Investigation of the Performance Parameters of a Compression Ignition Engine using Different Fuel Combination

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Abstract: Alternate automotive fuels are currently an important issue all over the world due to the efforts on reducing global warming which is contributed by the combustion of petroleum or petrol diesel. Biodiesel is non-toxic, biodegradable, produced from renewable sources and contributes a minimal amount of net greenhouse gases, such as CO2, SO2 and NO emissions to the atmosphere. Need of a suitable sustainable fuel for existing internal combustion engines is being desperately felt these days, when petroleum reserves are soon going to vanish from the surface of earth. The growing concern due to environmental pollution caused by the conventional fossil fuels and the realization that they are non-renewable have led to search for more environment friendly and renewable fuels. Among various options investigated for diesel fuel, biodiesel obtained from vegetable oils has been recognized world over as one of the strong contenders for reductions in exhaust emissions.

Keywords: - CI Engine, Biodiesel, gasoline, Brake Specific fuel Consumption**,** fossil fuel

I. INTRODUCTION

India ranks sixth in the world in the term of energy demand accounting for 3.5% of world commercial energy demand. It is expected to grow at 4.8%. The growth in energy demand in all forms is expected to continue unabated owing to increasing urbanization ,standard of living and expanding population with stabilization not before mid of the current century. The demand of diesel (HSD) is projected to grow from 52.33 millions of tons in 2006-07 to 61.55 millions of tons in 2009-10. Our Crude oil production as per the tenth plan working group is estimated around 33-34 million metric tons per annum. The import bills are raising to $ 15.7 billion or so which is a huge amount for a country like ours. Consumption of diesel can be minimized by implementing biodiesel program expeditiously. More research work in this field will help the country in saving precious foreign currency, which otherwise is wasted in purchasing petroleum products instead of helping poor for their pure drinking water and meals [1].

Biodiesel is suitable for environmentally friendly fuels because of there are not any toxic compounds produced during the period of combustion. In this matter, Demirbas[1] reported that the advantages of biodiesel is better quality of exhaust gas emissions, its biodegradability and its contribution to the reduction in carbon dioxide (CO2) emissions. The now days serious problem for biodiesel production is the high price of vegetable oil which leads to a highly expensive of biodiesel product price compared to that of petroleum based diesel product for anticipating such that situation, many researchers have started to utilize the waste resource based oils as reaction feedstock.

Fossil fuels are one time energy gift to the human race once they are gone they are gone forever, alternative non-petroleum fuels yield energy security and environment benefits. They have been with us in one form or another for more than one hundred years. Before the introduction of gasoline as a motor fuel in late 1800s, vehicles were often powered by what are now considered alternate fuels. The first Internal Combustion Engine designed, built and demonstrated by Rudolf Diesel at the 1900 Paris World fair ran on peanut oil. This was his dream to power an efficient Internal Combustion Engine with crude oil or vegetable oil.

II. LITERATURE REVIEW

Experimental study of diethyl ether and Ethanol additives with Biodiesel blends fuel engine D.D. Nagdeotel, M.M. Deshmukh, M.Tech Student, Dept. Of Mech. Engg. Govt. College, Amaravati, Maharastra INDIA, 2016.

An experimental investigation is conducted to evaluate the effects of using diethyl ether and ethanol as additives to biodiesel blends on the performance and emission of a direct injection diesel engine. The test fuels are denotes as DI (100% diesel), BD (20% biodiesel and 80% diesel, 80% diesel and 5% ethanol in vol.) respectively. The results indicate theat, compared with BD there is slightly lower brake specific fuel consumption (BSFC) for BDET. Drastic reduction in smoke is observed with BDET and BDE at higher engine loads. BDET reflects engine performance and combustion characteristics than BDE and BD.

Simultaneous reduction of NOx and smoke from a direct injection diesel engine with exhaust gas recirculation and diethyl ether 2014

An experimental investigation was carried out to analyse the simultaneous reduction of oxides of nitrogen (NOx)

and smoke emission. The tests were performed on a signal cylinder direct injection diesel engine. The engine was
made to run on both pure diesel and diethyl ether (DEE) diesel blends. The DEE diesel blends were prepared by mixing certain proportions of DEE and diesel fuel. The amount of DEE in the diesel fuel blends was varied up to 30% vol % in steps of 10 Vol% by volume. The results obtained from DEE diesel blends were compared with those from pure diesel and it was found that the 20 vol% DEE diesel blends resulted in the optimum performance and emission characteristics. The study was further extended by using exhaust gas recirculation (EGR) with 20% DEE diesel blends and diesel. At 5 Vol% EGR operated with 20 Vol% DEE diesel blends, there is asimultaneous reduction of NOx and smoke emission by 54% and 20% respectively. In contrast, in the case of the pure diesel mode, when the EGR rate was fuel, namely the DEE diesel blend shows very promising results with respect to emissions, efficiency, and durability.

Application of Diethyl Ether ro Reduce Smoke and NOx Emissions Simultaneously with Diesel and Biodiesel Fueled Engines (MasoundIranmanesh, J.P. Subramanyam and M. K.G. Babu) 2011

In this investigations tests were conducted on a single cylinder DI diesel engine fuelled with neat diesel and biodiesel as baseline fuel with addition of 5 to 20% DEE on a volume basis in steps of 5 % as supplementary oxygenated fuel to analyse the simultaneous reduction of smoke and oxides of nitrogen. Some physicochemical properties of test fuels such as heating value. Viscosity, specific gravity and distillation profile were also determines in accordance to the ASTM standards. The results obtained form the engine tests have shown a significant reduction in NOx emission especially for bio diesel and a little decrease in smoke of DEE blends compared with baseline fuels. A global overview of the results has shown that the 5% DEE- diesel fuel and 15% DEE biodiesel are the optimal blend based on performance and emission characteristics.

Pugazhvadiual et al. 2009, investigate the effect od adding DEE to biodiesel blends (B25, B50 and B75) and biodiesel (B100). DEE was added in 10% , 15% and 20% (v/v) to the biodiesel fuels

All the biodiesel blends produced a higher NOx emission compared to diesel. With B25 blends, the NOx emission was reduce by the addition of DEE at all load conditions. With B75 and B100 blends, the NOx emission was lowered by the addition of DEE at low and medium loads. However, at high loads the NOx emission was higher relative to diesel; but lower compared to the corresponding fuel blens. The addition of 15% to 20% DEE was more beneficial in reading NOx compared to 105 DEE.

DEE as a fuel additive has shown to offer beneficial effects in terms of both performance and emissions. Anandet. Al. 2007, have showed that a 20% DEE in diesel along with 5% EGR result in the simulations simultaneous reduction of smoke and NOx emission

Recently, Ramadhaset.al 2008.,studied the was of DEE as a fuel additive for reducing the cols starting problem and to improve the performance and emission characteristics of a diesel engine fuelled with biodiesel. In the work, pongamia oil derived from the seed of Pongamia Pinnata is used to produce biodiesel. P. Pinnata has been recognized as one of the most suitable among other plant species such as Jatrophacurcus and Madhucaindica for producing biodiesel.

III. EXPERIMENTAL SETUP

The following equipment are consists for experimental setup:

- DI diesel engine with rope dynamometer Single Cylinder
- Engine Data Logger
- Smoke Analyser
- Exhaust Gas Analyser

Procedure preparation of biodiesel from coconut oil

- The production of biodiesel, or alkyl esters, is well known. There are three basic routes to ester production from oils and fats:
- Base catalyzedtransesterification of the oil with alcohol.
- Direct acid catalyzed etherification of the oil with methanol
- Conversion of the oil to fatty acids, and then to alkyl esters with acid Catalysis.
- Making Biodiesel from the waste cooking oil & grease which contain higher value of FFA.

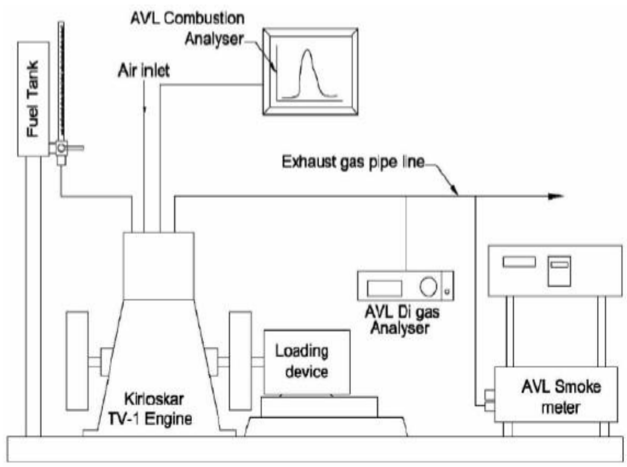


Fig. 1:

Biodiesel preparation: The filtered oil was heated up to a temperature of 50°C in water bath to melt coagulated oil. It is important not to overheat the oil above 65°C, because at that temperature alcohol would boil away easily. The heated oil of 100 ml was measured and transferred into a conical flask containing catalyst-alcohol solution. The reaction was considered to start at this moment, since heated oil assisted the reaction to occur. The reaction mixture was then shaken by using shaker at a fixed speed for 2 h.

Separation of Biodiesel from by-products: The product of the reaction was exposed to open air to evaporate excess methanol for 30 min. The product was then allowed to settle down overnight. Two distinct liquid phases: crude ester phase atthe top andglycerol phase at the bottom were produced in a successful trans esterification reaction.

Purification of Biodiesel by washing: The top ester phase (biodiesel) was separated from the bottom glycerol phase by transferring to a clean 250 ml conical flask. The biodiesel was then purified by washing with distilled water to remove all the residual by-products like excess alcohol, excess catalysts, soap and glycerine. The volume of distilled water added was approximately 30% of the biodiesel volume. The flask was shaken gently for 1 min and placed on the table to allow separation of biodiesel and water layers. After separation, the biodiesel was transferred to a clean conical flask. The washing process was repeated for several times until the washed water became clear. The clean biodiesel was dried in an incubator for 48 h, followed by using sodium sulphate. The final product was analyzed to determine its ester content (that is, purity of product) and also other equipment were used to determine related properties.

Precaution before starting Engine:

- All nut bolts are tight. The universal joint is safely connected. b) Safety guard is closed to avoid any damage or accident.
- Sufficient oil in oil chamber of engine.
- Fuel in Diesel Tank.
- Water is flowing through engine, calorimeter & dynamometer f) Vibration to control panel should be minimized.
- Adjust weighing machine at zero and put diesel pot on the weighing Machine.
- All electrical connections and sensors are tight and protected and not in contact with water.
- Any rotating part, otherwise it will damage costly Electronic equipment's.

Experiments Procedure: The experimentation is conducted on the cylinder direct injection diesel engine operated at normal room temperature of 280C to 330 C. The fuels used are diesel fuel in neat condition and as well as methyl Easter of waste frying oil. The engine is initially made to run at 1500 rmp continuously for one in order to achieve the thermal equilibrium under operating conditions.

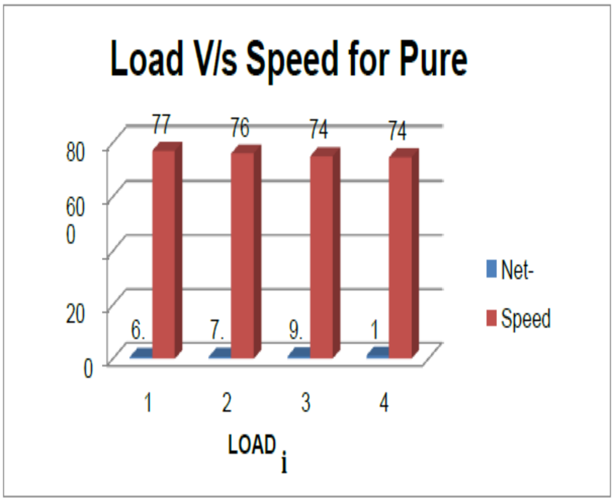
IV. RESULT AND DISCUSSION

Experimentation Diethyl Ether DEE contains Oxygen by 21% gravimetrically, highly as an additive alongwith the main fuel, waste frying oil Methyl ester (CME) Replacing total petroleum diesel in a direct injection diesel engine is conducted. Some important properties to elicit benefits of CME and DEE combination have been enlisted below:
Repeated experimental work was done by using this single cylinder 4-stroke diesel engine and datawere recorded at different loads for neat diesel, neat biodiesel and by mixing different ratio of diesel and biodiesel, using different blends all data was collected and represent in the graph which is shown below.

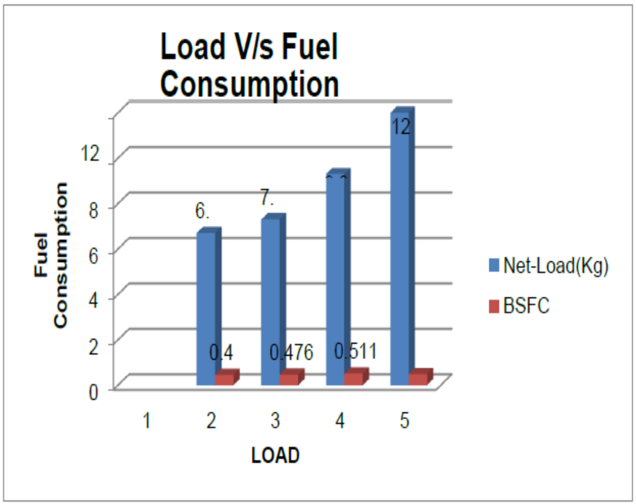
Table 1: DIESEL WITHOUT BIO DIESEL (PURE DIESEL)

Net-Load(Kg)	Speed (RPM)	Fc(Kg / hour)	BSFC (kg.Kwhr.)	B.P. (W)	BMEP Bar	μ_{bth}(%)	μ_{vol}(%)	A/F
6.7	770	0.415	0.460	1019	2.45	20.1	89	37.4
7.3	760	0.561	0.476	1160	2.78	19.0	91	33.7
9.3	749	0.695	0.511	1375	3.36	17.8	92	22.8
12	745	0.890	0.494	1745	4.30	17.8	93	18.9

Graph 1 speed is plotted against the load for neat diesel and blend of bio-diesel and speed decrease as load increase. In the beginning speed is nearly same for neat diesel and blend at all load and have lower value at 20% blend of bio diesel.



Graph 1: Load vs speed



Graph 2: Variation of fuel consumption with load for pure diesel

V. CONCLUSION

- The smoke levels decreased substantially with 15% DEE blends with biodiesel at full load and at immediate part load except very low loads at which the diesel engine may not be put to operation normally because of high BSFC. CO and smoke levels have decreased in tendem better combustion.
- 25 3% and 15% blends create delay period difference of 0.4 ms (lesser for 15% blends) which can be observed from the, time wave at full load. But in the case of 15% blends, the diffused combustion aspect is very much improved.
- 26 There is No reduction at part loads in the cased of additive. But at full loads the NO emission has increased due to excessive molecular oxygen in both additive and biodiesel.
- 27 There is slight increase in CO emission with respect to additive percentage. But when compared to diesel and biodiesel operation there is substantial reduction up to 0.07% in general with the injection of blends.
- 28 There is approximately 67% reduction in the Co emission with 15% DEE biodiesel blends at full load running of the engine.
- 29 15% DEE blends is proved to be more compatible blends when compared to other blends tested in view of the all round performance exhibited by the additive.
- 30 The thermal efficiency rise and SFC are better in the case of 15% additive blend and since diesel engines give efficiency at part loads this percentage of blends can be recommended.

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