An Investigate study on the effect of Aluminum Oxide Nanoparticles blended alternative fuel of Diesel Engine

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***Abstract:** This paper presents an investigate study on the effect of aluminum oxide nanoparticles blended alternative fuel with pongamiya pinnetta's oil. To evaluate the outcome from the investigate study, practical experiments were conducted to determine engine performance, emissions and combustion characteristics in a single cylinder diesel engine using B20 with (80% diesel and 20% PME) and B20A50 (80% diesel and 20% pongamia oil and with dispersed 50 ppm Aluminum oxide nanoparticles) and B30A100 (80% diesel and 20% pongamiya oil and 100 ppm dispersed Aluminum oxide nanoparticles) respectively without any engine modifications.*

***Index Terms**— Aluminum oxide nanoparticles (Al_2O_3 Nano particles), combustion, diesel, ultrasonicator, emissions.*

I. INTRODUCTION

The recent advancements in the field of Nano Science and Nanotechnology covered the way to produce Nano scale energetic materials which have more advantages over the micron sized materials. To enhance the performance and emissions in a diesel engine can be achieved by combustion behavior of traditional liquid fuels with the addition of Nano scale energetic materials as fuel additive thing. For the decomposition of hydrogen from water during the combustion process, its suggested to add aluminum nanoparticles to diesel provides a large contact surface area with water. Its noted that during the combustion process, the alumina serves as a catalyst and the aluminum nanoparticles are bared and decomposed the water to yield the hydrogen. The total combustion heat increases while oxide in the exhaust emission from diesel engine decreases and the concentration of smoke and nitrous oxide in the exhaust emission from diesel engine decreases while the combustion of the diesel fuel mixed with aqueous aluminum Nano fluid. Nano metal oxide additives are reported in the literature to reducing diesel emissions. The metal-based additives reduce diesel engine pollution emissions and fuel consumption values. The major reason for drop in the emission is that the metal reacting with water to create hydroxyl radicals, which improve soot oxidation, or by direct reaction with the carbon atoms in the soot, in so doing lowering the oxidation temperature. In this context a broad literature has presented previously. [1]-[7].

In this paper, to evaluate the effect of Aluminum Oxide Nanoparticles blended alternative fuel of diesel engine, the following standard formulae have been considered.
Mass Flow Rate of fuel mf = ρ* V/ t kg/hr.
Brake Power BP = *0.746 kW
Brake Specific Fuel Consumption BSFC = mf / B.P kg/kWh Indicated Power IP = FP+BP
Brake Specific Energy Consumption BSEC = BSFC*C.V.
Brake Thermal Efficiency ηbth = B.P/ Mf * CV *100
Indicated Thermal Efficiency ηith = I.P/ Mf * C.V
Mechanical Efficiency ηme = B.P/ I.P * 100

II. EXPERIMENTAL VERIFICATION AND RESULTS

For the blending of aluminum oxide nanoparticles in diesel, taken a sample of diesel say 1litre and then 0.030g of aluminum oxide in the nanoparticles form is added to make the dosing level of 30 ppm. The dosing level of 30 ppm is 0.030 g/l, respectively. After the addition of aluminum oxide nanoparticles, it is shaken well and then it is poured into mechanical homogenizer apparatus where it is agitated for about 30 min in an ultrasonic vibrator making uniform dispersion. It should be shaken well before use, as excess of nanoparticles settle down on solution. Similar procedure carried out for 50ppm with 60 min agitations. Table. 1 shows the properties and name plate details of the experimental study.

Table. 1. Properties and Name plate details of the experimental study

	Flash point (°C): Diesel 48 PPM Diesel blend: 30 PPM Aluminum nano particles is 50 and when the same diesel blend is 50 ppm then flash point is 52 when the blend is with pongamia oil there is variation of 2% in flash point.
	Fire point (°C): Diesel: 52 PPM Diesel blend: 30 PPM Aluminum Nanoparticles is 55 and when the same diesel blended to 50ppm of aluminum nano particles is 57 and when the same diesel blend is 50 ppm then 59 when the blend is with pongamia oil the fire point is increased by 2%.

Properties	**Density (kg/m^3):** Diesel: 52 PPM Diesel blend: 30 PPM. Aluminum Nanoparticles then the density is 831.5 and when the same diesel blended to 50ppm of aluminum nano particles then the density is 833.5 and when the same diesel blend is 50 ppm then density observed to be increased by 834.9.
Name Plate details	Kirloskar Number of cylinders One Bore 87.5 mm Stroke 110 mm Compression ratio 17.5:1 Maximum power 4.4 kW Dynamometer Electrical Speed 1600 rpm Injection timing 23 deg CA (before TDC) Injection pressure 200 bar

III. Experimental Results

The following features are implemented in our proposed system

In this study the fuel Consumption has measured using burette method and digital stopwatch and used for consumption of 10 ml of fuel. Variation of mass flow rate of fuel with brake power is shown by Fig.1. Mass flow rate reduction is because of better combustion with addition of biodiesel because addition of biodiesel reduces the phase stratification effect.

The effect of brake power on indicated power is shown in Fig. 2. Indicated power is summation of brake power and friction power. Frictional power was found out from Willian's line. As brake power increases indicated power also increases linearly. At same brake power with addition of biodiesel indicated power reduces and further reduction in indicated power can be seen with addition of nanoparticles.

Variation of brake thermal efficiency with the effect of brake power on brake thermal efficiency is shown in Fig. 3. The mechanical efficiency varies with brake power is shown by Fig.4. Significant increase in mechanical efficiency is seen with addition of biodiesel and also further increase is seen after adding nanoparticles.

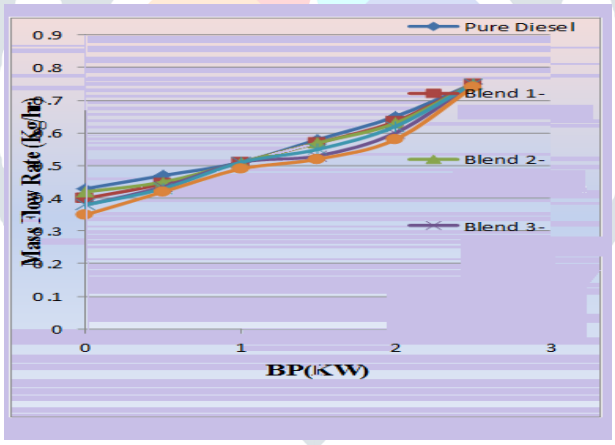

Fig. 1. Variation of mass flow rate of fuel with brake power

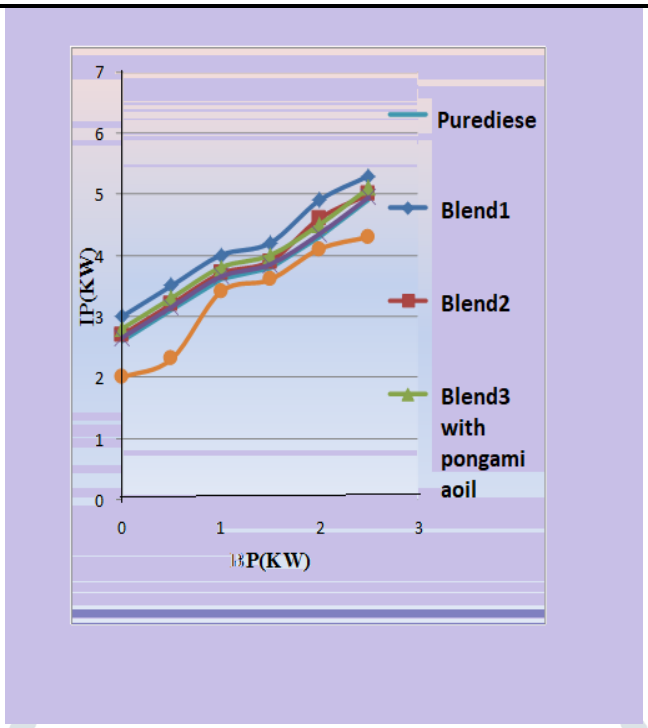

Fig. 2. Effect of brake power on indicated power

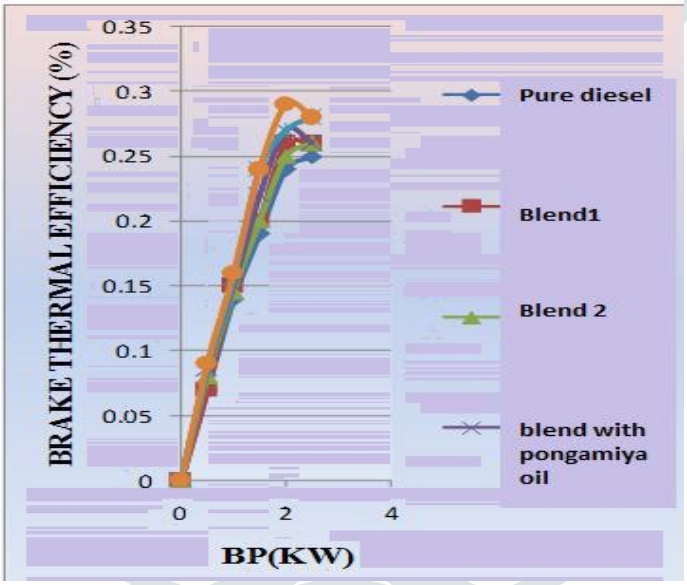

Fig. 3. Variation of brake thermal efficiency with the effect of brake power on brake thermal efficiency

IV. CONCLUSION

Hence, in this paper the outcome from the experimental study is

i) A significant decrease in mass flow rate is observed with addition of biodiesel which is proportional to the amount of biodiesel added.

ii) The reduction in mass flow rate is observed with addition of alumina nanoparticles as alumina nanoparticles acts as a catalyst for combustion to improve combustion. Mass flow rate of fuel for blend 30% has reduced by 3.5% in comparison to conventional fuel diesel at full load.

iii) Reduction of 20% can be seen in indicated power of blend 30% as compared to that of neat biodiesel.

iv) 11% increase in mechanical efficiency is seen as compared to conventional fuel diesel. If compared with blend in which nanoparticles along with pongamiya oil was added mechanical efficiency has increased by 5%.

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