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Experimental Study of Performance Characteristics of Diesel Engine by using Nano Particles Blended with Biodiesel

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***Abstract*: Increase in energy demand, emission depletion of oil resources has required the researches to find alternatives fuels for internal combustion engines. The rapidly increase consumption of fossil fuel has been a matter of concern for the many countries which imports more crude oil. Because it causes huge foreign exchange out-go on the one hand and increase exhaust emission on the other. Therefore, it is necessary for the development of renewable energy sources. Present an experimental work is conducted to obtain the operating and emission characteristics of Undi Oil Biodiesel on engine run on various blends of biodiesel, and load conditions.**

***Keywords*: Diesel Engine, Undi Oil, Aluminium Oxides nanoparticles, Transesterification, Performance, Combustion, emissions**

1. Introduction

Increasing environmental pollution and continuous consumption of fossil fuels have caused researches to find the alternatives fuels for Internal Combustion Engines. The alternative fuels are biodiesel, natural gas, alcohols, etc. Biodiesel (fatty acid methyl/ethyl ester) which is derived from triglycerides by transesterification, present hopeful options as a renewable, biodegradable fuel. Diesel engine is better power sources due to higher efficiency, performance and fuel economy than spark ignition (S.I) engine. The use of biodiesel in Diesel engine requires no modification. Many researchers studied that use of biodiesel in diesel engine produce higher NO_x emissions compared to diesel.

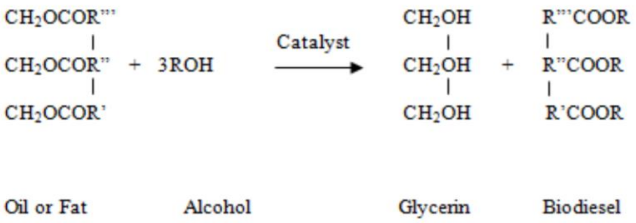
1) Problem statement

The main objectives of present work is to analyze the engine Performance and Emissions characteristics of diesel engines with biodiesel produced from "Undi Oil" and blends with diesel and nano oxides, which will helps in both the direction of reducing emissions problems and search of alternative fuel for diesel engine.

2. Biodiesel preparation

The steps in biodiesel production process are mentioned below.

Transesterification: The major components of animal fats, vegetable oils are triglycerides. The vegetable oil or animal fat is undergone through a chemical reaction known as transesterification as shown below.



The step of transesterification of biodiesel as shown in below.

1. First 1 liter of Undi oil is poured in a pan and then heated up to a temperature of 60°C.
2. A beaker is filled with 200ml of methanol and then about 3.5 g of Potassium Hydroxide is added as a catalyst.
3. The beaker is closed and then stirred for about half an hour and Potassium Methoxide is formed as a result.
4. The heated oil is poured into a separate container and then the Potassium Methoxide solution is mixed along with the heated oil.
5. The mixture is allowed to settle fr about 12 hours and then the biodiesel is formed along with glycerin, deposited at the bottom.
6. Finally, the biodiesel is separated from the container by using the separating funnel and then it is added in the definite proportions along with the conventional diesel to be used for the experimental verifications by adding aluminium oxide.

Fig. 1. Pure biodiesel

Blending of Aluminium Oxides in Biodiesel:

For blending of aluminium oxide (Al_2O_3) nanoparticles in biodiesel, taken sample of biodiesel say 1 lit and then 0.025gm of aluminium oxide form of nanoparticles is added to make dosing level of 25 ppm. The dosing level of 25 ppm is 0.025gm/lit, respectively. After the addition of Aluminium oxide, it is shaken well and it is poured into mechanical homogenizer apparatus where it is agitated for about 30 minutes in an ultrasonic vibrator making uniform dispersion. It is shaken well before the use, as excess of nanoparticles settle down on solution.

Fig. 2. Biodiesel blends

1. Raw Material of Undi Oil
2. Transesterified Oil (top biodiesel, bottom glycerol layer)
3. H00 : 100% Diesel
4. H20 : 20% Biodiesel + 80 % Diesel
5. H30 : 30 % Biodiesel + 70% Diesel

3. Experimental set-up and test procedure

The experiments were conducted on Kirloskar AV1, four Stroke and single cylinder diesel engine. The rated power of the diesel engine was 3.7 kW. The engine was operated at a constant Speed of 1500 rpm by maintaining the in pressure from 250 to500 kgf/cm^2 at various. The first step of procedure is engine is run initially with pure diesel and corresponding readings are noted down. Graphs are plotted for brake thermal efficiency (BTE) and brake specific fuel consumption (BSFC) versus given load of the engine. The different biodiesel blends such as B20 and B30, are used to carry out test on diesel engine. BTE and BSFC results are calculated for all blends. In engine performance analysis graphs of BTE Vs Power, BSFC Vs Power have been plotted for diesel fuel and biodiesel blends.

Table 1
Diesel Specification

Type	Vertical, water cooled, four stroke
Number Of Cylinder	One
Bore	87.5mm
Stroke	110mm
Compression Ratio	17.5:1
Maximum Power	3.7 kw
Speed	1500 rev/min
Dynamometer	Electrical
Injection Timing	23^0

Electrical dynamometer was used for loading the engine. The AVL smoke meter was used to measure the smoke density present in the exhaust. AVL five-gas analyzer was used to measure HC, CO and NOx emissions. In-cylinder pressure and heat release rate were measured by using data acquisition system interfaced with dual core processor. The experimental set-up is indicated in Fig. 3.

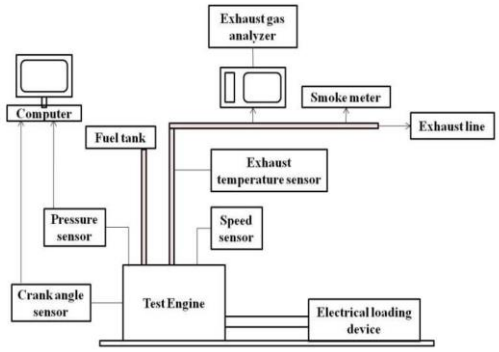


Fig. 3. Diesel engine

4. Conclusion

The engine tests were conducted with blends of B20 and B30 Undi oil with 0.025gm/l of alumina nanoparticles as additive for no load to full condition and the corresponding performance and combustion characteristics were studied in comparison with diesel fuel. All the tests were conducted under the same conditions. Undi oil biodiesel blended with diesel is determined to be suitable replacement to pure diesel. From the results, following features were noticed. Transesterification of the Undi oil leads to reduction in kinematic viscosity and density whereas the calorific value is increased, the B20 Undi oil biodiesel with and without alumina nanoparticle as additive showed increased BTE with respect to diesel at full load. The cylinder pressure was found to be same for all. During full load condition, the variations of heat release rate were almost similar for all blends. The oxygen content in B20 and B30 helps in the premixed combustion phase to progress in a better way which leads to better combustion. For B20 the emission of HC, CO decreases with a slight increase in NOx as compared to diesel. The use of nano additives of alumina not only improves the mechanical performance of diesel engine, but also reduces the emission level of all pollutants (co_{2s} UBHC and CO) in the exhaust gases.

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