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Performance and Emission Characteristics of Biodiesel Fuels

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Abstract— The researchers are much interested to find a suitable alternative fuel which should compensate both in power and efficiency. Recent survey reveals that the diesel fuel consumption is several times higher than that of gasoline fuel. The alternative fuels chosen for this need are vegetable oil and biodiesel. The fuel should be chosen in such a way that it should be adaptable with the conventional engines with very little or no modification. Wide research has been done in this field with various biodiesels. Hence in this paper two different biodiesel fuels were used as the test fuels and the performance results were compared with the standard fuel (Diesel). The engine chosen for this research was a constant speed Kirloskar engine with eddy current loading. The performance and emission parameters chosen for comparison are Brake thermal Efficiency, Specific fuel Consumption, unburnt hydrocarbon, CO and NOx. The tests are been carried out with two different biodiesel fuels. The performance and emission parameters these fuels were compared with standard fuel (Diesel). Compromising performance and emission results were obtained expect NOx. The suggestions were discussed for the reduction of NOx emission.

Keywords- *Biodiesels, HC and NOx emission*

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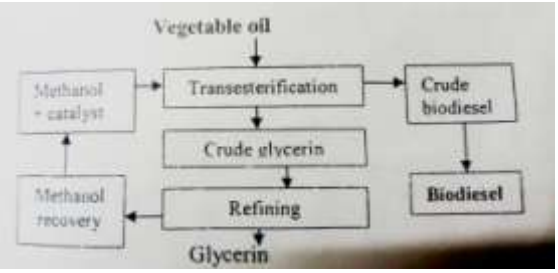
I. INTRODUCTION

Various biodiesel fuels presently under research are Jatropha curcas, pungamia pinnata, bosewellia, nerium etc.India has great resource for production of biodiesel from various non edible oil seeds. From about 100 seeds only 10-12 seeds are under research. In recent years researches are involved with various biodiesel fuels with different engines at varying load conditions. IOC has setup biodiesel production plant facility at 60 kg per day. Production of biodiesel is comparatively less cumbersome process than the production of petroleum fuel. Therefore production time is lesser for mass production of biodiesel fuel. Biodiesel is a clean burning alternative fuel produced by Transesterification process with vegetable oil as the source.

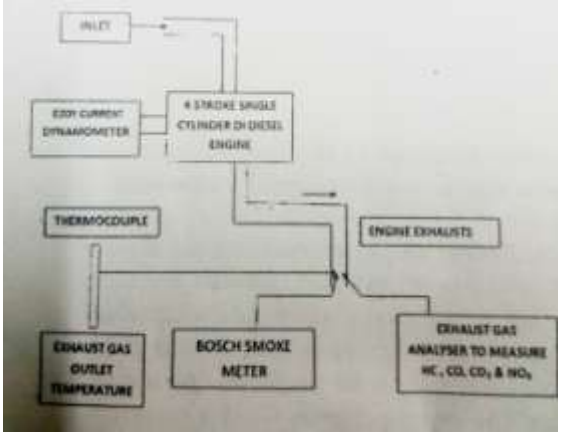
II. PRODUCTION OF BIODIESEL

Vegetable oil is first filtered then processed with alkali. The oils triglyceroids react to form mono esters and glycerol. Glycerol is separated for industrial purpose. Vegetable oils can be chemically reacted with the alcohol in presence of catalyst such as sodium hydroxide or potassium hydroxide.



Transesterification process of producing biodiesel is shown above. Vegetable oil is the source methanol or ethanol is supplied with catalyst sodium hydroxide or potassium hydroxide. Glycerin is the byproduct and methanol is recovered during refining of glycerol and it recirculated.

III. EXPERIMENTAL SETUP



For the experimental study Kirloskar engine with injection timing 27° bTDC with a constant speed of 1500 rpm was used. Bosch smoke meter was used to measure smoke. HC, CO and NOx emission were measured with AVL smoke meter. Eddy current dynamometer was used for loading.

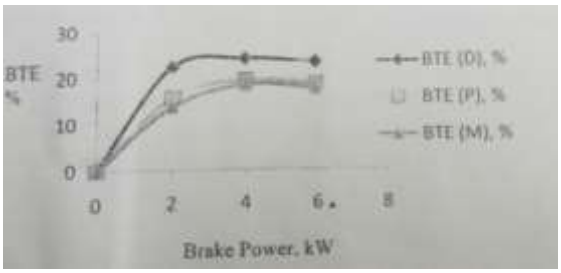
In the experimental study two different biodiesel fuels are taken and blend with diesel 20% by volume. The biodiesel fuels taken for comparison arte pongamia and mahua.

IV. RESULTS AND DISCUSSION

In this discussion the term BTE refers to Brake thermal efficiency, CO refers to Carbon Monoxide emission, HC refers to Hydrocarbon emission and NOx refers to Nitrix oxide emission. D refers to the standard fuel diesel. P refers to

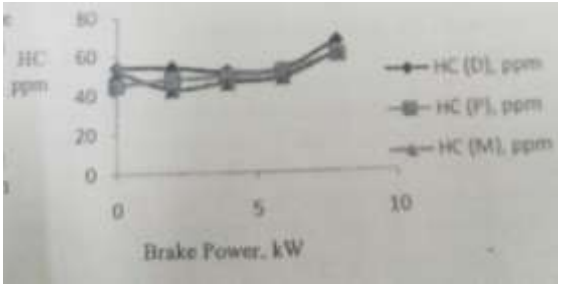
pongamia biodiesel blend and M refers to Mahua biodiesel blend.

(a) Brake Power Vs brake thermal Efficiency



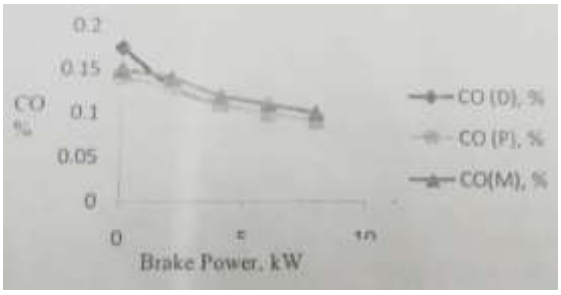
The maximum brake thermal efficiency for that diesel occurs at three fourth of load. From the above curve is it seen that the brake thermal efficiency is highest for diesel fuel and it is lesser in case of both the biodiesel fuel. This increase of brake thermal efficiency is due to the higher calorific value in diesel and less viscous. Higher viscosity and lesser calorific value are the reduced brake thermal efficiency in biodiesel blends.

(b) Brake Power Vs HC Emissions



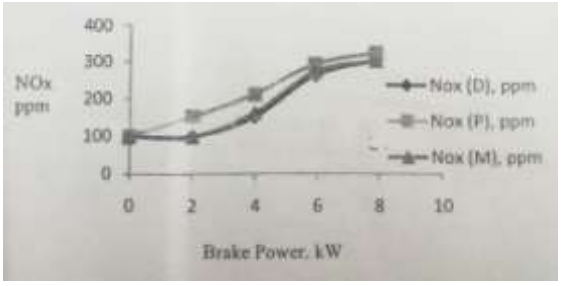
For both the biodiesel blends the HC emission decreases upto part load and then increases. Hydrocarbon emission is more in diesel than both biodiesel blends. It is due to the oxygen content in the biodiesel helps for a better combustion. But Hydrocarbon emission increases at higher loads.

(c) Brake Power Vs Emission



CO emission decreases with the increase of brake Power. CO emission is higher in case of diesel fuel and it is lesser in both biodiesel fuels. It may be due to the power carbon to hydrogen ratio. Pongamia biodiesel blend gives less CO emission compared with Mahua Biodiesel blend.

(d) Brake Power Vs NOx Emission



Oxygen content at elevated temperature are the reasons for NOx emission. NOx emission is lesser in diesel fuel and higher in both biodiesel fuels. Presence of Oxygen in the biodiesel fuels lead to complete combustion. Hence the combustion temperature raises. Hence the reaction of oxidation of nitrogen is enhanced. NOx emission is higher in Pongamia biodiesel blend than Mahua Biodiesel blend.

V. CONCLUSION

In the experimental study pongamia and mahua biodiesels were blended with diesel 20% by volume and the results were analysed.

Brake thermal efficiency is higher in diesel fuel and it is at compromise level for biodiesel blends. Hydrocarbon , CO emission is lesser with biodiesel blends than diesel. NOx emission is higher in biodiesel fuels and it is lesser in diesel.

Pongamia biodiesel blend gives a better result than mahua biodiesel blend. It may be due to the calorific value and viscosity of biodiesel fuels chosen.

VI. SCOPE FOR FUTURE WORK

NOx emission may be optimized by varying the injection timing and internal EGR method. Higher viscosity of biodiesel blend may be reduced by preheating before injecting.

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