Significance of Ethanol Blended Biodiesel Powered Diesel Engine

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Abstract— In recent years, energy consumption is increasing due to increase in the demand for the energy due to industrialization and increase in number of automobiles. This leads to depletion of fossil fuels and hence researchers concentrate on alternative fuels which reduce the engine emission and are environmentally friendly. This leads to biodiesel produced from non-edible as an immediate substitute to the fossil diesel. In this work, we used Kenaf oil for the production of the biodiesel as it has considerable potential for the production of the biodiesel. In this work, biodiesel was produced from the Kenaf oil using transesterification and we found that the properties of the biodiesel are close to diesel. The engine performance with higher biodiesel blend is not comparable to the diesel due to higher viscosity and lower volatility of the biodiesel. Hence, in this work, we have used ethanol as an additive to improve the combustion and flow properties of the biodiesel blend. The engine tests were carried out and the performance parameters like BTE, BSFC, ME were analyzed. Emission of CO, CO2, and NOx is examined through experimentation. These parameters are checked for the blends B10, B15, B20.Performance characteristic of blends having different percentage of ethanol additive are experimented. From this work, we conclude that the ethanol can be used as an additive to improve the performance of the engine operated with B20blend.

Keywords: Diesel Engine

I. INTRODUCTION

In developing countries like India, the transportation becomes an essential part of life. About hundred years ago, the petroleum products became the major source of energy. Still today the technology is generally leading to a more preponderant utilization of hydrocarbon fuels, making civilization vulnerably susceptible to decrement in supply. But the emission from the fossil fuel has much bad effect on living things. This makes the search of bio fuel as an alternative fuel for internal combustion engines.

Additionally, the prices related to raw oil steadily increasing in National and International market. Highlighting these particulars, Government is aggressively encouraging the usage of bio fuel as auxiliary for diesel. Utilizing bio fuel might shrinkage the Nation's necessity on foreign raw oil then helps in saving foreign exchange investments. Biodiesel production also helps in giving jobs to needy rural peoples.

Biodiesel is the methyl ester originated by various kinds of vegetable oils as well as animal fats. Viscosity of animal fats as well as vegetable oil is about eleven to seventeen times greater than diesel. The flow properties such as vaporization, atomization are affected by the viscosity of oil. Hence the usage of great viscid oil in the engine leads to argumentative effects on combustion process. Therefore, the oils should be chemically reacted to be well-suited with engines. This chemical treatment is known as transesterification. Transesterification involves breaking of large triglycerides into a smaller Monoalkyl ester. The High Viscosity of triglycerides can be reduced by the transesterification process in which triglyceride decompose into glycerol and glycerin, which is the biodiesel. The biodiesel can be produced from a variety of edible and nonedible oils, animal fats etc. The chosen oil will be subjected to transesterification in the existence of catalyst to produce biodiesel.

Indian consumption of petroleum fuels for the period of 2008-09 was 30.50 million tons. This necessitates bringing in crude petroleum from other countries. The importation bill on petroleum products was 18,850 crores. It is also observed that, utilization of Kenaf oil biodiesel leads to increase in efficiency of engine. Increase in efficiency of the engine will have a greater impact on Indian economy.

II. LITERATURE SURVEY

S. P. Chincholkar in 2005 expressed that vehicles using diesel are real hotspot for pollution of air; there is extraordinary possibility for a dangerous atmospheric deviation because of release of greenhouse gasses like CO_2 from vehicles. Particulate substances released by diesel fuel vehicle with ash have various issues related to lungs. Biodiesel mixed with diesel fuel has advantages such as no poisonous gases like sulfur, net carbon dioxide and has less content of carbon monoxide and more amount of oxygen. Complete combustion can be achieved with more oxygen. Usually emissions in biodiesel are less contrasted with emissions in diesel fuel that is promising contamination-free environment. Biodiesel is harmless, biodegradable and furthermore renewable fuel. Biodiesel also helps in providing jobs to needy rural people and helps in greening the degraded land which reduces pollution.

Gog Adriana in 2007 expressed that biodiesel is better-quality fuel compared to petro diesel with meeting the majority of chemical and physical rules of petro diesel. Bio fuels such as plant oils, biodiesel, and biogas have been effectively presented and they are being used. Biodiesel may be referred as most excellent alternative fuel which has the biggest possibilities that could guarantee fuel supply in future. Powers obtained from biomass are possibly renewable as well as adequate, but fossil fuels are non- renewable. Wide mixture of energy transporters by transformation advancements, biodiesel can possibly be substantial new wellsprings of energy in 21st century.

S.L. Ghodake in 2008 says that biodiesel is a renewable fuel included mono- alkyl esters having long chain unsaturated fats made using vegetable oils, creature fats & reused cooking oils. It is one of the few option fills that can important role in development of energy policy. Bio diesel contains no petrochemical items. In this way it is clean

blazing fuel, subsequently supportive in reducing emission levels and eventually avoiding an Earth-wide temperature boost. Bio diesel is able to be blended with the petroleum diesel in different extents to make bio diesel blends. B-20 is broadly utilized blend in light of the fact that it adjusts the property contrast with conventional diesel, performance, emission advantages and expense. B-20 can be utilized in engines with no real alterations. Bio-diesel mixes up to a most extreme up to B5 doesn't cause engine or fuel framework issues gave that bio-diesel utilized for mixes meets the ASTM models. Bio-diesel may require added substances to enhance stockpiling dependability and permit use in extensive variety of temperatures also, the states of seals hoses, gaskets and coatings ought to be observed consistently when bio-diesel fills are utilized.

Bio-diesel is non-lethal, bio-degradable and clean blazing fuels which may advance their utilization. Bio diesel reduces motor wear by as much as one half, fundamentally in light of the fact that it gives magnificent lubricity.

Naga Prasad in 2009 considered the performance of castor oil and its mix with diesel. At first, castor neat oil and their mixes were picked. The physical properties of Castor oil were resolved. The viscosity of neat castor oil is high and can be reduced through mixing with diesel. The blend of castor oil and diesel should be heated to reduce viscosity. The heating temperature increases with the increment in the rate of neat oils with diesel running from 70°C to 120°C preceding going into the ignition chamber. The performance and emission qualities of engine are resolved utilizing Castor neat oil and their mixes with diesel. These outcomes are contrasted with those of fossil diesel. It was noticed that the performance qualities were reduced and emission attributes were expanded at the evaluated load when compared with diesel due to lower calorific value, high viscosity and postponed ignition process. Castor non-consumable oil could be presumed to be utilized as alternative to diesel. The performance and emission curves for 25% neat castor oil mixed with 25% of diesel shows that, it is the most appropriate blend without any engine modification.

K. Pramanik in 2003 researched the high viscosity of the Jatropha curcas oil. The high viscosity was diminished by mixing with diesel. Mixes of fluctuating amounts of Jatrophacurcas oil and diesel was done, examined and contrasted with diesel. Impact of temperature to viscosity of diesel along with Jatropha oil was additionally considered. Performance utilizing mixes of Jatropha oil was assessed and contrasted with diesel. Noteworthy change in performance of engine was noted and contrasted with vegetable oil alone. Due to the reduction in vegetable oil's viscosity, the SFC and EGT were reduced. Blend B50 gives satisfactory BTE.

E. Palaniswamy in 2011 investigated utilization of preheated Jatropha in addition to Pongamia oil as fuels in single chamber, DI engine. It was found that these oils have moderately high viscosity than fossil diesel fuel. Viscosity related with the Jatropha oil is reduced on preheating. Preheating the oil gives the viscosity comparable with the diesel. They researched that when preheated fuel is introduced into the chamber improved spray pattern, atomization attributes enable the fuel to experience great combustion and henceforth it prompts to good performance and decreased emissions. It was found that BTE of preheated oil was almost close to that of fossil fuel and smoke levels of oils after preheating diminished from 4.25 BSU to 3.45 BSU, the increment in temperature lessens the CO and HC emanations to 0.21%. They demonstrated that the pre-heating of vegetable oil shows good results in CI engine.

S. K. Bhele in 2006 researched neat Karanj oil Methyl ester (KME) and also the blends of changing extents of Karanj biodiesel as well as diesel to run engine. Esterified Karanj oil can be used in diesel engine which is feasible in existing diesel engine. The Brake Fuel Consumption at lower load is lower when contrasted with diesel. As load increases BSFC increases marginally when contrasted with diesel. At all load conditions, the Brake means effective pressure and volumetric efficiency was superior to diesel fuel. Due to lower calorific value, Brake thermal efficiency was less than diesel in all load conditions. Several blends of esterified Karanj oil along with diesel substitutes can helps in decreasing vulnerability of fuel availability, preservation measure, making farmers more confident and boosting farm economy.

Rehman. A. in 2009 conducted the performance test to ascertain the prospect of use of modified Karanja oil as fuel in compression ignition engine. Examination of test fuels was done with diesel fuel. Performance characteristic was examined for esters of Karanja oil, mixes of Karanja oil, as well as the diesel oil at different loads which was performed at governor controlled rate. Impact on engine performance with different fuels was studied to watch its variations in the injection parameters. Test results demonstrated that at lower injection pressure, diesel engine gave meager performance than esterified Karana oil and its mixes with diesel.

Dr. C. Prabhakar Reddy in 2012 investigated rubber seed oil as an alternate fuel and its usage in CI engines. The study includes the variation of the injection pressure from 215 bar to 245 bar to complete the investigation. At full load for a blend of 80% Diesel and 20% Rubber seed oil, heat balance sheet was drawn at different Injection Pressures. The heat balance sheet shows that in engine, Rubber Seed oil could be utilized as substitute fuel with 245 bar injection. Heat carried by exhaust gasses is reduced marginally with 80% Diesel and 20% Rubber Seed oil blend.

V.S.Hariharan in 2009 conducted experiments to review the discharge as well as performance features of direct injection diesel engine utilizing sea lemon oil and its blends. Study shows the decrease of NOx. The hydrocarbon in addition to carbon monoxide emissions were marginally increased in comparison with diesel. Sea lemon oil and its methyl ester were having slight ignition delay contrasted with diesel. Combustion features of sea lemon oil and its methyl ester were same as that of diesel.

Jayant Singh in 2007considered the emanation features of refined rice bran oil methyl ester – diesel blend (B0, B10, B50, B100). The CO, NOX and UBHC at different load were compared with diesel. At a particular load, carbon monoxide emission from the engine was discovered to be less on all blends of rice bran oil methyl ester –diesel contrasted with diesel. Unburnt hydrocarbon emanation was found to be more compared with pure diesel. NOx emission was increased contrasted with diesel.

Dileep N. Malkhede in 2010 studied the use of ferrocene as an additive. This ferrocene is added to the

Jatropha oil for evaluating its performance. This additive is added to Jatropha Straight Vegetable Oil (JSVO) in various proportions. The performance of each concentration of ferrocene is investigated over entire load range. Increased concentration of ferrocene in Jatropha straight vegetable oil reduces smoke. Use of ferrocene enhances the BTE of both vegetable oil as well as diesel. Utilization of the straight vegetable oils with ferrocene can prove to be effective in existing diesel engines without much alteration. With addition of 0.065 % ferrocene in JSVO helps in reduction of smoke opacity by 45% at full load compared with neat JSVO.

S. Jindal in 2011 carried out engine tests for obtaining performance as well as emission features of Kenaf oil biodiesel along with its blends with diesel. From the investigation, Jindal found that properties of Kenaf oil were a like to Karanj and Jatropha. These physical properties help in using Kenaf oil as biodiesel. The BTE rises with raise in load. The thermal efficiency increases for the blends of Kenaf with diesel. This is because the biodiesel offers enhanced lubrication to the fuel which results in less power loss in pump. As load increases the BP will upsurge to an esteemed value which helps in better fuel utilization. Raise in brake power is more when compared to rise in fuel consumption which results in lower BSFC. It was noted that, for all blends, BSFC decreased. UBHC along with smoke shrink to a great amount with a blend of 20% Kenaf and 80% diesel.

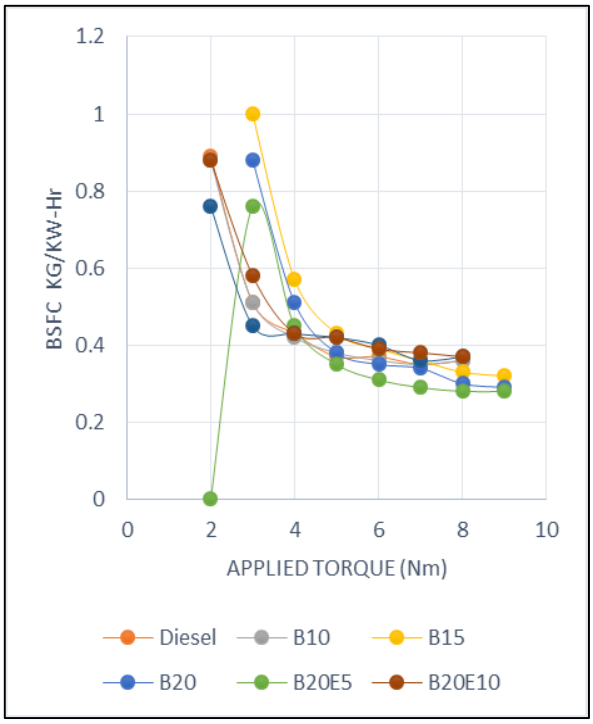
K A. Sorate in 2009 studied the suitability of Kenaf oil biodiesel as alternative fuel. Kenaf oil properties were comparable with diesel. The mechanical efficiency and brake thermal efficiency for all blends of Kenaf were nearly same at all load conditions to the diesel fuel. For 10% and 20% blends, the BSFC was more. 30% and 40% blends were having nearly same BSFC. Experimental investigations show that Kenaf oil can be used in blending proportions up to40%.

III. GRAPH

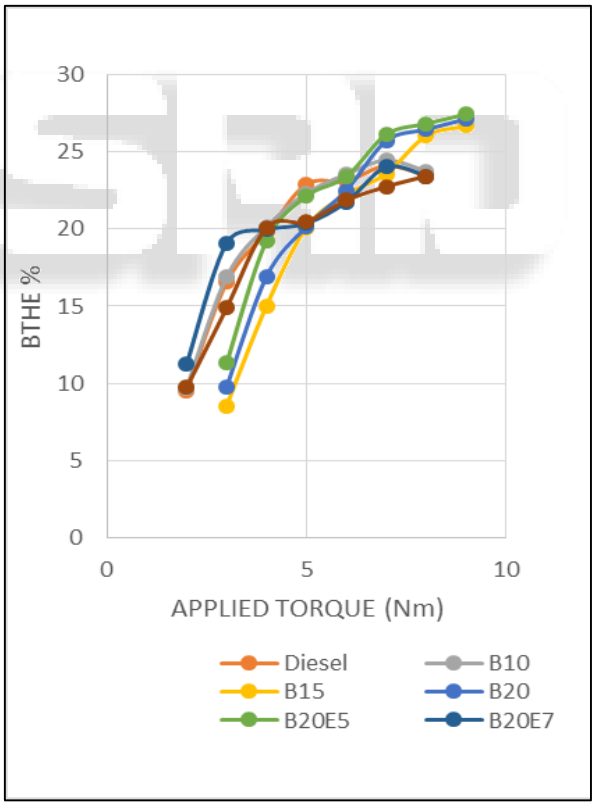
A. BSFC VERSUS BP

The distinction of BSFC with BP is shown in Figure 5.2. BSFC of diesel and blends decreases with increasing load. As the load increases, the brake power increases resulting in better utilization of fuel. At lower load, the BSFC of diesel and B10, B20 blends were same. Blend B15 has raised BSFC at low load situation. The blends B15 and B20 have lower BSFC compared to diesel at higher loads. The lower BSFC of blend B20 is 0.29 Kg/(Kw-hr) at higher load. The raise in brake power is more contrasted with raise in fuel consumption resulting in lower BSFC. The excess oxygen available in the Kenaf biodiesel also helps in reducing the BSFC.

At low load situations, the Kenaf biodiesel leads to incomplete combustion and demands for additional air fuel mixtures to produce same power contrasted with diesel



B. BTE VERSUS BP



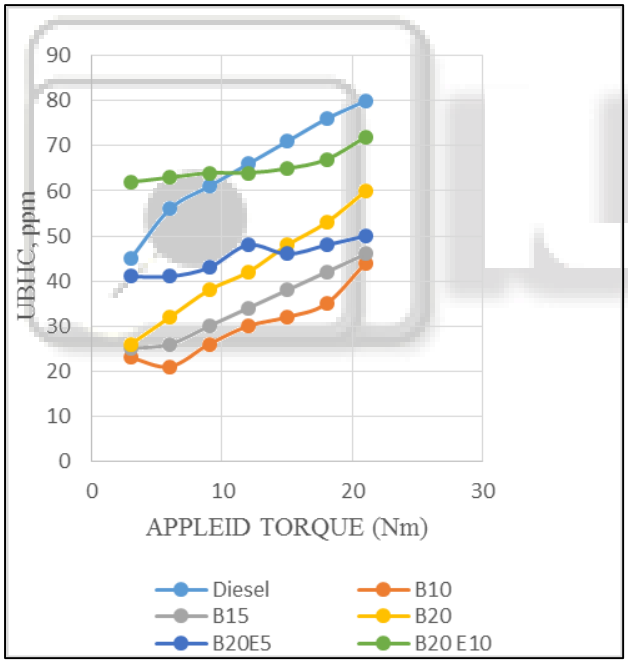
The distinction of brake thermal efficiency with brake power for blends B20, B20E5, B2E7 and B20E10 is shown in Figure 5.5. Here B20E5 refers to the blend of B20, diesel and 5% of ethanol (20% of B20+70% of diesel+5% of ethanol). The blends B20E5 and B20E7 have higher BTE at low load condition compared to diesel and B20E10. When the load increases BTE decrease for blend B20E7 compared to B20 also BTE for B20E5 rises above B20. At higher load the BTE of the blend B20E5 is found to be increased above the BTE

for B20. The maximum BTE for the blend B20 is 27.43%. The maximum efficiency for the blend B20E7 is 26.02%. The BTE for the blend B20E10 is found to be lower than B20 at all loads. From the graph it is seen that using of ethanol till 5% gives high BTE. In Figure 7.1, the BTE of B20 is found to be higher than diesel and other blends. The BTE of B20 can be increased by adding 5% ethanol.

C. Emission parameters of engine tested with different blends

1) UBHC VERSUS BP

Unborn hydrocarbon variation for various blends and for diesel is displayed in Figure 5.9. The incomplete combustion of fuel results in UBHC emission. UBHC percentage rises with rise in load for all blends and diesel. All blends of Kenaf (B10, B15 and B20) have low UBHC emission compared to diesel. B10 has the least UBHC emission contrasted with diesel and the blends B15, B20. Blend B20 give less UBHC emission at all loads. The blends B15 and B20 have the UBHC emission in between the diesel and B10. The decrease in UBHC compared diesel is because of complete combustion in after burn zone in the engine. The availability of excess oxygen also helps in reducing UBHC emission. The high combustion temperature associated with high load tends to decrease the UBHC emission.

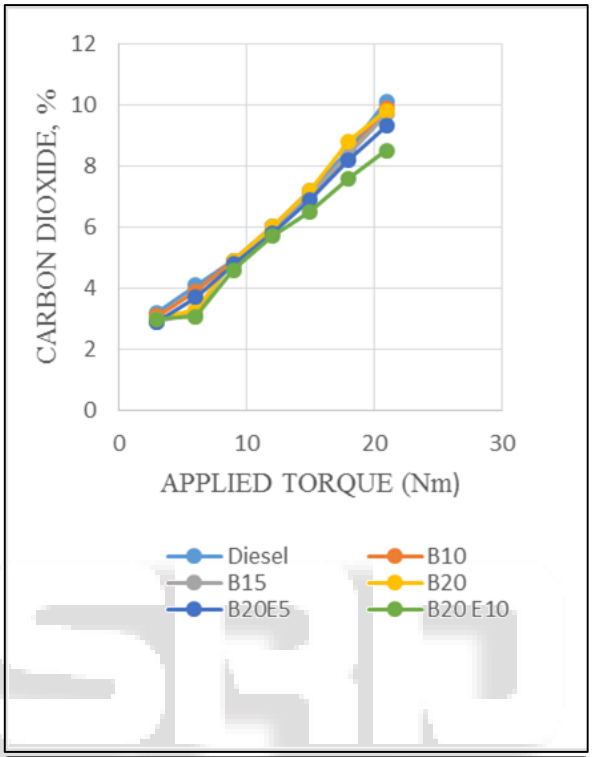


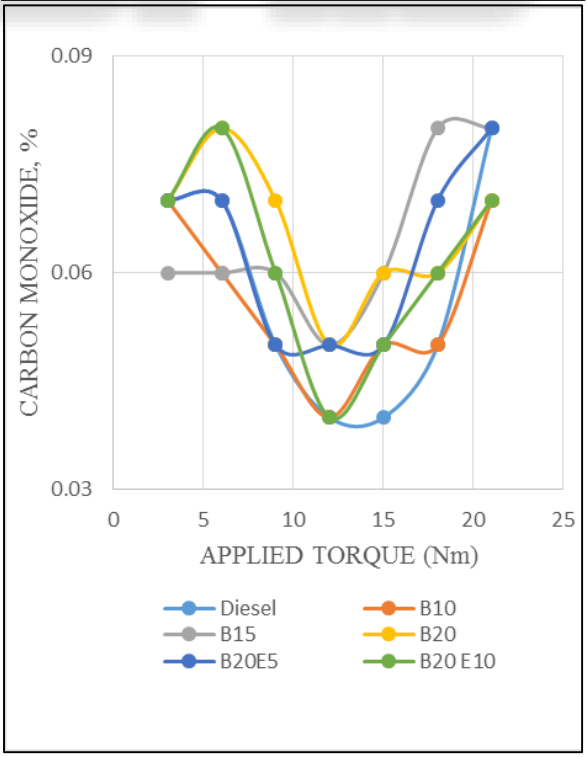
D. CO VERSUS BP

The distinction of CO with BP is shown in below graph. CO reduces for all blends and diesel till 50% of the applied load later it will increase at higher loads. The CO emission for the blend B20E5 is lower than co emission for B20 till 75% of the applied load. At 100% load the CO emission for the blend B20E5 increases above the B20 CO emission. The CO emission for the blends B20E7 and B20E10 were same and lower than CO emission for B20 for lower load condition. For high load condition the CO release for B20E7 and B20E10 are different and lower than CO emission for B20. The blends B20E7 and B20E10 gives less carbon monoxide emission compared to B20 at every load situation. B20E5 gives lower CO release till 75% of the applied load.

E. CO2 VERSUS BP

The distinction of CO2 with brake power is shown in below graph. CO2 emission rises with load for all blends. The blend B20E10 has low CO2 emission compared to B20for all load conditions. Blends B20E5 as well as B20E7 have slightly higher CO2 release contrasted with B20 at low load condition. At higher load these blends have lower CO2emission compared to B20. By adding ethanol in 5%, 7%, 10% the CO2 emission can be reduced at all loads.

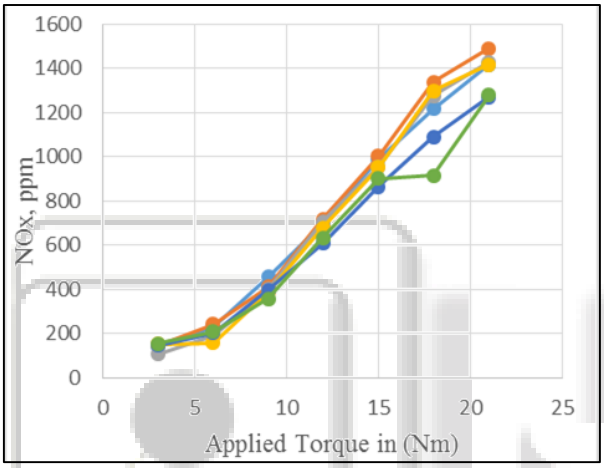




F. NOx VERSUS BP

The distinction of NOx with BP is shown in Figure 5.16. The formation of NOx in the exhaust mainly depends on oxygen availability and combustion temperature. At low load condition, the oxygen availability is more, which reduces NOx emission. At high load condition the combustion temperature is more which increases the NOx emission. At high load condition availability of excess oxygen promotes NOx emission.

For all load conditions, the NOx release increases for all the blends. At low load condition the NOx emission for the blends B20E5, B20E7 and B20E10 is higher than that for B20. But with increasing load the NOx emission for these blends decrease below the B20. The blend B20E10 gives less NOx emission compared to B20 at high load condition. NOx emission for the blends B20E5 and B20E7 lies in between B20 and B20E10. By adding ethanol to the blend B20, NOx emission can be reduced.



IV. RESULT

A. Biodiesel production

Biodiesel was successfully produced from the Kenaf oil. The properties of the biodiesel and diesel are determined as per ASTM / BIS standards and compared with the crude oil. Table 5.1 compared the properties of Kenaf oil, Kenaf oil biodiesel and diesel.

Sr. No	Properties	Crude Kenaf oil	Kenaf Biodiesel	Diesel
1	Calorific value (MJ/kg)	39.63	39.343	42.7
2	Viscosity @40C (m^2/s)	22.09×10^{-6}	3.0984×10^{-6}	3.5×10^{-6}
3	Density (kg/m^3)	871.72	875	850
4	Flash point °C	164	140	56
5	Fire point °C	172	151	65
6	Cetane number	---	32	47

Table 1: Properties of Diesel, Crude Kenaf oil and Kenaf biodiesel.

Sr. No	Properties	B10	B15	B20
1	Calorific value (MJ/kg)	44.52	43.92	43.33
2	Viscosity @40C (m^2/s)	3.23×10^{-6}	3.46×10^{-6}	3.66×10^{-6}
3	Flash point °C	53	58	61
4	Fire point °C	62	65	72

Table 2: Properties of different blends of Kenaf biodiesel.

V. CONCLUSION

1) The biodiesel energy content is affected by which oil it is produce out of.
2) The result indicated that the different FAME in each different biodiesel does not affect energy output.
3) Based on the result of the project, the ideal fatty acid methyl ester that will make the perfect biodiesel should before from fatty acid with number between 15-22 carbons atoms.
4) The lard biodiesel had the highest energy content.
5) Most of vegetable oil has high percentage of man unsaturated and poly unsaturated fatty acid.
6) Since the biodiesel was so full of impurities it produces a lot of soap when it was washed.

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