Performance and Emission Characteristics of Diesel Engine Fuel Blended with Mahua Oil and Diesel

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Abstract— In this paper, we would like to review the compatibility to use vegetable oils as a blended fuel for CI Engines at different injection pressure & inlet air pressure. The main problem with the vegetable oils is that they have very high viscosity, which leads to injection problem in Diesel Engines. Various techniques are used to reduce the viscosity; one of its techniques is fuel blending. Commonly vegetable oils available are Jathropa, Linseed, Rapeseed, Mahua ,Palm oil etc. are blended with diesel fuel in constant speed single cylinder & subsequently showing its effects on performance and emission characteristics of diesel engine. The vegetable oil is blended with varying proportions like 10%, 20% and 30% with diesel fuel in the CI Engine and find most preferable & optimize combination of blend for diesel engines.

Key words: Blended fuel, Diesel fuel, Vegetable oil, Exhaust emission, Engine performance, Injection Pressure, Inlet Air Pressure

I. INTRODUCTION

Most of the oil in India is imported from foreign countries. In many countries the demand of fuel for diesel engines increases because of much usage in agriculture, transportation and power generation. But, on account of high fuel consumption of diesel fuel the need for replacement of diesel fuel has become essential. The increasing population on the earth caused over increasing demands of energy. By the year 2100, the world population is expected to be in excess of 12 billion and it is essential that the demand of energy will be increased by five times of what it is now. According to the world energy report, we get around 80% of our energy from conventional fossil fuels like oil (36%), natural gas (21%), and coal (23%). It is well known that the time is not so far when all these sources will be completely exhausted. The alarm bells started ringing as the survey indicates that petroleum will become increasingly scared beyond the present rate of consumption. In this research, it is try to reduce diesel fuel consumption. One of solution of this problem is alternate fuel or blended fuel which can be partially mixed with diesel. By using alternate fuel, not only reduce requirement of diesel but also helpful to nation by reducing fuel consumption and find and use the other useful sources of fuel production and also reduce the effect of greenhouse gases.The primary advantage of this kind of fuel is that they are renewable and eco-friendly. When using alternate fuels, main issue is modification required in engines. In order to reduce cost of modification some optimization techniques must be applied. So that efficiency and performance may not be reduced. In this paper we will review the effect of injection pressure & inlet air pressure on the performance & emission of CI Engine.

II. REVIEW

Damor et al.(2014): Investigates the effect of supercharging on performance and exhaust gas emission of diesel engine fueled pyrolysis oil and diesel blend. oil taken is tyre pyrolysis oil which was obtained by the waste automobile tyres. It was observed that the increasing supercharging pressure, the performance of the engine is gradually improving. Performance parameter like Specific fuel consumption is gradually Reduction with comparison Un-supercharging. Thermal efficiency is gradually increasing and Mechanical efficiency is also gradually increasing. Emission parameter CO, CO2 and HC emission are decreased significantly with supercharging. [1]

Nitrogen Oxide (NOx) Emission: Fig.shows the variation of Unburned hydrocarbon Emission with brake power at various blend proportion in the diesel.

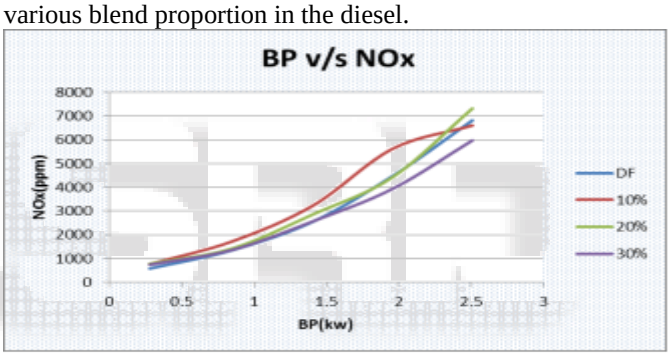

Fig. 1

The Variation of NOx emission with Brake power is shows Fig.1. The Nitrogen oxide Emission increased with the increased engine load due to temperature in the combustion chamber,D70 P30 found decreased nitrogen oxide compared to D90 P10, D80 P20 and Diesel fuel.[1]

Prasad et al(2012)[2]: The main aim of this study is to investigate the effect of injection pressures on emission and the Performance analysis of non-edible rice bran oil (NERBO).The initial experiments were done at injection pressure of 180 bar. Later the injection pressure was changed to 200 bar, 220 bar, 240 bar, 280 bar and lastly at 300 bar. It was observed that the Brake thermal efficiency increased as the injection pressure increased from 180 bar to 220 bar . [2]

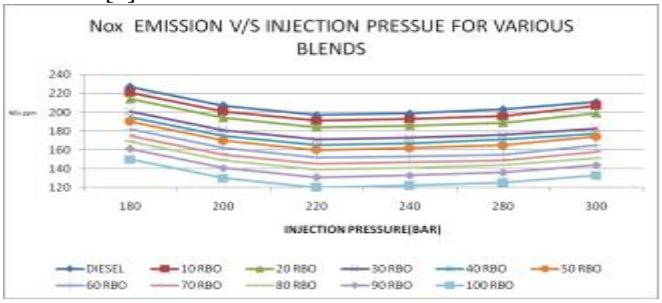

Fig. 2

Fig.2 shows that NO_X decreases initially as the injection pressure increases from 180 to 220 bars and then slightly increases as the injection pressure increases. Another observation is that NO_X decreases as the Rice bran proportion increases and the NO_X increases as the load increases. The vital factor that causes NO_X formation is due to availability of oxygen and high combustion temperatures. As the load on the engine increased so also the NO_X emission increased, this is perhaps due to the increase in the combustion temperature.[2]

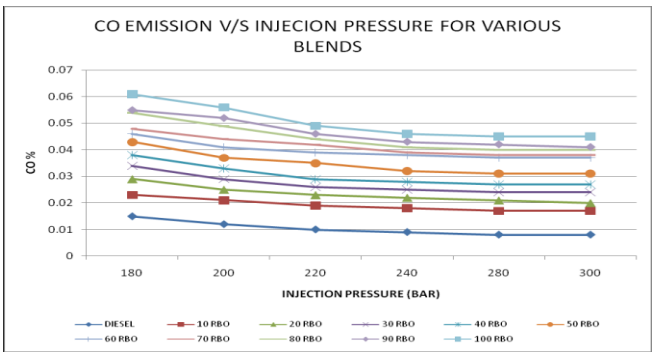

Fig. 3

Fig. 3 shows that the CO emission decreases with the increase in the injection pressure of 180 bar to 300 bar. The Carbon monoxide emission increases with the increase in proportion of non-edible rice bran oil in the blends. This may be due to the fact that at higher injection pressure complete combustion occurs.[2]

Pandya et al. (2013): Investigated effect of Compression ratio and Injection pressure on the performance and emission of C.I. Engine with Multiple Injection techniques - A Review Study. The study shows that the reduction in compression ratio will reduce the combustion peak temperature and that will reduce NO_X but there will slight in-crease in CO and HC. By increasing compression ratio, it is possible to extract maximum possible mechanical efficiency from the engine. Increasing Compression ratio enhances Brake thermal efficiency increases from 27.3% to 29.1%, HC reduced from 166 to 130ppm, NO_X level increases with increasing IOP (Injection Opening Pres-sure) due to faster combustion and higher temperatures reached in the cycle and Smoke level reduced from 4.6 BSU to 3.2 BSU. By Combination of variation in compression ratio and injection pressure shows that, the best effect is seen with the combination of injecting fuel at 250 bar while maintaining the compression ratio as 18:1, where the BSFC is minimum for whole of the load range with an improvement of about 10% over standard setting. [3]

Dwivedi et al. (2013): The aim of the present work is to focus on the work done in the area of production of biodiesel from Pongamia and the characterization of properties of various blends of Pongamia biodiesel. The work also includes the impact analysis of Pongamia oil and its biodiesel on engine performance and exhaust emission. The results obtained are also compared with the Jatropha curcas biodiesel and Waste cooking biodiesel. The research has indicated that up to B20, there is no need of any modification. From the test result it is found that the use of biodiesel leads to the substantial reduction in particulate emission, CO emissions accompanying with the imperceptible power loss, the increase in fuel consumption and the increase in NO_X emission on conventional diesel engine with no or fewer modification. So from the result it can be observed that biodiesel will replace diesel as a source of fuel in near future. [4]

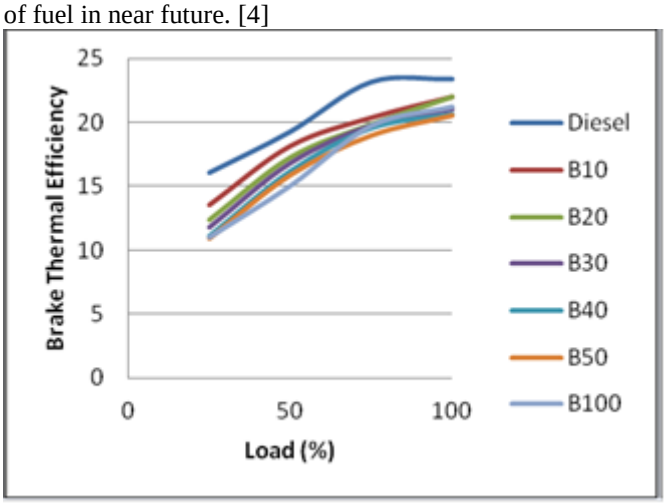

Fig. 4: Variation In Bte With Load For Different Blends Biodiesel From Pongamia.[4]

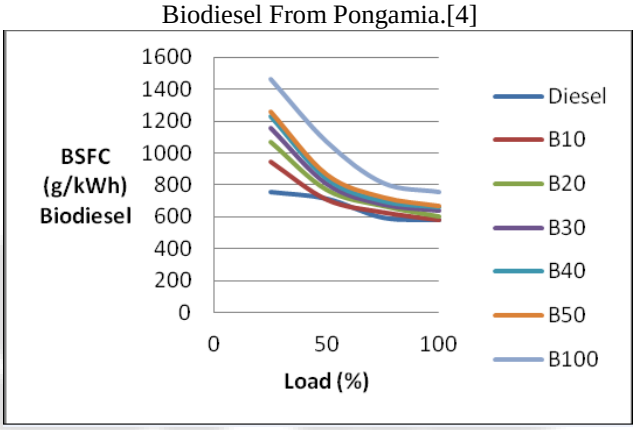

Fig. 5: Variation In Bsfc With Load (%) For Different Blends Of Biodiesel From Pongamia.[4]

The present study has dealt with the production of biodiesel from Pongamia oil, measurement of properties and performance evaluation of 2 KVA DG set on blends of biodiesel at various loads. The following conclusions can be drawn. The fuel properties like density, flash point, viscosity and calorific value of B10, B20 are very similar to diesel and therefore diesel may be well replaced by biodiesel in near future. The performance evaluation of engine has found that BSFC for B100 in case of Pongamia biodiesel was 30.4 % higher than diesel at full load, thereby indicating that more amount of B100 produce power similar to diesel. This makes the fuel to become the "On Farm Fuel" where farmer can grow his own resource, convert to biodiesel and use in agricultural sets itself without the need of any diesel for blending. The low efficiency may be due to low volatility, slightly higher viscosity and higher density of the biodiesel of Pongamia oil, which affects mixture formation of the fuel and thus leads to slow combustion.

Deva Kumar et al. (2012): In present work a single cylinder 5HP diesel engine is used to investigate the performance characteristics. The main objective of this work is to study the effect of the fuel injection pressure on performance and pollution of the single cylinder diesel engine at different intake manifold inclinations. From experiment it is found that engine at 600 manifold

inclinations at 180 bars has given efficient performance and less pollution.

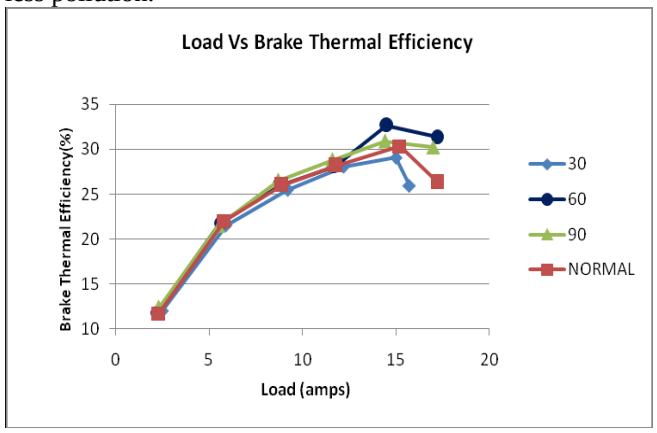

Fig. 6: variation In BTH With Load (Amps).[5]

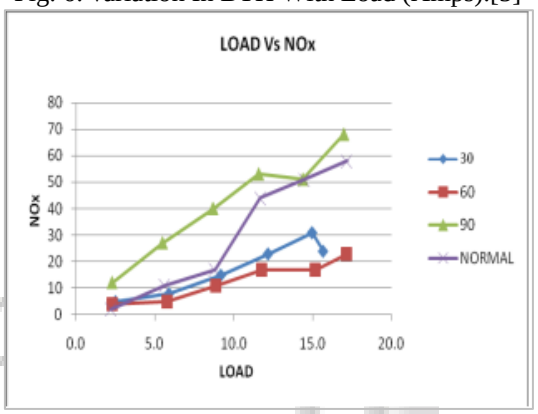

Fig. 7: variation In NOX Emission With Load .[5]

In cylinder flow structure is greatly influenced by the intake manifold inclination. It is found that at 60degree intakes manifold inclination, at 180bar gives the maximum brake thermal efficiency. This work improves both performance and fuel economy. By varying the manifold inclination we get better performance than normal one. By increasing fuel injection pressure, pollution levels reduce due to complete combustion of fuel. Emissions are reduced at 200 bar with different manifold inclinations compared to other pressures. Finally, it is concluded that the information obtained in this investigation is very much useful in reduction of pollution and increasing the performance of the engine by varying the manifold inclination of the modern I.C engines. [5]

III. CONCLUDING REMARK

The major problem with the direct use of vegetable oils as fuel into CI engines is their higher viscosity. It interferes the fuel injection and atomization and contributes to incomplete combustion, nozzle clogging, excessive engine deposits, ring sticking, producing thick smoke, etc. The problem of higher viscosity of vegetable oils can be overcome to a greater extent by various techniques, such as heating of fuel lines, transesterification, modification of injection system, etc. In the present investigation, short term tests were conducted on different biofuels untreated cotton seed oil, linseed oil ,pongamia oil, mustard oil, soyabean oil etc. in a single cylinder, four stroke, and direct injection diesel engine. Increasing the injection pressure & inlet air pressure the increases brake thermal efficiency & decrease the brake specific fuel consumption. It also decreases the harmful pollutants like HC, Smoke, Particulate matter etc.

IV. SCOPE OF WORK

Instead of modifying the existing engine, new designs of engines may be attempted keeping in mind comprehensive combustion optimization. Test may be conducted on combine effect of inlet air pressure & injection pressure. This experiment will be done for same blend by other DOE method or other optimization techniques. The effect of other oxygenated additive like dimethoxy methane, diethyl ether, ethylene glycol acetate etc blend with the biofuel and diesel, the performance and emission characteristics of diesel engine can be checked.

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[5] Deva Kumar et al : Effect of Fuel Injection Pressure on Performance of Single Cylinder Diesel Engine at Different Intake Manifold Inclinations (2012).

