International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 04 Issue: 12 | Dec-2017 www.irjet.net p-ISSN: 2395-0072

PERFORMANCE EVALUATION OF Al_2O_3 NANO FLUID WITH CANOLA OIL

Dr. S. SUNIL KUMAR REDDY [1], C. VENKATESH [2]

[1] Professor, Department of Mechanical Engineering, SIETK, Puttur, Chittoor (Dt.), A.P, India.
[2] PG Student, Department of Mechanical Engineering, SIETK, Puttur, Chittoor (Dt.), A.P, India.

ABSTRACT - *In view of recent developments, the cost of petroleum supplies are raising and the budding danger of environmental pollution have led to an intensive search for an alternative fuel or increasing the efficiency of the available diesel engines. The alternative fuel selected must be a renewable, environmentally friendly liquid fuel, and should provide less pollutant emissions. As ours is an agricultural country, the production of canola seeds is good which is considered to be a substitute for diesel. With the properties of canola oil, it becomes difficult to burn in the existing diesel engines. Hence in the present work it is blended to B15 and used in the existing diesel engine without any modification. Further the performance and the emission characteristics of the engine are tested. As the combustion performance depends on the fluid flow, it is also planned to work with Al2O3 nano fluids at various proportions. It is concluded that B15 showed best results at 90ppm Al_2O_3 nano fluid.*

Key words: Biodiesel, Nano particles, Canola oil.

INTRODUCTION

Compression ignition engines are employed particularly in the field of heavy transportation and agriculture on account of their higher thermal efficiency and durability. However, diesel engines are the major contributors of oxides of nitrogen, carbon and particulate emissions. Hence stringent norms are forced on exhaust emissions. With the global energy crisis and the increasingly stringent emission norms, the search for alternative renewable fuels has intensified**.** The characteristics of renewable fuels are Low cost, Easy availability and transportation, High calorific Value, produced by farmers and renewable in nature.

Various types of biodiesel such as cotton seed oil, jathropha, sun flower, canola oil etc are reviewed and among them Canola biodiesel plays a vital role in the replacement of diesel with its characteristics. The major advantage is with its availability, because the Canola plant will grow in any environmental conditions in India. With minor changes in the engine, one can easily use Canola biodiesel as a fuel in diesel engine. As India is an agricultural country, if the cultivation of Canola plants is made by farmers it will be very useful to the farmers and also to our Indian economy.

A considerable amount of work has been done on diesel engine for increasing the performance with various biodiesel blends. Some of the works are as follows.

Ali Keskin et al, [1] investigated in DI diesel engine for the effect of Mg and Mo based fuel additives with tall oil biodiesel and concluded that the engine performance values do not change significantly but the HC, CO and NO_x emissions are reduced significantly. Further M.Shahabuddin et al, [2] studied the effect of IRGANOR NPA fuel additive on turbocharged IDI diesel engine fueled with B20 POME biodiesel with various proportions of additive and found that the engine performance is best at 1% additive with significant reduction in CO, HC and NOx emissions compare with POME biodiesel. A substantial experimental work has been done with numerous proportions of diethyl ether and ethanol as fuel additives with Neem oil methyl ester biodiesel by S.SivaLakshmi et al,[3]. and found that there is a substantial change in the engine performance and emissions with the both additives compare with Neem oil methyl ester biodiesel. Y. V. Hanumantha Rao et al, [4] investigated the effect of DM-32 and methyl-ester as a fuel additive on diesel engine performance fueled with Jatropha oil biodiesel and found that the engine performance values increases significantly with DM-32 and methyl-ester fuel blends compare with jatropha oil biodiesel and also the brake specific energy consumption is lower in both fuel additives blends compare with Jatropha oil biodiesel and also the engine emissions like HC, CO and NO_x are educed significantly in both the DM-32 and methyl-ester fuel blends compare with jatropha oil biodiesel.

Biodiesel production (Trans-esterification)

In this study, the base catalyzed Trans-esterification process is used to prepare biodiesel from Canola oil. For trans-esterification process 500 ml of Canola oil is heated up to 70°C to drive off moisture. Methanol of 99.5 % purity having density of 0.791 g/cm^3 is used. Further 2.5 gram of catalyst KOH is added to Methanol and stirred the mixture continuously. The mixture was maintained at one bar pressure and 60°C for one hour. After completion of trans-esterification process, the mixture is allowed to settle under gravity for 24 hours in a separating funnel. The products formed during trans-esterification were Canola oil methyl ester and Glycerin. Canola oil methyl ester (biodiesel) is mixed, washed with hot distilled water to remove the unreacted alcohol; oil and catalyst and allowed to settle under gravity for 25 hours. The biodiesel which is separated is taken for characterization.

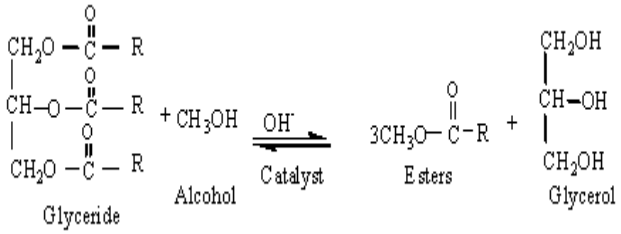


Fig 1 The process for trans-esterification.

METHODOLAGY:

The detail of the experimental set up is shown below.

Fig 2 Experimental Set up

Specifications of the Engine:

For the experimentation single cylinder water cooled DI diesel engine is used. The specifications are as follows.

Engine	Four stroke, single cylinder, water cooled, D.I diesel engine, Kirloskar engine Ltd
Rated power	5 HP
Speed	1500 rpm
Bore	80 mm
Stroke	110 mm
Calorific value (C.V)	43000 kJ/kg
Specific Gravity	0.860 kg/m^3
Co-efficient of discharge (C_d)	0.62
Orifice diameter	0.033m
Compression ratio	16.5:1
Density of air (ρ_{air})	1.29 kg/ m^3
Dynamometer	Belt brake
Injection Pressure	180 bar

Experimental Procedure:

The experimental procedure is as follows.

- The engine is started with no load condition and is allowed for 10 min for the stabilization.
- Loading has been done with 25% increment up to full load for B15 blend.
- Engine performance and emission parameters were taken as per the observation table.
- The same procedure is repeated for diesel and B15 blend with different mass fractions of Nano particles.
- Further the piston is changed with an air gap insulated and the same experiment is repeated.

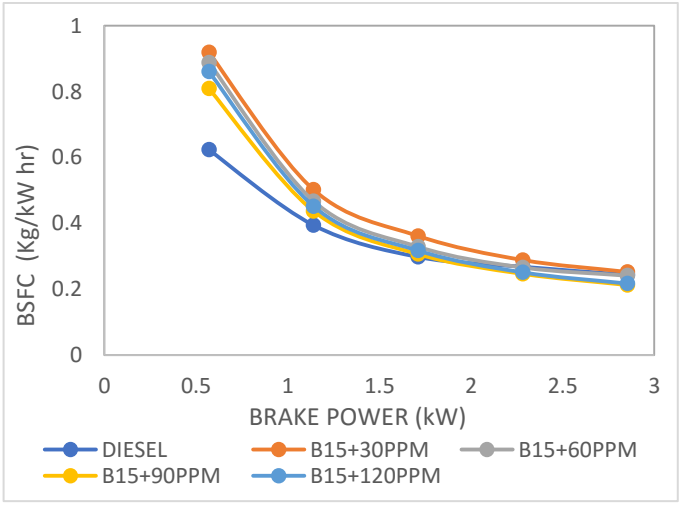
Finally, the engine was made to run on canola biodiesel and diesel blend with nano additive, the corresponding observations are noted.

RESULTS AND DISCUSSIONS:

The tests were conducted on diesel engine with and without air gap insulated piston with the blending of diesel and canola biodiesel (B15) with different proportions of Al_2O_3 nano fluid as additive of 30ppm, 60ppm, 90ppm and 120ppm. The obtained results are represented in the form of graphs.

Specific fuel consumption:

The performance of any engine depends on the specific fuel consumption. Here with in the graphs1, the variation of specific fuel consumption is represented. The Specific fuel consumption is decreased by 3.9% with B15 canola oil and 90 ppm.



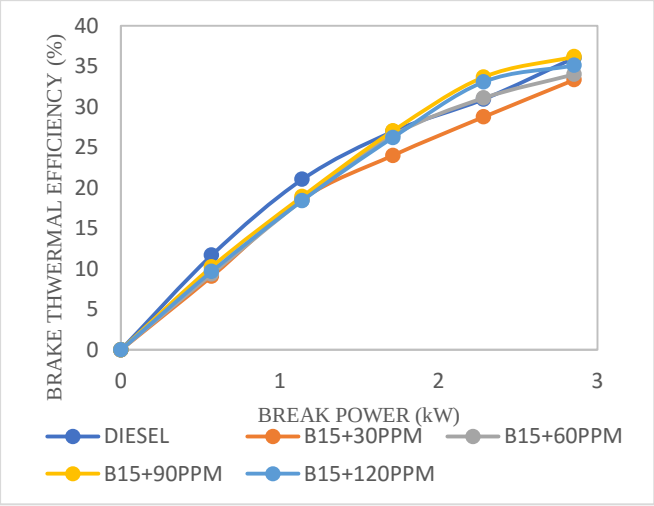
Graph1. Variation of Specific fuel consumption with Brake power

With the addition of nano fluid the flow capability of the fuel increases. With that sufficient amount of fuel entered in to the combustion chamber and stoichiometric air fuel mixture is formed which aids the combustion. Hence with

the increase of nano fluid the SFC decreased up to 90 ppm and further addition of nano fluid makes the air fuel mixture lean.

Brake thermal efficiency:

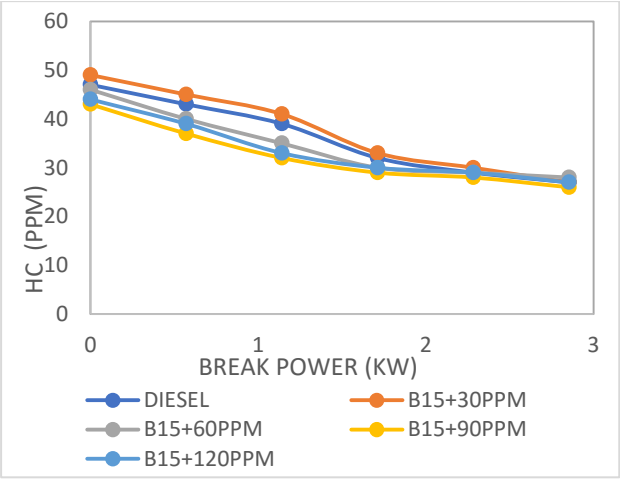
The Brake thermal efficiency of the engine with B15 increased by 3.29% gradually up to 90 ppm. The oxygen content in the nano fluid enhances the combustion with homogenous mixture formation which makes the combustion complete. With the further addition of nano fluid it becomes mixture lean and reduces the brake thermal efficiency.



Graph2. Variation of Brake thermal efficiency with Brake power

Emission Characteristics:

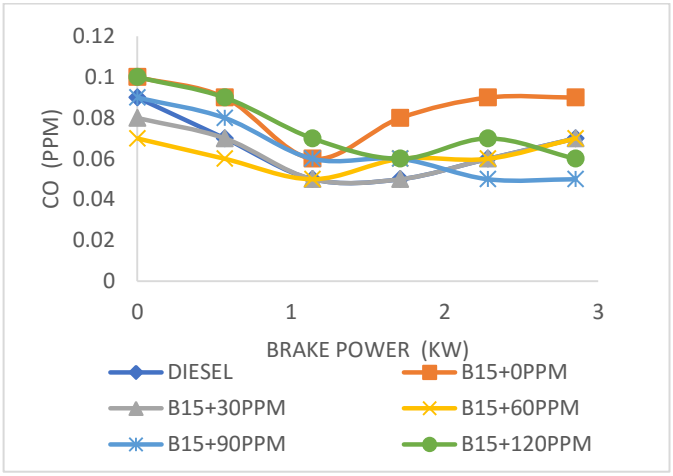
HC Emissions:



Graph3. Variation of HC Emissions with Brake power

The HC emissions are formed due to improper combustion and sudden quenching. With the addition of nano additive the flow capacity of the fuel and oxygen are increased which helps in the combustion. The HC emissions are decreased by 14.81% for 90ppm and by 11% for 120ppm blend of canola biodiesel and diesel respectively.

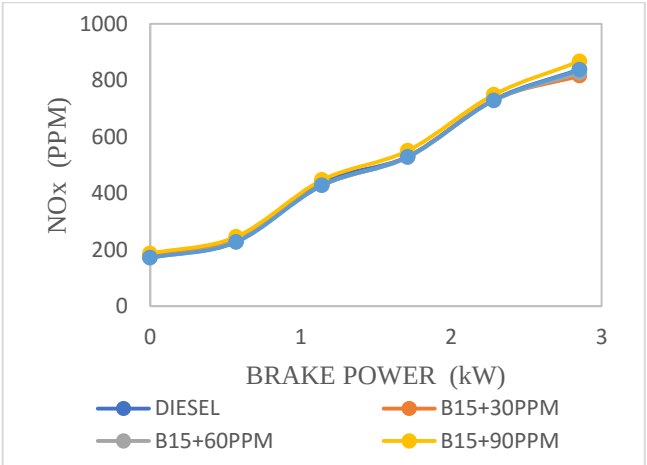
CO Emissions



Graph4. Variation of CO emissions with Brake power

The formation of CO emissions is due to lack of oxygen for combustion in the chamber. In the present work, the CO emissions are decreased by 19% at 90ppm and 10.8% at 120ppm. At B15+90ppm the air fuel mixture is equal to the stoichiometry air fuel ratio; the complete combustion takes place in the combustion chamber. As the percentage of nano fluid increases, it becomes lean mixture and reduces the combustion performance.

NOx Emissions



Graph 5 Variation of NOx emissions with Brake power

Nitrogen is inactive at lower temperature. As the combustion is complete, that enhances the temperature in the combustion chamber which increases the NO_x formation in the combustion chamber. In present work, the NO_x emissions are increased by 4.3% at 90ppm and 2.3% at 120ppm blend of biodiesel.

CONCLUSION

The experiments were conducted with Canola oil biodiesel and Al_2O_3 as a nano-fluid has been studied and investigated the performance and emission characteristics. From the results the following conclusions are drawn based on the experiment are,

1. The Brake thermal efficiency is increased by 1.14% at biodiesel blend15 (B15) compare to diesel and also it is increased 3.29% the biodiesel blend with 90 ppm.

2. The Specific fuel consumption is decreased by 2.29% at biodiesel blend15 (B15) compare to diesel and also it is decreased by 3.9%compare at 90ppm blends of biodiesel.

3. The HC emissions are decreased by 14.81% at biodiesel blend15 (B15) compare to diesel

4. The CO emissions are decreased by 19% at biodiesel blend15 (B15) compare to diesel

5. The NO_x emissions are increased and 4.3% at biodiesel blend15 (B15) compare to diesel.

REFERENCES

1. S. Ghosh, D. Dutta. Performance and exhaust emission analysis of direct injection diesel engine using pongamia oil. Volume 2, issue 12, December 2012.International Journal of Emerging Technology and Advanced Engineering.

2. S. Manibharathi, B. Annadurai, R. Chandra prakash. Experimental investigation of CI engine performance by nano additive in biofuel. Volume 3, issue 12, December 2014.International Journal of Science, Engineering and Technology Research.

3. AR. Manickam, K. Rajan, N. Manoharan & KR. Senthil Kumar .Reduction of exhaust emissions on a biodiesel fuelled diesel engine with the effect of oxygenated additives. Vol 6 no 5 oct-nov 2014.International Journal of Engineering and Technology.

4. Ghanshyam S.Soni, Prof. Dr.Pravin P. Rathod, Prof. Jigish J. Goswami. Performance and emission characteristics of CI engine using diesel and biodiesel blends with nanoparticles as additive. A review Study. Volume 3,issue 4 2015.International Journal of Engineering Development and Research.

5. Suthar Dinesh Kumar L, Dr. Rathod Pravin P, Prof. Patel Nikul K. Performance and emission by effect of fuel additives for CI engine fuelled with blend of biodiesel and diesel. A review study,Vol.3/issue 4/oct-dec,2012/01-04.Journal of Engineering Research and Sciences.

6. K. Nantha Gopal, R. Thundil, Karupparaj, VIT university, vellore. Effect of pongamia biodiesel on emission and combustion characteristics of DI compression ignition engine. October 2014.Ain Shams Engineering Journal.

7. M.S. Kumar, A. Ramesh. An experimental comparison of methods to use methanol and Pongamia oil in a compression ignition engine. Biomass and Bioenergy, Vol.25 2003,309-318.

8. Ganesh D. Effect of Nano-fuel additive on emission reduction in a Biodiesel fuelled CI engine. Institute of Electrical and Electronics Engineerin. pp.3453- 3459,2011.

9. M. Nagarhalli, V. Nandedkar, K. Mohite. Emission and performance characteristics of karanja biodiesel and its blends in a CI engine and it's economics. Journal of Engineering and Applied Sciences.5, (2010) 52-6.