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EMISSION ANALYSIS OF DI-DIESEL ENGINE AT DIFFERENT INJECTION PRESSURES USING JATROPHA AND RUBBER SEED OIL BLENDED WITH DIESEL

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ABSTRACT: *Biodiesel as a renewable fuel has been considered as the best alternate for diesel fuel now a days. This fossil fuel can be used in diesel engine with or without any modification.The injection pressure and injection timing are the major influencing parameters for the performance and emission of diesel engine. In this present study, the emission analysis of vegetable oil, Jatropha oil and rubber seed oil crushed from the seed, esterified and blended with pure diesel fuel. A single cylinder constant speed direct injection (DI) diesel engine has been used to analyze the emission characteristics of biodiesel. The diesel engine for various fuel injection pressures (210,220 and 240 bar) at no load to full load was investigated. The injection pressure was changed in the engine head by adjusting the fuel injector spring tension. The two proportions of biodiesel were used in diesel engine such as 20% of biodiesel (Jatropha oil and Rubber seed oil) with 80% of pure diesel fuel named as B20 and 40% of biodiesel with 60% of pure diesel fuel named as B40.From the test result, the nitric oxide (NOx) was analyzed for different injection pressures. In emission characteristics analysis, it was found that the increase in injector opening pressure increases the NOx emission. The injection pressure of 240 bars and B20 proportion gives better emission reduction compared to other blended fuels.*

Keyword: Injection pressure, emission, Jatropha oil, rubber seed oil

1. INTRODUCTION

Direct injection diesel engines are commonly used in the transportation and power production sectors due to their high brake thermal efficiency and low specific fuel consumption. For solving the problem of increased demand for petroleum products, many researchers are focusing on biofuel nowadays. Varieties of biofuels were derived from the vegetable oil and animal fats. These types of biofuels are not directly used in engine because they have high viscosity land lower calorific value. The different type's esterification process is used to improve the fuel properties and reduction of emissions. Due to the increasing of compression ratio and advancement of injection timing, the brake specific fuel consumption and exhaust gas temperature were increased, whereas the brake thermal efficiency was decreased with increase in the proportion of biodiesel in different blends of biodiesel-diesel mixture.[1].The EGR is increasing the injection pressure; the NO_x was considerably reduced in multicylinder diesel engine [2]. The injection timing was retarded from the original injection timing in a diesel engine using ethanol blended fuels the NO_x and CO_2 emission increased [3]. Three injection timing such as 24^0, 27^0, and 300 were used in the single cylinder diesel engine. The waste cooking oil as biodiesel was blended with the diesel fuel to analyze the emission and performance of the engine. The engine injection parameter was retarded and advanced the corresponding NO_x, CO2, CO emission were increased and decreased, and these experimental results were compared with that of the ANN model to predict the relative mean error values [4].The bio-diesel emission characteristics not met the standard NO emission in combustion process. The different exhaust gas treatment was used to reduce the NO_xemission of biodiesel.[5] previous investigations on the NO reduction of direct injection diesel engine fuelled with biodiesel by employing fuel injection retardation, advanced and EGR results was obtained in reduction of brake thermal efficiency(BTE)and increased exhaust smoke density[6-8].They are vegetable oil, CO neutral with lesssulphur content and can be easily produced in rural areas. Due to High combustion, engine deposits, engine oil contamination and high exhaust smoke emissions [9–10]. In this study, the effects of injection timing of jatropha oil and rubber seed oil blended with diesel fuel on the exhaust emissions characteristics of CO, $_{NOx}$ were experimentally investigated on a single cylinder constant speed diesel engine.

2. EXPERIMENTAL PROCEDURE

A constant speed diesel engine was used to evaluate the emission characteristics of rubber seed oil and jatropha oil. The diesel runs from no load condition to full load condition maintaining a speed of 1500 rpm with the proportions B20 and B40. The brake power was measured with the help of an electric dynamometer and air cooled system. An AVL415 smoke meter was provided for measuring the smoke opacity and exhaust emission temperatures. The AVL software was also used to obtain various curves and results during engine operation. An exhaust gas analyzer was used to measure the emission characteristics such as CO2, CO, HC, NOx, and O2 values from the exhaust gas. The emission test was conducted at the compression ratio of 17.5 for different injection timing such as 210, 240, and 270 with brake power of 4.4 kW

3. RESULTS AND DISCUSSIONS

3.1 Nitric oxide (NOx)

Fig.1shows the NO_x exhausts emission data for the diesel engine with the different injection pressures. NO_x emissions are produced inside the combustion chamber during the combustion process due to the chemical reaction of atomic oxygen and nitrogen. If the exhaust temperature increases, the NO_x increases with different power. Additional fuel input to the engine result in the higher temperature in engine cylinder and delivered large amount of NO_x exhaust emission.

From the graph, it was observed that when injection pressures increases, the NO_x emission was reduced. The test carried out using three different pressures such as 200 bar, 220 bar 240 bars. Two biodiesel proportions such as B20 and B40 were used to analyze the NO_x emission in constant speed diesel engine. At the 200 bar of test result always higher compare to another two pressures. At 200 bar, the NO_x emission was varied from 204ppm to 1007 ppm.When the engine pressure was maintained at 220 bar, the NO_x was increased with the blends of biodiesel. From the result for pure diesel fuel, the NO_x was increased from no load condition as 99 ppm to full load condition as 815 ppm. For B20 proportion, it was varied from 216 ppm to 899 ppm. The NO_xemission for the B20 blend was increased when compared to the pure diesel fuel. When the biodiesel concentration was B40 at 220 bars, the NO_x was again increased to a range of 154 ppm to 933 ppm from no load to full load which was higher than other two pressures. It might be due to poor concentration and high viscosity of blended fuels. The next stage of pressure was increased as 240 bars, which is the highest injection pressure of this experiment. For this pressure using normal diesel fuel, less amount of NOx was emitted compared to other pressures. This might be due to the higher pressure in combustion chamber complete combustion takes place inside the engine. The comparison of three pressures in test engine shows that when using pure diesel at 240 bar gives better results. The two blends of B20 and B40 were also tested at highest injection pressure of 240 b ar. From the test result, for B20 the NO_x was slightly closer to that of the pure diesel fuel. It was varied from 137 ppm to 710 ppm.This gives better result than other two pressures. Further increasing the biodiesel concentration as B40 at 240 bar, the NO_x was increased. It was varied from 155 ppm at no load condition and 815 ppm at full load condition at the rated power of 4.4 kW.

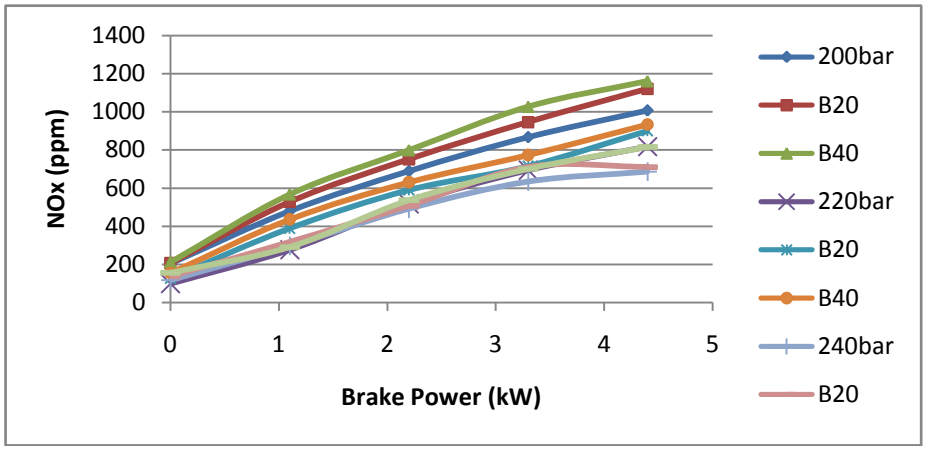

Fig 1.BP VS NO_X

4. CONCLUSION

The constant speed DI engine was used to analyze the NO_x emission characteristics and compared with pure diesel fuel. The test result was discussed based on the experimental investigations carried out with the jatropha oil and rubber seed oil blends in pure diesel. The following results were obtained for three different injection pressures.

1. The injection pressure was reduced from the designed pressure as 210 bar, the NO_x was increased. The injection pressure increased as 220 bar, the NOx was reduced. For 220 bar pressure less amount of NO_x was emitted when compared to 210 bar pressure.
2. Further increasing of injection pressure to 240 bar, the NO_x was again reduced. Finally for the B20 blend at 240 bar, the NOx emission was very less which gives better performance when compared to the other injection pressures and proportions. From the test result, it was found that the increasing of injection pressure in a single cylinder constant speed diesel engine reduces the NO_x emission considerably to a minimum level.

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