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A REVIEW ON CALOPHYLLUM INOPHYLLUM METHYLESTER AS A POSSIBLE ALTERNATE FUEL IN COMPRESSION IGNITION ENGINE

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Abstract - *Fossil fuel will face a serious shortage in the near future and become rare. Scarcity of conventional petroleum resources is problem to be addressed immediately and that let to the research in alternative fuels for internal combustion engines. So there is a high priority to find alternative energy as their sustainable energy sources. Besides having various sources of alternative fuels, best substitution for diesel fuel in without any modification of the engine can be biodiesel The main rewards of using biodiesel are its renewability, availability, and better quality of exhaust gas emissions. In this paper we try to understand the performance and emission of Calophyllum inophyllum 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 HC,CO and smoke opacity showed reduction with increase in compression ratio, NOx emission slightly high for Biodiesel blends when compared to diesel.*

Key Words: Calophyllum Inophyllum Biodiesel, diesel engine, Performance, Emission

1. INTRODUCTION

Global warming and environmental pollution is the serious problem that the world is facing today and it should be addressed at the earliest. Energy is the major need for the all the activities for any economical and social development of the world .The petroleum products and fossil fuels are the main source of energy. In the transportation and industrial activities diesel engines will have a lot of application. Because of the increased usage of these fossil fuels there is a lot of shortage of these fuels as the reserves are depleted. But the progress of the world should not be hampered due to the decrease in these reserves. So a search of the possible use of any other fuel is taking the lead. The fuel that can replace the fossil fuel in all aspects in needed. So the researchers started the work in the exploration of the alternative fuel. And amongst the various alternatives, biodiesel stood first in the possible replacement to the fossil fuel. Biodiesel has got its own benefits of being an oxygenated fuel, bio degradable, renewable and nontoxic in nature. Biodiesel derived from animal fats and vegetable oil. It is defined as the mono-alkyl esters of long chain fatty acids that are obtained from vegetable oils or animal fats and alcohol with or without a catalyst. There are diverse feed stocks from which the biodiesel can be synthesized. Some are edible in nature and some non-edible. The edible feed stock like soyabean , seasame, palm oil and so on. But if the production of the biodiesel is done using the edible oil then there will a disturbance in the food web. So in order not to hamper the food chain the non edible sources are considered for the production of the biodiesel.

1.1 List Of Non Edible oils:

To name a few non-edible oil seed crops are Jatropha curcas, Calophyllum inophyllum, Sterculia feotida, Madhuca indica Croton megalocarpus, Salmon oil, Pilu, Crambe, Pongamia glabra (koroch seed), Linseed, Ponagame pinnata (karanja), syringa, Scheleichera triguga (kusum), Cuphea, Camellia, Champaca, Simarouba glauca, Garcinia indica, Ricebran, Hingan (balanites), Desert date, Asclepias syriaca (Milkweed), Guizotia abyssinica, Deccan hemp Radish Ethiopianmustard, Syagrus, Idesia polycarpa var. vestita, Sapindus mukorossi (Soapnut), M. azedarach (syringe), Copaiba, Milkbush, Laurel, Cumaru, Andiroba, B. napus Almond piqui, Tomatoseed, camlisasativa, Zanthox-ylum bungeanum ,Azadirachta indica (neem), Lesquerella fendleri, Nicotiana tabacum (tobacco), Babassu, Deccan hemp, Ricinus communis L. (castor), Simmondsia chinensis (Jojoba),etc[1].

2. CALOPHYLLUM INOPHYLLUM OIL

After referring all the research work on various biodiesel oils, Honne oil (Calophyllum Inophyllum) is a promising for further studies since this oil is not much explored as an alternative biofuel for CI engine application.The Calophyllum Inophyllum linn is a species of family Guttifereae (Clusiaceae) and it is a native to India, East Africa, Southest Asia, Australia and South Pacific. It is called as 'Indian laurel', 'Alexandrian Laurel', Sweet Scented Calophyllum (in English), Sultan Champa, Surpan(in Hindi), Kokani, Pinamai, Punnai,,Namere(in Tamil) Burmese, Nagachampa, (in Marathi). The growth of this tree is found particularly near the sea coast and sufficient amount of sun light will help in

good growing of the tree. The yearly yield of the tree is around 20-100 kg/tree of fruit and it takes 4-5 yr for the tree to bear fruits. Tree grow to height of 8-20m sometimes reaching up to 35 cm . More oil content is found in the nut kernel of the fruit as much as 50-70% oil. The production of the oil per mature tree is around 1-10 kg per year but it depends on the effective extraction procedure that is followed. The tree has got a lot of medicinal properties and is effective utilized in the skin healing and anti inflammation. The oil that is obtained from this tree can be used as hair oil, in soap making and curing the skin burns. [1]

2. 1. PERFORMANCE AND EMISSION REVIEW:

S V Channapattanaa et al:

Conducted tests on the VCR Diesel with Calophyllum Inophyllum Linn oil. The combination of 20% of the biodiesel with 80% of diesel is called as B20 blend. Test were conducted on B20,B40,B60,B100 at various compression ratio of 15,16,17,18 on Kirloskar model single cylinder four stroke diesel engine at a constant speed on full load. The thermal parameters like the Specific fuel consumption, Brake Thermal efficiency, Exhaust Gas temperature, Brake power, Indicated mean effective pressure, and mechanical efficiency when the and in the emission aspect the CO,CO2,NOx, HC were taken to consideration.
In thermal parameters As the compression ratio increased the Brake thermal efficiency increased in Honne bio diesel blends But at highest compression ratio the variation of the Brake thermal efficiency of B20 with diesel is reduced to minimum extend. The Brake specific fuel consumption decreased for all the blends with the increase in the compression ratio. At the highest compression ratio the brake specific fuel consumption is least for the blend because of complete combustion at high compression ratio. The Exhaust gas temperature was significantly decreased with the increased compression ratio and also with the increased blend percentage.
Emission Characteristics: The emission of carbon monoxide decreased drastically with the increased compression ratio and the variation in the emission of the carbon monoxide found to be reduced to a great extend with the increased amount of the biodiesel present in the blend. The emission of CO2 initially decreased within the same blend as the compression ratio increased and then increased at the highest compression ratio. The emission of hydrocarbons decreased on a remarkable not as the compression ratio increased and B100 showed the least emission hydrocarbon at the highest compression ratio. NOx emission increases for blends while it decreases for Diesel. At higher compression ratio NOx emisson is high for all the blends when compared to diesel. 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 [2]

C. Srinidhi et al.:

Prepared Honne methyl ester through trasesterification process and conducted tests on CI engine for the performance and emission parameters on the blends of B20,B40, B60,B80, and B100 by varying the load on the engine with constant compression ratio. The brake mean effective pressure was increased with the increased loading and increased biodiesel content in the blend. The brake mean effective pressure for the B100 blend is maximum at the maximum load. The BMEP of Diesel has increased by 53% on average with diesel. The Brake specific fuel consumption decreased as the load increased for all the blends a diesel and is found to be maximum for the B100 at full load.
The Brake thermal efficiency increased with the increased load and it is also noticed that as the load got increased the difference between brake thermal efficiency of B20 and diesel also increased. Exhaust gas temperature showed an increasing trend with the increase in the load and the exhaust gas temperature for B20 and for that of diesel is almost similar. The CO2 emissions increased for increased load but the increase of percentage of carbon dioxide emission at maximum load is very negligible for B20 and Diesel. Carbon monoxide emission increased with the load but decreased with the blend i.e the B100 gave minimum emission of CO at maximum load when compared all the blend and diesel. NOx emission is slightly high than that of the diesel at all load for B100 but for B20 at lower load it is similar to diesel but at higher load B20 N0x is high when compared to diesel .It is understood that Honne oil methyl ester – diesel blends was comparable to the diesel in the aspect of performance.[3]

A.S. Silitonga et al:

The production process of Jatropha curcas, Ceiba pentandra and Calophyllum inophyllum biodiesel were studied and the properties were compared within and tried to experiment with the B10,B20,B30,B50 blends of all the three biodiesels as well as diesel fuel . The brake thermal efficiency and brake specific fuel consumption and brake power and exhaust gas temperature and exhaust gas emission are analyzed a varying speed .The brake specific fuel consumption for the 10% blend that is JC10,CB10,CP10 found to be lowest at 1900 rpm and then it was increased with the speed. The brake thermal efficiency increased for all the blends with the increase speed reached maximum at 1900 rpm the trend was reduced as the speed increased.EGT increased consistently for all the blend with the increased speed. Emission parameters for the increased speed showed that the CB10,JB10 ,CP10 blends had similar trend as petrol diesel . The smoke opacity was found to be less for the 50 % blend of all the biodiesel of Calophyllum Inophyllum ,

Jatropha Curcas and Ceiba Pentantra. When compared to petrol diesel at 1900 rpm. NOx emission are at the higher end when compared to petrol diesel for all the biodiesel blends .[4]

B.K Venkanna et al:

Conducted the experiments on the use of non edible Honne 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 Injection opening pressure of 200 to 260 bars. The brake thermal efficiency 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. As the Injection opening pressure increased the CO, HC , smoke opacity reduced and NOx was increased. It was also observed that the BTE was increased and Ignition delay was reduced with increase in IOP. [5].

Varathan R Karuppasamy K et al:

Non-edible calophyllum inophyllum (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 [6]

Ashish G.Bandewar et al:

Experiments were conducted to understand the Emission characteristics of CO,CO2,HC,NOx using Calophyllum Inophyllum biodiesel and its blends on Rocket Engineering Model VRC engine by compression ratio from 14.5to 17.5 on H25, H50, H75.
For full load condition, when the compression ratio was 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. Biodiesel and the blend emit lower CO2 because of the oxygen content present in it .But at lower compression ratio the H25 blend emit CO2 emission on higher end when compared to other blend. HC emission decreased with increased CR because of complete combustion which was probably due to the complete combustion of fuel. It was concluded that the biodiesel blends had equivalent emission Characteristics with no modifications in the VCR engine. [7].

R. Bhaskar Reddy et al :

Conducted experiments to analyze effect of injection pressures on a blend of B50 Honne biodiesel was compared with pure diesel on performance and emission characteristics at constant speed and variable loads. Experiments were conducted on the four stroke single cylinder diesel engine at varied injection pressure from 180 bar to 220 bar. BSFC decreased with increased in injection pressure probably because of the good atomization at high injection pressure. Mechanical efficiency increased for all the blends with increased load and injection pressure. The volumetric efficiency which is indicator of the berthing capacity of the engine increased for B50 with increased injection pressure from 180 bar to 220bar when compared to diesel. BMEP for B50 and diesel for all the injection pressure showed similar trend. The EGT of diesel is higher when compared to B50 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 can be a suitable substitute for diesel produce lesser emission and better performance then diesel.[8]

3. CONCLUSIONS

Based on the study it was very clear that the need of the hour is to improve the performance and decrease the emission characteristics in CI engines. And this should be achieved without modification of the diesel engine. Use of biodiesel was not the invention but production and application of the biodiesel as a successful alternative to diesel fuel is the challenge. Based on the literature review Calophyllum Inophyllum can be a source to enhance the performance and same time reduce the emission with

variation in the compression ratio, load, and injection pressure and the different type of blends. The research done in Calophyllum Inophyllum can be concluded that this Calophyllum Inophyllum biodiesel can be used as alternate fuel without any alteration in engine.

REFERENCES

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

[2] S V Channapattanaa,Kantharaj Cb,V S Shindec Abhay A Paward, Prashant G Kamble Emissions and Performance Evaluation of DI CI - VCR Engine Fuelled with Honne oil Methyl Ester / Diesel Blends Science Direct Energy Procedia 74, 281 – 288 (2015)

[3] C. Srinidhi , S. V. Channapattana J.A. Hole, A.A.Pawar P.G.Kamble Investigation On Performance and Emission Characteristics Of C.I. Engine Fuelled With Honne Oil Methyl Ester : International Journal of Engineering Science Invention Volume 3, Issue 5,59-66,May 2014

[4] A.S. Silitonga, H.H. Masjuki , T.M.I. Mahlia , Hwai Chyuan Ong, W.T. Chong, Experimental study on performance and exhaust emissions of a diesel engine fuelled with Ceiba pentandra biodiesel blends, Energy Conversion and Management 76 ,828–836(2013)

[5] B.K Venkanna C.Venkataramana Reddy. Influence of injector pressures on performance, emission and combustion characeteices of Didiesel engine running on Calophyllum Inophyllumlinne oil International Journal Of Renwal energy. Vol6. No1,15-19, Jan-Jun(2011)

[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, Vol. 5 No.1,38-42, (2015)

[7] Ashish G.Bandewar, Raahul Krishna, SV Chanapattana Experimental Investigation of Emission Characteristics of VCR engine using Calophyllum Inophyllum Bio-Diesel Blends as a Fuel , International Journal on Recent Technologies in Mechanical and Electrical Engineering, Volume 2, Issue 2, 022-025, (2015)

[8] 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, Vol. 4, Issue 8 Version 1, 10-20 August (2014)