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IMPACT OF ADDITION OF CUO2 AND AL2O3 ON BIODISEL PERFORMANCE

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Abstract: In this experimental study that is made to examine the impact of nanoparticles blended with biodiesel to improve engine and emission characteristics of compression ignition engine. Biofuels are fast advancing as alternative sources of renewable energy due to their non-polluting features and cost-competitiveness in comparison to fossil fuels. However, in order to fast-track their development, focus is shifting towards the use of technologies that will maximize their yields. Nanoparticles are gaining increasing interest amongst researchers due to their exquisite properties, which enable them to be applied in diverse fields such as agriculture, electronics, pharmaceuticals and food industry. They are also being explored in biofuels in order to improve the performance of these bioprocesses. The B20 with 25, 50, 75, and 100 ppm dosage of CuO2 and Al2O3 nanoparticles were examined at various engine loads and constant engine speed. The experimental outcomes show that the use of biodiesel blend along with CuO2 and Al2O3 nano particles in diesel-fueled engine revealed better combustion, good improvement in performance characteristic and also decreased in exhaust emissions. The experimental outcomes show that the use of biodiesel blend along with CuO2 and Al203 nano particles in diesel-fueled engine revealed better combustion, good improvement in performance characteristic and also decreased in exhaust emissions.

Keywords: term, term, term

I.INTRODUCTION

Biodiesel is a domestic renewable fuel made from vegetable and animal fat/oils. Biodiesel the most promising alternative diesel fuel has been received considerable attention in recent years due to its following merits: biodegradable, renewable, non-toxic, less emission of gaseous and particulate pollutants with higher cetane number than normal diesel. Biodiesel contains no petroleum, but can be blended at any level with petroleum diesel to create a biodiesel blend. It can be used in CI engines with little or no modifications. Biodiesel is made entirely from vegetable sources it does not contain any sulphur, aromatic hydrocarbons, metals or crude oil residues. Biodiesel is an oxygenated fuel and the use of biodiesel can extend life of diesel engines because it is more lubricating than petroleum diesel fuel. Compression ignition engines play a substantial role in transportation, locomotives, irrigation sector and industrial sectors due to their simplicity of operation, high reliability, durability and well-established design. On the other hand, diesel engines are considered one of the primary sources of many toxic emissions, especially, the particulate matter (PM), and nitrogen oxides (NOx) which have hazardous environmental impacts. These toxic compounds cause the formation of acidic rains, the depletion of ozone layer, the increase of greenhouse phenomena, the formation of smog, and undesirable climatic changes. There are essential approaches to reduce diesel emissions; including engine design modifications, engine combustion enhancement, and the use of exhaust gas treatment tools. The modification of engine combustion seems to be the most recommended because it may need only minor changes to engine systems rather than the use of new designs or the use of additional systems. This approach is realized by regulating the fuel properties, modifying fuel injection, and use of fuel additives. In this regard, the use of oxygenated fuels as biodiesel is found to be a promising alternative to substitute the conventional diesel fuel. Therefore, the main aim of this work is to compare the engine performance, combustion and emissions characteristics of the recommended Jatropha biodiesel-blended diesel fuel without and with the CUO2 and AL_2O_3 additives at different engine speeds and loads to obtain the optimum concentration of nanoparticles. The CUO2 and Al_2O_3 were added to the Jatropha biodiesel-blended diesel fuel at five different dose levels of 25, 50, and 100 ppm. The combustion characteristics parameters, such as cylinder pressure, pressure rise rate, gross heat release rate, ignition delay and mass fraction of burned fuel were considered. The engine performance parameters, such as brake thermal efficiency (BTE), brake specific fuel consumption (BSFC) and exhaust gas temperature (EGT) as well as CO, NOx, UHC emissions and smoke opacity were also examined.

II. METHODS AND MATERIAL

2. Materials and methods

2.1. Engine setup

This study employed a single-cylinder, the four-stroke air-cooled diesel engine is used (Figure 1). The engine is being equipped with a rated power of 4.2 kW. The compression ratio of the engine is 17.5:1. The engine has a bore

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diameter of 87.5 mm and a stroke length of about 110 mm. The speed of the engine is maintained constant at the rate of 1300 rpm. The specification of the engine is listed in Table 1.

Table 1:. Specification of experimental setup.

Cylinder	**Single**
Rated power	4.5 kW
Rated speed	1500 rpm
Bore diameter (D)	87.5 mm
Stroke (L)	110 mm
Compression ratio	17.5:1
Cooling type	Air
Injection timing	21°bTDC
Injection pressure	210 bar

2.1 Preparation of BD Emulsion Fuel.

Reduction of the Fatty Acid as obtained in the test carried out on the jatropha oil, it was discovered that the free fatty acid (FFA) contents of oil are high (21.6%). Hence, it became necessary to reduce it. Procedure. Crude jatropha oil was poured into a conical flask and heated to a temperature of 60○C. A mixture of concentrated H2SO4 (1% w/w) with methanol (30% v/v) was heated separately at (50○C) and then added to the heated oil in the flask. The mixture was stirred for 1 hour and allowed to settle for 2 hours. The sodium hydroxide pellet was placed in the weighing balance to get exactly 0.25 g. A solution of potassium methoxide was prepared in a 250 mL beaker using 0.25g of sodium hydroxide pellet and 63 mL of methanol. The solution was properly stirred until potassium hydroxide pellet was completely dissolved. The potassium methoxide solution was then poured into the warm jatropha oil and stirred vigorously for 50 minutes using a magnetic stirrer. The mixture was then allowed to settle for 24 hour. The quantity of biodiesel collected.

2.2 Addition of Nanoparticles to Neat Jatropha Biodiesel

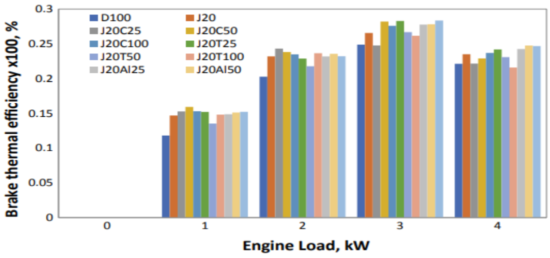
A GT Sonic ultrasonicator (Shenzhen, China) was used for mixing the nanoparticles in biodiesel-surfactant mixture. Quantities of 50 ppm and 100 ppm of nanoparticles were added to neat jatropha biodiesel (J100). Biodiesel-nanoparticles mixtures were placed in an ultrasonicator (frequency at 40 kHz and water at 45 ◦C) for a duration of 45 min. After that the samples were left for 72 h at room temperature to see the stability of the mixture.

III.RESULTS AND DISCUSSION

3. Results and discussion

3.1. Brake thermal efficiency (BTE)

Thermal efficiency is the relation between the power output and the heat supplied to the engine At lower load, the mixture is too lean to meet out the power which in turn results in lower BTE. However, at higher load, the mixture is rich enough for improved combustion and higher BTE. Brake thermal efficiency increased for nano biodiesel additives compared with the neat diesel fuel. The thermal efficiency increased for nano biodiesel blends compared to the neat diesel fuel. Addition of nanoparticles reflects the improved combustion and the effective energy conversion of fuel to useful work. Biodiesel blend with nanoparticles J20Al100 created a maximum increase in thermal efficiency upto 6.5% at 75% of engine load.



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3.2 Exhaust Gas Temperature

The exhaust gas temperature at different engine loads for neat diesel, Jatropha biodiesel blend with nano-additives is shown in Fig. 8. The exhaust gas temperature increases with load increase because of higher engine cylinder temperature. This leads to more fuel burning to meet the higher load requirement. The addition of nanoparticles to Jatropha biodiesel blend (J20) leads to decreases in the exhaust gas temperature. Fine dispersion of nano particles led to improved combustion, fuel- air mixing improvement and higher engine efficiency.

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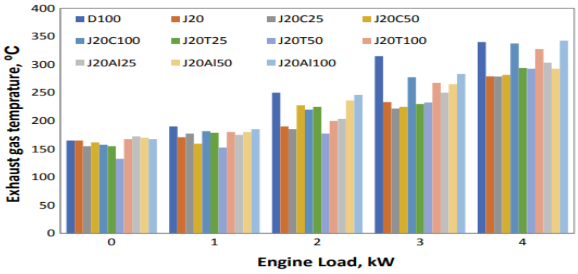
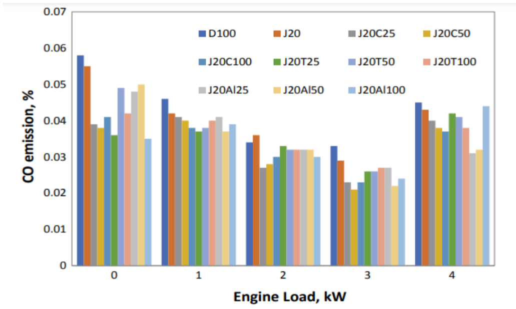


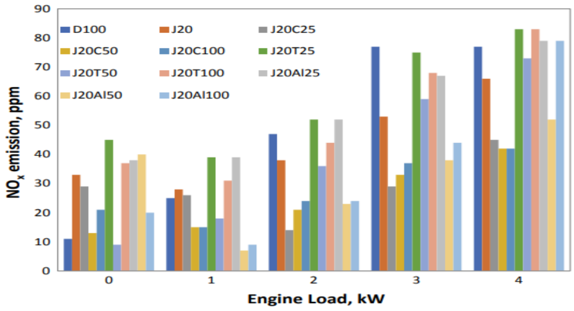
3.3. CO emissions

The variation of CO emissions with engine load for neat diesel and Jatropha biodiesel blends (J20, J20C25, J20C50 and J20C100) are indicated in Fig. There is a decrease in CO emission with the increase of engine load at part load. However, it increases corresponding to full load. This is due to the increase in fuel consumption, which leads to arich air–fuel mixture. A significant reduction of CO emission is noticed throughout the engine load range when the biodiesel blend was used. CO reduction is mainly due to more oxygen content of the biodiesel than neat diesel fuel.



3.4. NO_x emissions

The effect of engine load on NOx emissions for the tested fuels. NOx emission for the biodiesel blend is higher than that for the neat diesel. NOx emissions increased with increase in engine load due to the higher cylinder temperature and higher adiabatic flame temperature. The formation of NOx is favored by higher combustion temperatures, availability of oxygen, and lower ignition delay. Biodiesel produces higher NOx emission because of its oxygen content. NOx emission decreased with the increase in the dosing level of nanoparticles due to the effect of oxygenated additives and combustion enhancement.



IV.CONCLUSION

Performance and exhaust emissions of Jatropha biodiesel blended with nano-additives (CNTs, TiO_2 and Al_2O_3) were investigated in a single-cylinder diesel engine. Jatropha biodiesel blend with Al_2O_3 nano additive J20Al100 achieved performance parameters improvement. J20Al100 produced decrease in specific fuel consumption, increase in thermal efficiency and decrease in exhaust gas temperature by 6.5, 6.5 and 27%, respectively compared to J20. J20C50 produced decrease in CO and NO_x emissions by 35 and 62%, respectively compared to J20. Burning of nanoparticle added Jatropha biodiesel (J20C50) produced a maximum reduction in CO emission (up to 35% at 75% of engine load) compared with all other fuels.The maximum decrease in NOx emission is up to 52% at 75% of engine load for J20C50, compared to all other fuels.The maximum decrease in HC emission for Jatropha biodiesel with nanoparticle (J20T25) was about 22% at 75% of engine load, compared with neat diesel oil.Jatropha biodiesel blend with nano-additive (J20C100) has a maximum decrease in smoke emission (up to 50% at 75% of engine load), compared to all other fuels.

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