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EMISSION CHARACTERISTICS OF BIOFUEL IN CONSTANT SPEED DI ENGINE UNDER VARIOUS INJECTION PRESSURE

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ABSTRACT : *With the technological development, the research over alternate fuels is increasing day by day in order to help the upcoming generation with a bright and greener future. To preserve the existing petroleum resources for future generation, it is necessary to switch over to any alternate source which is easily available, renewable as well as environment friendly. The objective of this study describes the usage of Diesel, Castor Oil and Nano Particles for a compression ignition engine under the different pressure levels (200 bar, 220 bar, 240 bar) and study the emission characteristics of biofuel at mixing ratio of 100ppm Magnesium Oxide. The emission levels of hydrocarbon and* NO_x *are appreciably reduced with the addition of Magnesium Oxide nanoparticles.*

Key Words: *Magnesium Oxide, castor oil, injection pressure, Emissions.*

1. INTRODUCTION

In order to increase the performance characteristics of bio fuels, many Nano particles are being added. In one of the experiment, the nanoparticle formation during exhaust analysis, Growth rates of nanoparticles at different exhaust dilution ratios and temperatures have been determined by monitoring the evolution of particle size distributions in the first stage of the dilution system. From the experiment, it is observed that there is no sufficient sulphuric acid in the exhaust to explain the observed growth. However, sulphuric acid is the trigger for initial particle formation. Growth is influenced by particle surface area. Existing particles, especially soot agglomerates may strongly suppress the growth. Thus, a carbon emission from engines reduces as nanoparticle formation and growth increases unless an emission of sulphuric acid and hydrocarbons reduces correspondingly.

In a research work of chemical reaction of hydrogen combustion during aqueous Mgo nanocatalyst combustion in diesel fuel, the result shows that hydrogen burns in a diesel engine in the presence of an active MgO nanocatalyst. During combustion the alumina had served as a catalyst and the coated MgO nanocatalyst were denuded and had decomposed the water to yield the hydrogen. The combustion of the diesel fuel mixed with aqueous MgO nanocatalyst shows that the total combustion heat increases when the concentration of smoke and nitrous oxide in the exhaust emission from diesel engine decreases. [1]

Arul Mozhi Selvan Vet all [2]. Investigated that cerium oxide acts as an oxygen donating catalyst and provides oxygen for the oxidation of CO or absorbs oxygen for the reduction of NOx. The activation energy of cerium oxide acts to burn off carbon deposits within the engine cylinder at the wall temperature and prevents the deposition of non-polar compounds on the cylinder wall results reduction in HC emissions. The tests revealed that cerium oxide nanoparticle can be used as additive in diesel and diesel-biodiesel-ethanol blend to improve complete combustion of the fuel and reduce the exhaust emissions significantly.

Nehmer and Reitz experimentally investigated the effect of double-pulse split injection on soot and NOx emissions using a single-cylinder Caterpillar heavy-duty diesel engine [3]. They varied the amount of fuel injected in the first injection pulse from 10 percent to 75 percent of the total amount of fuel and found that split injection affected the soot- NOx trade-off. In general, their split-injection schemes reduced NOx with only a minimal increase in soot emissions and did not extend the combustion duration.

In other studies the various parameters affecting castor oil transesterification reaction were investigated using four basic catalysts NaOCH3, NaOH, KOCH3 and KOH. After the experimental analysis it was concluded that reaction temperature and mixing intensity can be optimized. Using the results, a kinetic model was proposed which resulted in establishing an equation for the beginning rate of transesterification reaction. On further research of applying ASTM D 976 correlation, minimum cetane number of produced biodiesel was also determined. [4]

Now days, there is technological development all over the world. The research work is progressing, but the resources involved in them are depleting rapidly. The demand of resources and fuels for the technological development is increasing day by day. In order to keep the pace of development high, we need to think about some alternate fuel with better efficiency which would help to overcome the demand to conserve the resources for the future generation. However, the net effect was nevertheless a reduction in the emission of CO_2. The emissions of HC, CO, NOx, some aldehydes and hydrocarbons were slightly affected by the new fuel composition. [5].

One of the other biodiesel which is commonly used for research work is pure castor and soyabean oils along with potassium hydroxide as the catalyst. Through analysis, the results revealed the absence of appreciable substrate preference when the vegetable oils were transesterified in admixture. However, higher reaction yields and increased efficiencies of the purification process were directly correlated with the proportion of soyabean oil present in the reaction mixture. [6]

2. EXPERIMENTAL SETUP

The experiments were conducted on a single cylinder Kirloskar build direct injection four stroke cycle diesel engine. Water cooled eddy current dynamometer was used for the experiments. The engine is equipped with crank angle sensor, cylinder pressure sensor, thermocouples to measure the temperature of water, air and gas. Rota meter is used to measure the water flow rate and manometer to measure the air flow and fuel flow. The various parameters that govern the Emission characteristics are Carbon monoxide, hydro carbon, Nitrogen oxide and smoke density.

The various samples of biodiesel are as follows:
Sample 1- 75% diesel + 25% Castor oil + 45ppm Magnesium Oxide nanoparticle (200 Bar)
Sample 2- 85% diesel + 25% castor oil + 45ppm Magnesium Oxide nanoparticle (220 Bar)
Sample 3- 85% diesel + 25% castor oil + 45ppm Magnesium Oxide nanoparticle (240 Bar)

3. RESULT AND DISCUSSION

The results obtained at six different injection pressures of 200, 220 and 240 bars respectively for all blends of castor oil methyl ester with 85% diesel + 25% Castor oil + 45ppm Magnesium Oxide (MgO) nanoparticle blends were analyzed. Based on the output results, the observations are discussed.

3.1. carbon monoxide.

The variation of hydrocarbon emission with varying Load is shown in Fig. 1. The addition of Magnesium oxide decreases the CO emission when compared with diesel-biodiesel blends under 200 and 220 bars with CO emission percentage of 8.2 % and 8.8 %. The usages of oxygenated additives induce the complete combustion which leads to the hydrocarbon emission reduction at 75 % load condition. The least CO emission is observed as .0102 % for the B25 blend at the 240 bar and during 75% load condition.

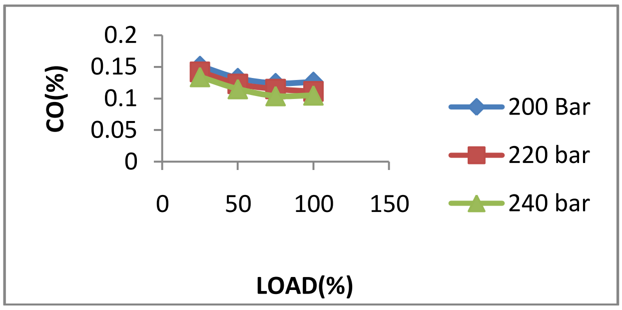

Fig 1 Brake Power Vs. Carbon Monoxide

3.2. Hydro carbon

Fig.2. shows a considerable drop in HC emission as injection pressure increases due to better combustion. Enhanced atomization also leads to a lower ignition delay. This will enhance the performance with castor oil which normally has a high ignition delay because of high viscosity (14.5). An improvement in the spray with addition of nano catalyst MgO, will lead to a lower physical delay. The improved spray also leads to better combustion at 75% load but later there will be a slight increase in HC at full load condition. HC reduces to 9.3% and 10.2% when the injection pressure is increased from 220 to 240 bar compared with 200 bar.. The highest Injection Pressure leads to slight decrease in the HC level, probably due of delayed injection. Also, very high injector opening pressures will lead a significant portion of the combustion to occur in the dissemination phase during small ignition delay.

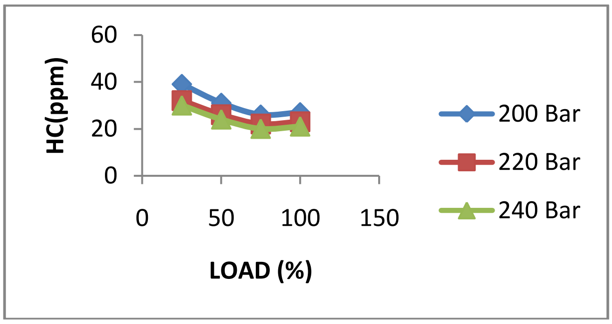

Fig 2. Brake Power vs. Hydrocarbon

3.3. Nitrogen oxide

As expected, NOx level Decreases with increasing injection pressure due to faster combustion and higher temperatures reached in the cycle shown in Fig 3. While increasing the injection pressure up to 240 bar from no load to 75% of load, the NO_x emission decreased at 75% load condition and reduced to the minimum range of 162 ppm. From the comparisons, 240 bar injection pressures gives the better performance.

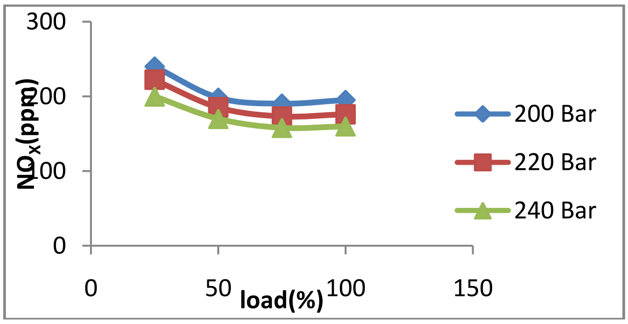

Fig 3. Brake Power vs. Nitrogen Oxide

3.4. Smoke density

From the Fig. 4. it was observed that at 100% load, maximum smoke density for blends have been observed at 200 bar injection pressure. With the increase in injection pressure from 220 to 240 bar for 25B blend at 75 % load, the smoke density diminished by 3.2% and 2.7 % compared to 200 Bar. It is also noted that all the blends have less smoke density than the baseline diesel fuel. The presence of oxygen in the blends in addition to good atomization of fuel at higher pressure may be the reason for lower smoke at higher injection pressures.

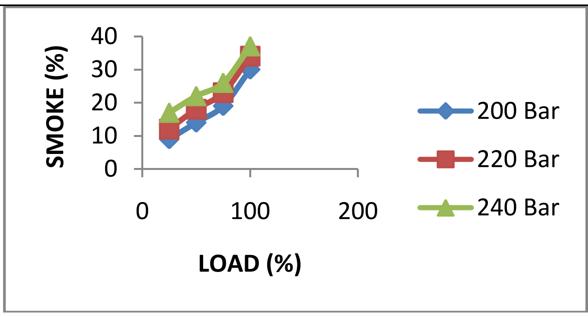

Fig 4. Brake Power vs. Smoke Density

4. CONCLUSION

Experimental measurements and analysis of MgO nanofluid combustion in diesel fuel using a single-cylinder engine was conducted at different injection pressures. The following results were obtained with respect to the experimental analysis.

(a). Increasing the injection pressure from the rated value for the diesel i.e. 220bar to 240 bar resulted in a significant improvement in emissions with castor oil due to better spray formation at 75% load condition compared with 200 Bar.

(b). Blends have lower value of CO, Hydrocarbon at 240 Bar than 200 and 220 Bars. This is due to better combustion of biofuel inside the cylinder than diesel.

(c). The NO emission is lower (162 ppm) at 240 bar with 75% load compared to other pressures. The smoke decreases with the fuel blends with oxygenated additive at 240 bar.

(d) On the whole, it was concluded that the engine can run in 240 bar and result to better reduction in emission characteristics.

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