with diesel. BTE B20 is similar to diesel but there is a 3% reduction in the performance B100. 11% reduction compared to diesel. EGT: 2%increase for B20 and 5%increse for B100.NOx emission of B100 increased by 36%. CO2 emissions for B100 is 14% and B20 3% respectively with respect to mineral diesel HC emission B20 exhibits a reduction by 14% and B 100 shows highest reduction of HC by 51%. The results of the investigation showed that the performance and emission characteristics of the engine fuelled with Honne oil methyl ester – diesel blends is comparable to the diesel.

AshishG.Bandewar et al(2015):
They tried to understand the emission characteristics of CalophyllumInophyllum biodiesel and its blends. Experiments conducted on Rocket Engineering Model VRC-1at Rocket Engineering Model VRC-1at 1500rpm.The injection timing 27ºbTDC and Injection pressures 210bar maintained and the CR variation from 14.5to 17.5 on H25, H50, H75.
For full load condition, when the compression ratio is varied from 14.5 to 17.5, the highest CO emission obtained by biodiesel at lower CR but at the highest CR, CO emission is less for diesel when compared to biodiesel. NOx emission is high for the entire range of fuel at lower CR. The highest CO2 emission obtained lowest emission as 0.4% for H25, CR of 17.5. The lowest CO2 emission obtained is 1.96% for diesel at the compression ratio of 14.5.HC emission decreased with increased CR because of complete combustion. It was concluded that the biodiesel blends had equivalent emission Characteristics with no modifications in the VCR engine.

B.K Venkanna et al(2011):
Studied the use of non edibleHonne oil and neat diesel performance and emission characteristics were experimented at varied Injector opening pressure and constant injection timing of 23 bTDC. Experiments were carried out with different IOP s of 200 to 260 bars. It was observered that the BTE increased when the IOP was varied from 200bar to 240bar because of good atomization and better mixing. The variation of EGT was observed that H100 has highest at 200 bar but the thermal efficiency is lowest.
Emission characteristics like CO, HC, and emission of H100 dropped as the IOP increased and reached to least at 240 bars. CO, HC, smoke opacity decreased with increase in IOP, this is due to the improvement in spray that leads to improved mixture formation. NOx emission was higher with increased IOP and this was due to the faster combustion and higher temperatures reached in the cycle. It was concluded that CO, HC, smoke opacity reduced as the IOP increased. NOx was increased as IOP increased. It was also observed that the BTE was increased and Ignition delay was reduced with increase in IOP.

Varathan R KaruppasamyK(2015):
Non-edible calophylluminophyllum (Honne) oil was selected and by catalytic transesterification process biodiesel was prepared and physio chemical properties noted blends B25, B50, B75, B100 are prepared. Experiments were conducted on Kirloskar single cylinder four stroke CR at16.5:1 speed of the engine at1500rpm/min constant and rated power 3.5KW Injection Pressure 240 bar/23° bTDC. Brake thermal efficiency increased with increase in Brake power for all the blends of biodiesel and diesel this is because of the reduction in heat loss and The maximum BTE of 38.86% for B25 against 45.16% of diesel. The specific fuel consumption is more of blend because of the low colorific value than diesel. The minimum BSFC (B100) is 0.065 kg/kWh higher compared with diesel. It has low CO, CO2 and hydrocarbon when it is compared to the diesel. At higher loads it was observed that the HC emission decreased with increase of load, because the combustion is improved and complete burning is done. For the biodiesel NOx emissions only higher than the diesel this is due

to the long duration of higher temperature combustion. Performance, combustion and emission characteristics of 25% blend are better than other blends and it is also close to diesel results, so it was recommended

III . CONCLUSIONS

Based on the study it is very clear that the need of the hour is to improve the performance of the engine and decrease the emission characteristics. And this should be achieved without modification of the diesel engine. Use of biodiesel is not the invention but production and application of the biodiesel as a successful alternative to diesel fuel is the challenge. So in this paper the review was on the possible non-edible feedstock and that is on CalophyllumInophyllum. Based on the literature review CalophyllumInophyllum can be a source to enhance the performance and same time reduce the emission with variation in the compression ratio, load, and injection pressure.

As the CR increase BTE increases for increased Honne bio diesel blends As CR increased BSFC decreased for all biodiesel blends. At maximum CR BSFC is found to least. At high CR was found that CO, HC, Smoke are reduced because of the better combustion of the fuel at higher CR due to high temperature in the cylinder. NOx emission is at a higher end.

As the injector opening pressure increase the Brake Thermal efficiency increases is understood and also has reduced CO, HC, smoke opacity reduced but for the increase in NOx. So the according to the study made the CalophyllumInophyllum Biodiesel can be used as alternate fuel but attempts must be made to reduce the emission of NOx.

IV. References

[1] Prabu, A., Anand, R. B Production and Application of Biodiesel – A Case Study International Journal of Engineering Research and Development eISSN : 2278-067X, ISSN : 2278-800X, Volume 2, Issue 2 (July 2012), PP. 28-41

[2].R. Bhaskar Reddy, B. Siddeswararao, Performance Characteristics and Analysis of 4-Stroke Single Cylinder Diesel Engine Blend With 50% of Honne Oil at Various Fuel Injection Pressures R. Bhaskar Reddy Int. Journal of Engineering Research and Applications www.ijera.com ISSN : 2248-9622, Vol. 4, Issue 8(Version 1), 10-20 August 2014,

[3]. C. Srinidhi , S. V. Channapattana J.A. Hole, A.A.PawarP.G.Kamble Investigation On Performance and Emission Characteristics Of C.I. Engine Fuelled With Honne Oil Methyl Ester : International Journal of Engineering Science Invention ISSN (Online): 2319 – 6734, ISSN (Print): 2319 – 6726 www.ijesi.org Volume 3 Issue 5‖ May 2014 ‖ PP.59-66

[4]. AshishG.Bandewar, Raahul Krishna, SV Chanapattana Experimental Investigation of Emission Characteristics of VCR engine using CalophyllumInophyllum Bio-Diesel Blends as a Fuel (IJRMEE) ISSN: 2349-7947

[5]. B.K VenkannaC.Venkataramana Reddy. Influence of injector pressures on performance, emission and combustion characeteices of Didiesel engine running on CalophyllumInophyllumlinne oil International Journal Of Renwal energy. Vol6. No1

[6]. Varathan R Karuppasamy K Performance Emission and Combustion Characteristics of Honne Oil Biodiesel Blends in Diesel Engine International Journal of Mechanical Engineering and Research, ISSN 0973-4562 Vol. 5 No.1 (2015) © Research India Publications

[7] S.V Channapattana, Abhay A Pawar, PrashantG.Kamble Effect of Injection Pressure and emission Characteristics of VCR engine using Honne Biodiesel as a Fuel www.sciencedirect .com (2015)1316-1325.

[8].H.C.Onga,H.H.Masjukia,T.M.I.Mahli,A.S.Slitonga,W.T.Chong.. Engine performance and emission using, JatrophacurcasCeibependtandra and Calophylluminophyllum Biodiesel in CI Engine Elevier PP 427-445

[9]. Chavan S.B. Kumbhar R.R. and Deshmukh R.B CallophyllumInophyllum Linn ("honne") Oil, A source for biodiesel Production Research Journal of Chemical Science Vol. 3(11), 24-31, November (2013)

[10]. B.K Venkanna C. Venkataramana Reddy. Biodiesel Production and optimization from CalophylllumInophyllum Linn oil (honne oil).A three stage method.

Acknowledgment

I am thankful to Head of the department of Mechanical Engineering and all the staff members who extended the preparatory steps. I am very much thankful to respected Principal Dr. L.V.Kamble for his support.

Finally I want to thank to all of my friends for their support & suggestions. Last but not the least I want to express thanks to my family for giving me support.

.