IJETCR Open Access

ISSN: 2348 - 2117

International Journal of Engineering Technology and Computer Research (IJETCR)
Available Online at www.ijetcr.org
Volume 2 Issue 4 Page No. 77-82

Study of linseed oil biodiesel as an alternative fuel and its petroleum characterization of various blends with diesel

Ajaygiri K. Goswami[1], G. A. Usmani[2]

[1]Associate Professor, Department of Chemical Engineering, University Institute of Chemical Technology, North Maharashtra University, Jalgaon

goswamiakg1@gmail.com

[2]Professor, Department of Oil Technology, University Institute of Chemical Technology, North Maharashtra University, Jalgaon

usmani_ga@yahoo.co.in

ABSTRACT

Methyl ester prepared from linseed oil is a good alternative fuel for petroleum diesel. India stands third in the production of linseed crop and hence it has great potential of being a great source of alternative fuel. Transesterification process was used for the production of the biodiesel from linseed oil. The blends of this ester with petroleum diesel fuel can be useful if the optimum percentage of alkyl ester blended in diesel considering all basic petroleum properties fulfilment so that there will be no problem for smoothly running in the diesel engine without modification and also useful in proper saving of diesel fuel. The increase in blend percentage leads to reduction in the percentage of polluted exhaust gases those are not environment friendly. This is the big advantage of use of biofuel as an alternative fuel. For various blends of diesel fuel and methyl ester, its petroleum properties such as kinematic viscosity, density and specific gravity were studied whereas other important properties such as ASTM Distillation temperatures study, pour point determination, diesel index evaluation, aniline point calculations, fire point and flash point studies were experimentally done and those petroleum characteristics was compared with the diesel fuel.

Keywords: Aniline Point, Diesel Index, Kinematic Viscosity, Linseed Oil, Transesterification

INTRODUCTION:

With rising energy demands from the developing economies and fast depletion of natural reserves of fossil fuels, it is now imperative that new improved alternative fuels be developed [1 - 4]. The alternative fuel must be environmental trendily and be relatively cheap [5]. One such type of alternative fuel is biodiesel and has been considered to be one the best option fuel, which additionally has preference of being renewable in nature in light of its biodegradability and hindrance of a dangerous atmospheric deviation [6 - 14]. Biodiesel generation from a renewable source can aid in keeping up an adjusted environment as well as budgetary manageable quality [15].

Linseed oil is a colorless to yellowish oil obtained from the dried, ripened seeds of the flax plant (Linumusitatissimum). The oil is obtained by pressing, sometimes followed by solvent extraction. Flax-based oils are sought after as food due to their high levels of α-Linolenicacid [16]. Linseed oil is a drying oil i.e. it can polymerize into a solid form [17]. The oil is edible and since it dries quickly it is also used for the preparation of paints, varnishes, soap, patent leather, and waterproof fabrics [18]. Linseed is an important oilseed and fibre crop are grown both for its seed as well as fiber which is used for the manufacture of linen. The seed has a healthy percentage of oil varying from 33 to 47 per cent in different varieties. The oil cake left after the oil is pressed out contains 36 per cent protein, 85 per cent of, which is digestible and is hence used as cattle feed. Straw from seed varieties are used in the manufacturer of upholstery two, insulating material, rugs, twine, and paper. U.S. FDA suggests that Lin Flaxseed oil is suitable for human consumption and can be used as a nutritional supplement. Since it has high content of omega-3 fatty acids, especially alpha-linolenic acid, it is beneficial for heart disease, inflammatory bowel disease, arthritis and a variety of other health conditions [19 - 20].

According to Ministry of Agriculture, Govt. of India, global output of linseed is estimated around 2.60 million ton per years and countries such India, China, United States of America and Canada dominate the list of producers. Canada is the leading linseed producer accounting nearly 80% of the global trade. India is considered as the third largest producer of linseed in the world. In India linseed is mainly cultivated as rabi crop in with October-November being the main sowing season. Harvesting is done in the months of February-April. Madhya Pradesh is the leading producer of the crop, which is broadly divided into two categories- peninsular and alluvial types according to the root formations. Paint and allied industries are the main consumers of linseed oil accounting for nearly 70% of the total consumption. West Bengal, Maharashtra, Delhi and Uttar Pradesh are the main centers of linseed oil consumption in the country.

METHADOLOGY:

The linseed oil has been utilized for preparation of biodiesel fuel (alkyl ester of linseed oil). In a measuring cylinder some pellets of potassium hydroxide is taken and methanol is incorporated according to stoichiometric extent. By shaking catalyst pellets, proper blending with the methanol was done. In the center opening, stirrer is firmly fitted. Warming and stirring of the oil begun in the meantime. Blending and warming was in persistent blending for 2 hrs at temperature of 65 ^{0}C. The response of mixture normally changes to a turbid orange tan color inside the initial 5-10 minutes. At that point it changed to a reasonable transparent dark shade. At the finish of the response mixture gives sort of sweet smell, this demonstrates that response is in the finishing stage. Blending and warming was carried for another 60 minutes. In a decent finished mixture glycerol starts to be divided promptly, when blending and warming is halted. In the ester phase, there were likewise hints of glycerol, unreacted methanol and traces of soap as impurities. These impurities could be removed by adding 100 ml of warm water to the ester. Again it was passed through the calcium hydroxide pellet for removing moisture content properly. The other phase was glycerol as a byproduct. Then the linseed ester was blended with petroleum diesel fuel in several proportions and the petroleum analysis was carried out.

STUDY OF PROPERTIES OF LINSEED OIL METHYL ESTER AS AN ALTERNATIVE FUEL:

1. DIESEL INDEX EVALUATION:

The ignition quality is the main aspect of diesel fuel which is depends on Diesel index value. The value of the diesel index for high speed diesel has to be around 45 min as per BIS specification studies. Diesel index property is obtained is related to API gravity of fuel and aniline point temperature in ^{0}F.

Diesel Index = Aniline pt. temp. in ^{0}F x API Gravity / 100

The diesel has a DI of 55.18 whereas the DI of the linseed oil is approximately 19.48. Thus use of pure linseed methyl ester as a fuel will shows poor ignition quality due to very less DI value. Use of linseed oil methyl ester as fuel will not be recommended since having the DI value 55 much above the value of pure diesel while the blend of 10% methyl ester of linseed results in diesel index was reported 48.52 which is slightly above the specified value resulting is superior ignition property. For the different blends of 20%, 30%, 40%, 60% and 80% of methyl ester, the obtained diesel index values much below the specified value and hence will have very poor ignition property. Hence, we can say that as blending concentration increases, the diesel index decrease. So 10% blend is most suitable one.

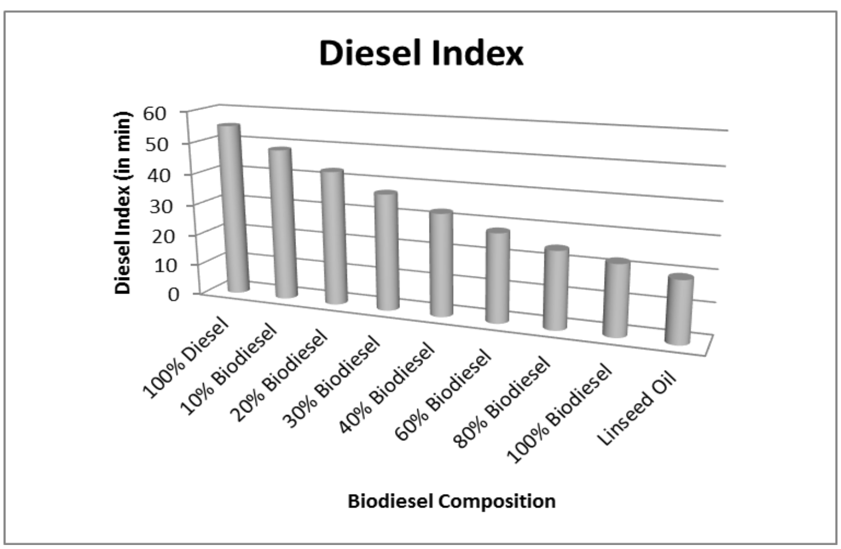

Figure 1: Change in Diesel index for changes in biodiesel composition

2. **Aniline Point Evaluation:**

3. High speed diesel i.e. 100% diesel has an aniline point of 68 ^{0}C whereas 100% biodiesel has very low aniline point of 26 ^{0}C. The blends of linseed methyl ester and high speed diesel have a lower aniline point when compared to high speed diesel but is higher than the aniline point for pure biodiesel obtained from the linseed oil. High Aniline point suggests that fuel is paraffinic in nature and will have a high diesel index.

The various aniline points for various blends have been shown in the graph.

The value of aniline point is larger represents, the fuel possessing large quantity of paraffin components. Larger the aniline point, larger the diesel index leads to superior quality of ignition in diesel engine. When the fuel is rich in aromatic contents, it shows lower values of aniline point and the ignition is poor.

Diesel has an aniline point of 68 ^{0}C whereas linseed oil methyl ester that is pure biodiesel of aniline point temperature, was found to be 26 ^{0}C. The blends of linseed oil biodiesel in diesel having lower aniline point temperature**.** Here the quantity of linseed methyl ester proportionately enhanced in diesel the aniline point linearly reducing order. The optimum value suggests the use of linseed biofuel as an alternative diesel fuel of 20 percent blend.

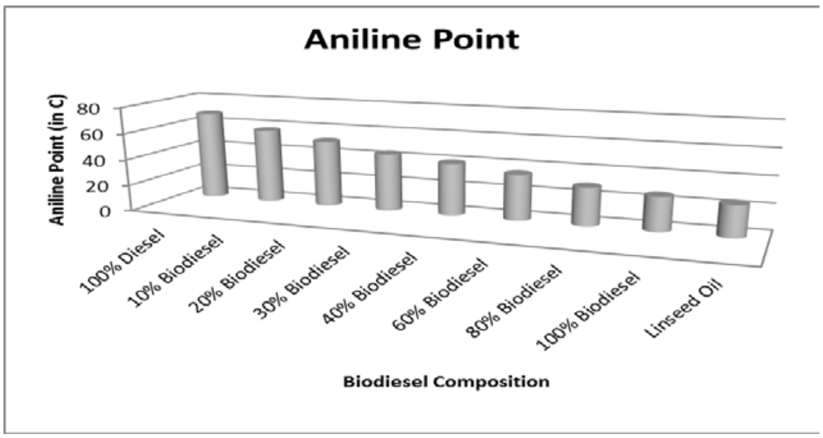

Figure 2: Change in aniline point for changes in biodiesel composition

4. Kinematic viscosity evaluation:

Efficiency of the fuel in the diesel engine depends on viscosity of the oil to be used. The kinematic viscosity the linseed oil methyl ester should be around 2.7×10^{-6} m^2/s (diesel viscosity) for satisfactory fuel performance. But this value was much higher, 5.75 cS and the different proportionate blends having the viscosities 3.29×10^{-6} m^2/s, 3.43×10^{-6} m^2/s, 3.95×10^{-6} m^2/s, 4.12×10^{-6} m^2/s, 4.81×10^{-6} m^2/s, & 5.12×10^{-6} m^2/s for 10%, 20%, 30%, 40%, 60% and 80% respectively. The first three blends consisting nearest values to diesel will be nicely used rather than linseed methyl ester. The blending technique save twenty to thirty percent oil and further useful for participating the major role for cleaning the environment due to unwanted gas percent reduction.

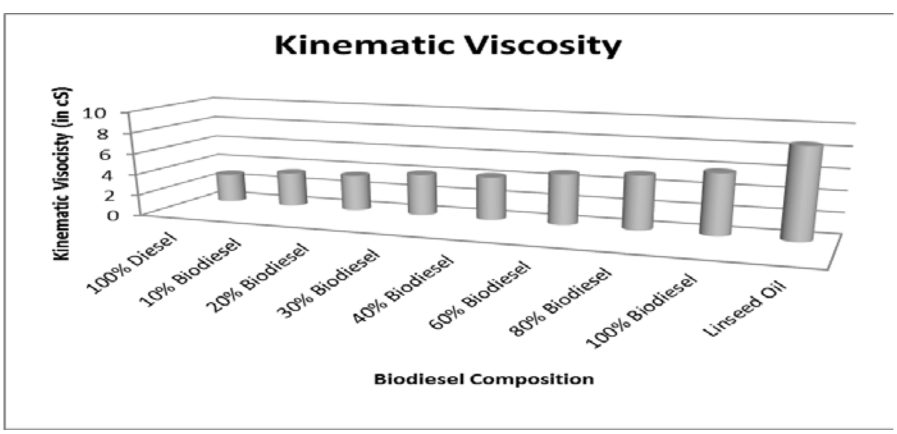

Figure 3: Change in kinematic viscosity for changes in biodiesel composition

5. Pour Point evaluation:

The need of pour point temperature has paramount importance because of its usefulness in the weather condition, storage and handling purposes. The fuel used in diesel engine should be free flowing at the lower ambient temperature condition. Indian conditions allow to at 5 °C pour point temperature while some regions like Himalaya boundaries to be at subzero level. The lower pour point is the priority but exceeds the cost of pumping.

According to BIS determination for diesel, pour point ought to be beneath 6 °C. Pour point is the least temperature at which it has utility in certain requisition. Market bought diesel has a pour point temperature of +5° C. Pour point of linseed oil is -7°C which is far below the requirements thus using linseed oil as a fuel is of no problem from pour point aspects. Pour point of methyl ester of linseed oil was found 2°C whereas the other blends of ester in diesel such as 10%, 20%, 30%, 40%, 60% and 80% were observed as 4°C, 4°C, 4°C, 3°C, 3°C and 3°C respectively. From the experimental values it is observed that percentage blending increase of linseed ester not drastic reduction in pour point temperature.

6. Distillation Characteristics:

The linseed oil methyl ester has initial boiling point temperature higher than diesel. The value for petro-diesel was 900C and for linseed ester 118 ^{0}C. Marginally increase in IBP is observed as the linseed ester blend percent increases upto 40 percent. The IBP values 120 ^{0}C, 126 ^{0}C, 128 ^{0}C & 132 ^{0}C were obtained for every ten percent ester blends increased. The ease of starting of an diesel engine governed by IBP temperature to the 10% distillate collection as per ASTM distillation technique. The Lower values of IBP are required preferably in cold weather conditions, but sometimes results to tendency of locking of vapors inside of the engine because of high rate of evaporation. The linseed oil methyl ester and their blends having greater IBP values has advantage to be used to avoid vapor locking effects.

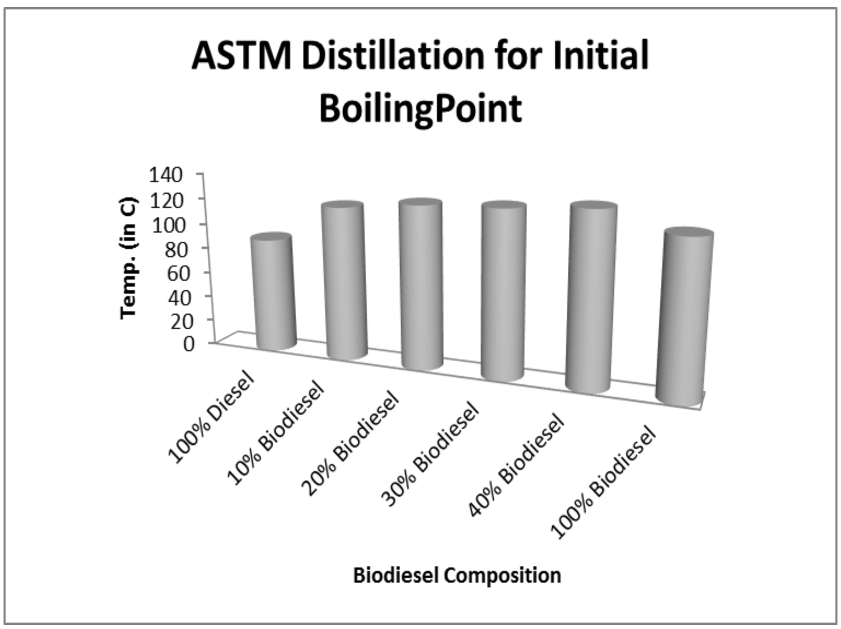

Figure 4: Change in Initial Boiling Point for changes in biodiesel composition

From the experimental study it was observed that for 10% linseed biodiesel blend, the FBP was 380 ^{0}C at distillate recovery 92%, for 20% biodiesel blend, FBP was 360 ^{0}C at distillate recovery 93% and for 30% blend, FBP was found 346 ^{0}C at slightly less distillate recovery of 85%.For 40% linseed biodiesel blend, 9% distillate collected at temperature 275 ^{0}C and after that cracking was observed while for higher blends cracking appeared at early stage. As per ASTM distillation technique only 10% and 20% linseed oil methyl ester blends in diesel is feasible. Higher blend gives poor distillation characteristics reflected in engine performance with respect to ease of starting, warm up period and ignition quality.

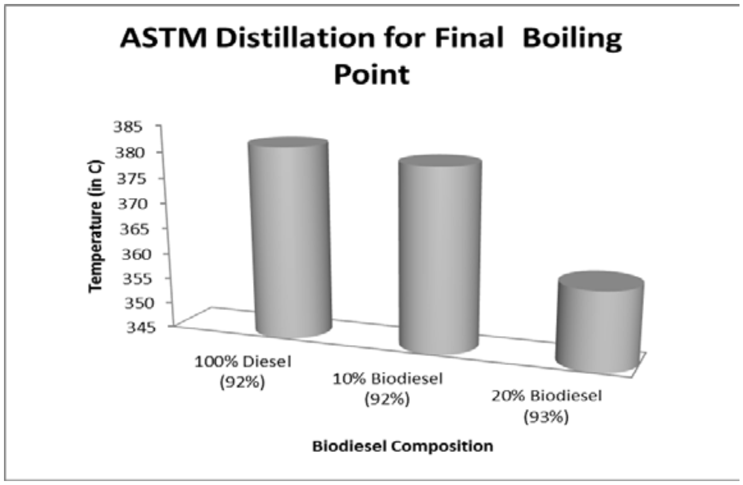

Figure 5: Change in Final boiling point for changes in biodiesel composition

7. **Flash and Fire Point Temperature-**

The flash and fire point of the petroleum diesel was noted as 68 ^{0}C & 71 ^{0}C and for linseed biodiesel 81 & 840C was obtained. Marginally increase in flash and fire point temperature as linseed biodiesel concentration increases such as for 10%, 20%, 30%, 40%, 60%and 80%, the flash and fire point temperature was found as 70 ^{0}C & 72 ^{0}C, 73 ^{0}C & 76 ^{0}C, 74 ^{0}C & 77 ^{0}C, 76 ^{0}C & 79 ^{0}C, 78 ^{0}C & 82 ^{0}C, 81 ^{0}C & 84 ^{0}C resp. The usefulness of the flash and fire point temperature to analyze the possibilities of any fire hazards at the time of fuel under transportation stage. This property is also helpful for easy handling and storage of petroleum fuel substances. The flash point study suggests the use of linseed oil methyl ester in diesel will improve fuel efficiency.

8. **Specific Gravity estimation :**

The specific gravity of market purchased diesel was noted 0.842.Its value linseed oil methyl ester 0.885.The specific gravity values was marginally increased as the blends proportion increased such as for 10, 20, 30, 40, 60and 80% linseed biodiesel blend in diesel were found 0.846, 0.855, 0.862, 0.869, 0.878 & 0.881 respectively. Therefore most useful blending percentage depends on diesel index and cetane index properties. The specific gravity values used for calculating API gravity and diesel index obtained from API gravity and aniline point. The cetane index is also related to diesel index. Hence the specific gravity values are also results to fuel performance. Specific gravity is more than diesel index is also high.

CONCLUSION:

Utilizing immaculate linseed oil, it is observed that the diesel motor will not work legitimately because of high kinematic consistency & real contrasts in diesel index record and ASTM refining properties. In any case it meets pour point properties perspectives. Properties like kinematic viscosity, diesel index and ASTM refining temperature are more critical than pour point. The biodiesel means methyl ester of linseed oil meets the pour point properties according to BIS determination but the viscosity values not convening. However petroleum properties like Distillation and diesel index does not meet the detail which is more imperative. In this manner utilizing pure methyl ester of linseed oil in diesel motor is unrealistic. Blends of 10% and 20% methyl ester of linseed oil with diesel meet the BIS requirements of kinematic viscosity, pour point, and diesel index and distillation temperatures. Hence utilizing 10% and 20% mixture of methyl ester of linseed oil with diesel may spare 20 % diesel necessity of the nation. Mixes of 30 % methyl ester of with diesel meet the kinematic viscosity and pour point properties. However it doesn't meet the diesel index and ASTM refining properties detail. Along these lines utilizing 30% or more mixes of methyl ester of linseed oil with diesel can't be conceivable, the better option is utilization of 20% linseed biodiesel in diesel which almost fulfill all petroleum properties which will be useful for 20% diesel saving and partially making pollutant free environment which is the todays need.

REFERENCES:

1. S. Lim and L. K. Teong, Renew. Sustain, Energy Rev., 2010, 14, pp. 938 – 954
2. D. Royon, M. Daz, G. Ellenrieder and S. Locatelli, “Enzymatic productions of biodiesel from cottonseed

oil using t – butanol as a solvent", Bioresource Technology, 2007, 98, pp. 648 – 653

3. V. Dhana Raju and P. Ravindar Kumar, "Experimental Investigations of Linseed and Neem Methyl Esters as Biodiesel on CI Engine", International Journal of Engineering Science and Technology, 2012, 4(6), pp. 2809 – 2815
4. T. Eevera and K. Pazhanichamy, "Cottonseed Oil: A feasible oil source for biodiesel production", Energy Sources, 2013, Part A (35), pp. 1118 – 1128
5. P. R. Muniyappa, S. C. Brammer and H. Noureddini, Bioresource Technology, 1996, 56, pp. 19 – 24
6. A. K. Mishra, N. Singh and V. P. Sharma, "Use of neem oil as a mosquito repellent in tribal villages of Mandla district", Indian J Malariol, 1996, vol. 3, pp. 99 – 103
7. Amol M. Ramning, Priya S. Dhote and V. N. Ganvir, "Production of neem oil methyl ester (NOME) from oscillatory baffled reactor", Research Journal of Recent Sciences, 2013, vol. 2, pp. 223 – 228
8. M. K. Lam, K. T. Lee and A. R. Mohamed, Biotechnology Advances, 2010, vol. 28, pp. 500 – 518
9. J. Xue, T. E. Grift and A. C. Hansen, Renewable and sustainable energy reviews, 2011, vol. 15, pp. 1098 – 1116
10. Mahesh N. Varma and Giridhar Madras, "Synthesis of Biodiesel fro Castor Oil and Linseed Oil in Supercritical Fluids", Ind. Eng. Chem. Res., 2007, Vol. 46, pp. 1 – 6
11. M. Hasheminejad, M. Tabatabaei, Y. Mansourpanah, M. Khatmi Far and A. Javani, Bioresource Technology, 2011, vol. 102, pp. 461 – 468
12. M. J. Ramos, M. C. Fernandez, A. Casas, L. Rodriguez and A. Perez, Bioresource Technology vol. 100 , pp. 261 – 268 (2011)
13. M. Canakci, J. Van gerpen, "Biodiesel productions from oils and fats with high free fatty acids", Trans ASME, 2001, vol. 44, pp. 1429 – 1436
14. A. S. Kumar, D. Maheshwar, K. Kumar, "Transesterification process of biodiesel", Proceeding of REA, Delhi, 2008, pp. 623 – 631
15. Anya Uzo Anya, Nwobia Noelle Chioma and Ofogbu Obinna, "Optimized reduction of free fatty acid content on neem seed oil for biodiesel production", J. Basic. Appl. Chem., 2012, vol. 2, pp. 21 – 28
16. A. Nag, "Biofuels Refining and Performance", McGraw – Hill Publications, 2008
17. Mallegol J., Lemaire J. and Gardette J. L., "Drier influence on the curing of linseed oil", Prog Org Coat, 2000, vol. 33, pp. 107 – 113
18. Juita, Bogdan Z. Dlugogorski, Eric M. Kennedy and John C. Mackie, "Low Temperature Oxidation of Linseed Oil: A review", Fire Science Reviews, 2012, pp. 1 – 36
19. Alister D. Muir, "Flax, The genus Linum", Taylor and Francis Ltd., 2003, pp. 298
20. Lilian U. Thompson and Stephen C. Cunnane, "Flaxseeds in human nutrition", 2nd edition AOCS Press., 2003, pp. 8 – 11