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"EXPERIMENTAL INVESTIGATION ON EFFECTS OF ADDITION METHANOL BIODIESEL FOR THERMAL PERFORMANCE, EMISSION AND COMBUSTION CHARACTERISTICS IN CI ENGINE"

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ABSTRACT

The Experimental Investigation is paying attention to improve the performance, combustion and to reduce exhaust emissions of diesel engine by using diesel- Methanol blends. The Experimental are conducted with a single cylinder, four-stroke direct injection, naturally aspirated, 4.4 kW air cooled diesel engine. The test was conducted in a diesel engine volume of Methanol by 5%, 10% and 15% with test fuel blends along with 50 ppm and 75 ppm of Nano-Addative. The performance, emission and combustion tests are carried out and the evaluations are compared with that of diesel fuel. The Brake thermal efficiency of the Methanol blends improved with an increase of Methanol content in fuel blends and at 20.9%, 22.2% against diesel fuel is 25.5%. This increase of Brake thermal efficiency for diesel-Methanol blends might be due to the calorific value and low boiling point of Methanol as compared to diesel fuel. Unburned hydrocarbons and NOX emissions are increased by 06 % and 3% respectively at full load for B-05 blend as compared with that of diesel fuel. This is due to high latent heat of vaporization of Methanol. Carbon monoxide and smoke opacity emissions are reduced by 13% and 3% respectively by using B-15 blend compared with that of the diesel fuel at full load. This is due to the enrichment fuel blend with the addition of Methanol. EGT is increased by 2% by using B-10 blend as compared with that of diesel fuel at full load. It is due to complete combustion of fuel blend. Brake thermal efficiency is increased by 2% by using B-10+75 ppm fuel blend with compared to that of diesel fuel at 75% load. It is because of the heating value and complete combustion of fuel blend. Engine exhaust emissions, carbon monoxide and smoke opacity emissions are reduced by 07 % and 11% using B-10+75ppm and B-05 +50 ppm fuel blend compared with that of diesel fuel at full load. It is due to nano-particles improved air-fuel mixture, uniform burning and complete combustion of fuel blends. The performance characteristics like BSFC decreased by 11% and BTE increased by 5% by using B-05 and B-15 with nano-partical fuel blends as compared with diesel fuel. This is due to nanoparticles enhances surface area to volume ratio and complete combustion of fuel blend.

Key Words: *Air Cooled, emissions, CO.*

I. INTRODUCTION

Diesel engines are used in various fields like transportation, power and industrial sectors because of their reliability, stability and robustness. The depletion of resources and with the demand in energy utilization, an immediate need for the alternate renewable fuel arise. India is world's third biggest oil consumer in the world .

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Diesel engines emit higher percentages of nitrogen oxides, stinking odor and smoke which are dangerous to the earth's environment causing such as acid rain, ozone layer depletion, global warming, smog and climatic changes etc. The effect of lowering emissions is in progress. Many researchers have studied to reduce diesel engines by using engine modification, fuel blending and treatment of exhaust gases. Conversely fuel blending method is frequently use by various researchers to attain desirable fuel characteristics. The selection of fuel based on supply and distribution of fuel, the integrity of the fuel being delivered to the engine, emissions and engine durability.

Reducing the sources of conventional fossil fuels, depleting petroleum reserves and variation in the crude oil prices are present day's. The future energy requirements to be achieved by new sources of energy. The way to reduce the energy crisis by bio-fuels which are renewable in nature. The large amount of bio-fuel production may boost the economy of the Nation and reduce the cost of fuel.

II. ALCOHOLS

It is an alternative fuel and it can be produced in both ways, natural and manufactured. It is mainly of Methanol. Methanol is a most common fuel and hence so many researchers use Methanol as alternative fuel in internal combustion engines. It is completely miscible with diesel fuel at temperatures in excess of about 30oC. The first method using methanol as diesel fuel is direct blend with the diesel fuel in different fractions

III. METHANOL

Methanol is currently considered one of the most useful chemical products and is a promising building block for obtaining more complex chemical compounds, such as acetic acid, methyl tertiary butyl ether, dimethyl ether, methylamine, etc. Methanol is the simplest alcohol, appearing as a colorless liquid and with a distinctive smell, and can be produced by converting CO2 and H2, with the further benefit of significantly reducing CO2 emissions in the atmosphere. Indeed, methanol synthesis currently represents the second largest source of hydrogen consumption after ammonia production. Furthermore, a wide range of literature is focused on methanol utilization as a convenient energy carrier for hydrogen production via steam and autothermal reforming, partial oxidation, methanol decomposition, or methanol–water electrolysis reactions.

IV. BENEFITS OF METHANOL AS DIESEL ENGINE FUEL

Methanol fuel can be distilled and dehydrated to create a high octane, water-free alcohol. It is used as renewable fuel because it can burn completely and cleanly when compared to gasoline and diesel fuel.

Bio fuels

Biofuels are the most effective and efficient form of renewable energy. They can be easily extracted from the biomass, and they are biodegradable and are environment friendly. Their combustion is almost similar to fossil fuels, and they produce less toxic compounds. The biomass absorbs carbon dioxide from the atmosphere, and when they are used as energy source, they release the carbon dioxide back into the atmosphere.

Biodiesel Production

Oil can be extracted from a variety of plants and oil seeds. It is estimated that about 3 million hectares plantation is required to produce oil for 10% replacement of diesel.

Methanol as diesel engine fuel

Methanol in diesel results faster-premixed combustion leading to higher combustion temperature, which causes higher NOX emissions in the engine exhaust emission? Before going for the commercial use of diesel–Methanol blends with high Methanol content, it is important to find a method to reduce the NOX emission. Many techniques are evaluated to allow the use of diesel and Methanol in compression ignition engines. But most commonly used techniques are alcohol fumigation, dual injection, alcohol-diesel fuel emulsion and alcohol-diesel fuel blends. Surfactants reduces the interfacial tension in a liquid medium and homogenizing the E-diesel blend, enhances engine performance and reduces ignition delay and exhaust emissions.

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V. NANOPARTICLES

Nanofluids are made up of nanoparticles and are made by using metals, oxides, carbides and carbon nanotube. Most commonly used base fluids are oil, water and ethylene glycol. At present nanofluids are used in many applications because of their different properties, such as heat transfer, microelectronics, fuel cells, hybrid-powered engines, engine cooling, chiller units, refrigerators, machining and boiler flue gas temperature reduction. Nanofluids unveil superior thermal conductivity and the convective heat transfer co-efficient as compared with base fluids. Alcohols are alternate renewable fuels for diesel fuel with some additives which can enhance the desirable properties of the fuel. Alcohols can be produced in rural areas by the availability of forest products as raw materials. The absences of sulfur content in alcohols no sulfur dioxide emission from engine exhaust. This can be overcome by large-scale production of Methanol with the help of government sectors and private firms with government funding. Biodiesel is a good source of renewable energy and can be produced by various methods and materials.

Figure No. 1 Cerium Oxide Nano-Particle

VI. RESEARCH OBJECTIVES

1. To check the appropriateness of the Methanol fuel for diesel engine as working fuel.
2. To prepare the stable blends of diesel-Methanol with metal oxide-nanoparticle.
3. To investigate the performance characteristics of diesel engine using diesel-Methanol-nanoparticle blends with metal oxide-nanoparticle and without metal oxide-nanoparticle
4. To discuss the combustion characteristics of diesel engine using Methanol- nanoparticle blends with metal oxide-nanoparticle and without metal oxide-nanoparticle
5. To illustrate the performance, emission and combustion characteristics of using Methanolnanoparticle blends with metal oxide-nanoparticle and without metal oxide-nanoparticle

VII. EXPERIMENTAL SETUP AND CALCULATION PROCEDURE

Experimental investigation for thermal performance, emission and combustion characteristics were carried out on a single cylinder diesel engine. The experiments of test fuels were investigated in a Kirloskar make single cylinder, four-stroke, direct injection diesel engine coupled with an eddy current loading system. Experiments were conducted with varying loads while the engine speed was kept constant at the rated speed of 1500 rpm.

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Figure No. 2 Experimental set-up

VIII. PREPARATION OF THE TEST FUELS

Methanol is immiscible in diesel over a wide range of temperature and water contents due to its properties. The addition of emulsion solution is required to avoid the phase separation and stability of the blends. The water-in-oil emulsion as oil phase and water free Methanol as water phase. Prepared fuel blends are

1. Diesel 95% and Methanol 5% (B-5),
2. Diesel 90%, Methanol 10% (B-10),
3. Diesel 85%, Methanol 15% (B-15 ,

The performance, emission and combustion experimentation are conducted to choose the best blend of the three fuel blends.

Fuel blends are prepared by using B-05 , B-10, B-15 with the addition of aqueous aluminium oxide nanoparticles and aqueous cerium oxide nanoparticles in two different proportions (50 ppm and 22

75 ppm). Solubility, absorption or emission, melting point and catalytic behavior are changed only by varying the nanoparticle size. Different particle size leads to a different physical and chemical behavior of the material. Dispersed nanoparticles are needed in order to retain their specific.

Sr.No	Properties	Diesel	Methanol	B-05	B-10	B-15
1	Density,g/cc	0.856	0.785	0.8615	0.8619	0.8312
2	Viscosity@40°C, mm^2/sec	2.0	1.2	4.78	4.80	3.17
3	Flash point,°C	50	58	69	72	58
4	Fire point,°C	56	65	78	81	68
5	Calorific valueMJ/kg	41.66	26.87	41.17	41.19	41.70

Table No. 1 Properties of test fuel blends

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Methanol rdx　　Methanol Biodiesel　　Cerium Oxide　　Cerium Oxide 50 ppm and 75 ppm

Figure No. 3 Experimental Fuel and Nano-Additive

IX. RESULT AND DISCUSSION

Performance, emission and combustion characterizes of diesel and methanol blends with metal oxides discussed here. The important properties of fuel blends i.e. physical properties and chemical properties are determined by using standard investigation method.

1. Brake specific fuel consumption and Brake thermal efficiency.

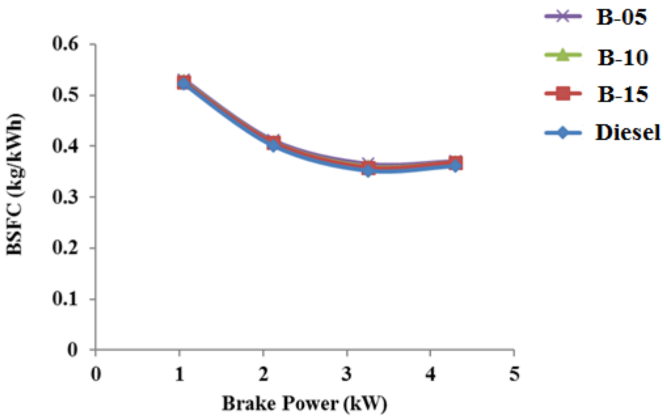

Figure 5 Comparison of Brake specific fuel consumption with Brake Power for diesel and diesel, Methanol blends.

Figure 5. shows the variation of Brake specific fuel consumption of different brake power conditions for diesel, three test fuel blends of B-05, B-10 and B-15 in the test engine. This increase capacity is due to higher the percentage of Methanol in the fuel blend, and the variations in density, heating values between diesel and methanol.

Brake thermal efficiency.

Brake thermal efficiency variation with brake power for the three test fuel blends and diesel fuel are shown in the Figure 6 the Brake thermal efficiency of the Methanol blends improved with an increase of Methanol content in fuel blends and at 20.9%, 22.2% against diesel fuel is 25.5%. This increase of Brake thermal efficiency for diesel-Methanol blends might be due to the calorific value and low boiling point of Methanol as compared to diesel fuel.

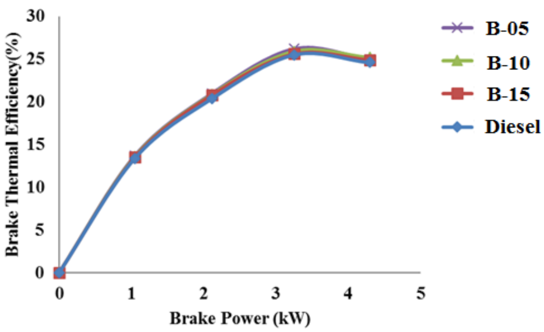

Figure 6 Comparison of Brake thermal efficiency with Brake Power for diesel and diesel, Methanol blends.

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Hydrocarbons

Unburnt hydrocarbons are formed due to poor fuel distribution, low exhaust gas temperatures and excess air in the combustion chamber. The effect of brake power with HC for three test fuel blends and diesel fuel in the diesel engine are shown in Figure 7

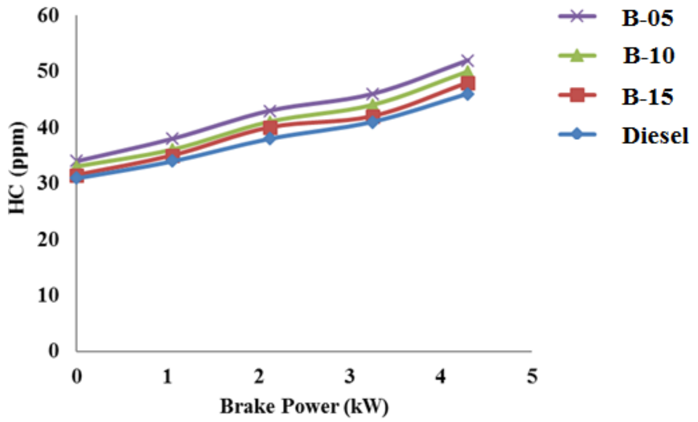

Figure 7 Comparison of HC with Brake Power for diesel and diesel, Methanol and surfactant blends

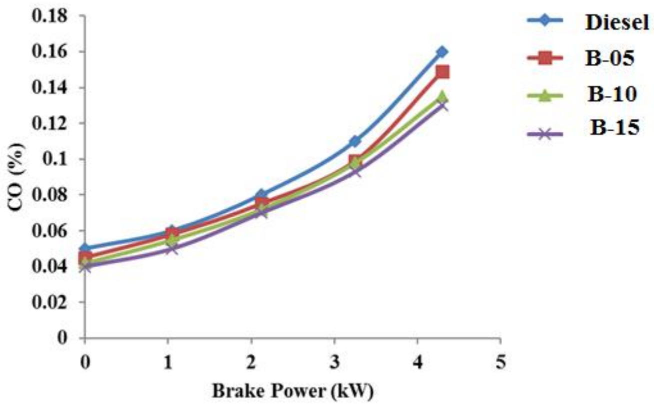

Figure 8 Comparison of CO with Brake Power for diesel and diesel, Methanol and surfactant blends.

The comparison of CO with the brake power for B-05, B-10 and B-15 blends and diesel fuel is shown in Figure 8. The CO emissions are reduced with the use of Methanol-diesel fuel blends compared to with that of diesel fuel. This reduction is higher when the percentage of Methanol is higher in fuel blend.

Oxides of nitrogen

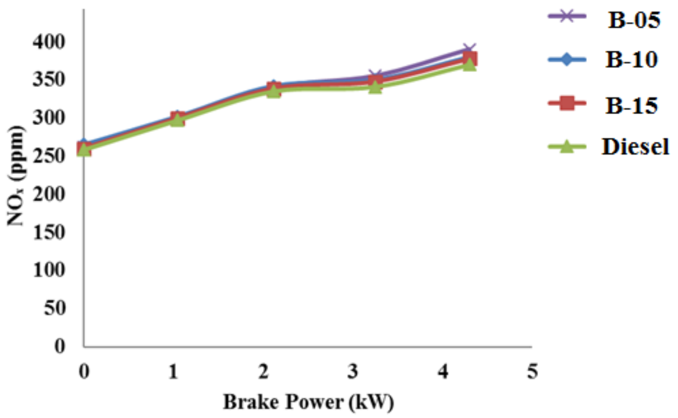

Figure 9 Comparison of NOX with Brake Power for diesel and diesel, Methanol and surfactant blends.

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Figure 9 shows the variation of NOX with the brake power for diesel, B-05 , B-10 and B-15 blends. NOX emission increased with increase of load on the engine and mainly depending on combustion temperature of the cylinder. The NOX emission at full load condition increased with an increase of Methanol percentage in the fuel blends as compared with that of diesel fuel.

Smoke opacity.

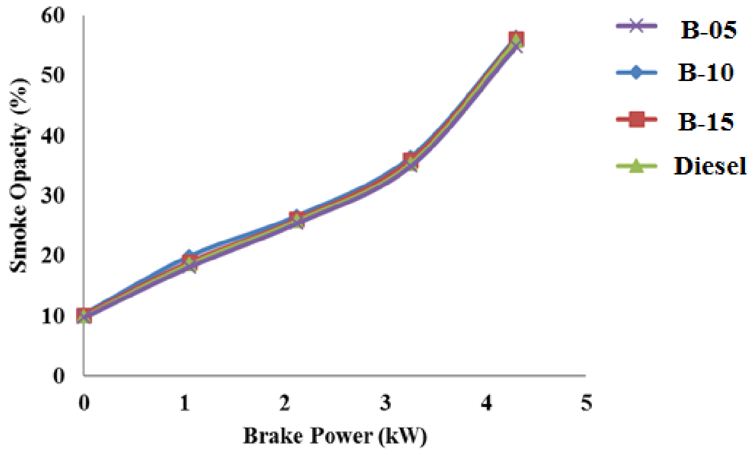

Figure 10. Comparison of Smoke opacity with Brake Power for diesel and diesel

The carbon content increase in the exhaust emissions blocking the light smoke is called smoke opacity. Variation in smoke opacity with brake power for diesel, B-05, B-10, and B-15 blends are shown in Figure 10. The smoke opacity emitted by Methanol-diesel fuel blends is significantly lower than that of diesel fuel.

Exhaust Gas Temperature

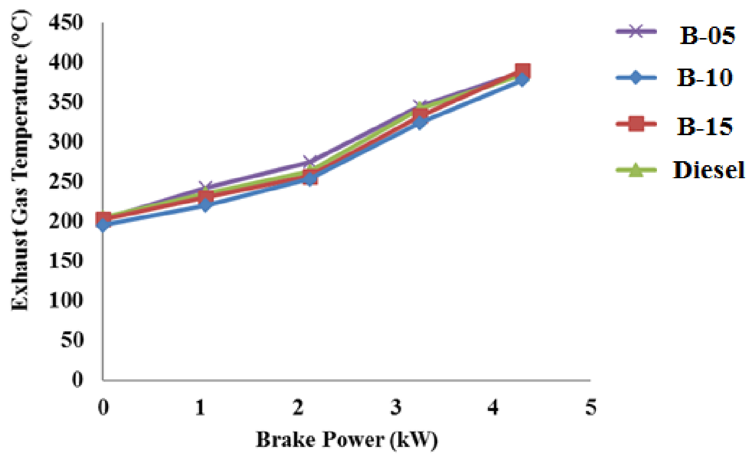

Figure 11 Comparison of Exhaust Gas temperatures with Brake Power for Diesel and Diesel, Methanol and Surfactant blends.

The variation of exhaust gas temperature with brake power for diesel, B-05, B-10, and B-15 blends is shown in Figure 11 From the graph, it is observed that the exhaust gas temperature increases for B-15 blends against diesel fuel. High HRR and cylinder pressures lead to higher gas temperatures at engine exhaust.

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Brake specific fuel consumption

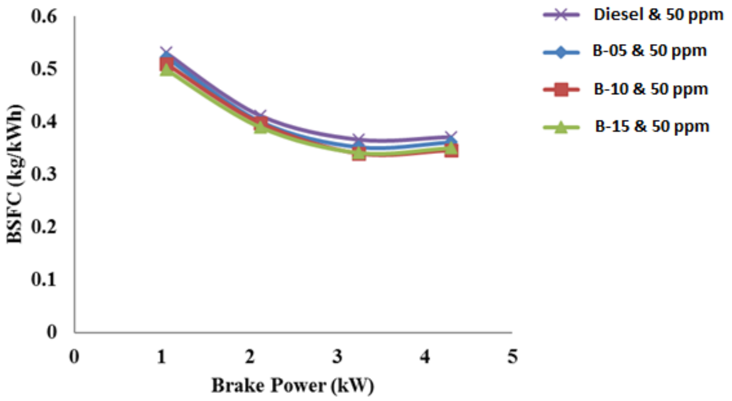

Figure 12 Comparison of Brake specific fuel consumption with Brake Power for diesel and cerium oxide nanoparticle additive in diesel Methanol.

Figure 12 shows the comparison of Brake specific fuel consumption with brake power for the three test fuel blends of B-05+50 PPM, B-10+50 PPM and B-15+50 PPM fuel in the diesel engine. From the graph, it is observed that at normal loads, B-15+50 PPM gives better Brake specific fuel consumption as Compared with that of remaining fuel blends and diesel fuel.

Brake thermal efficiency

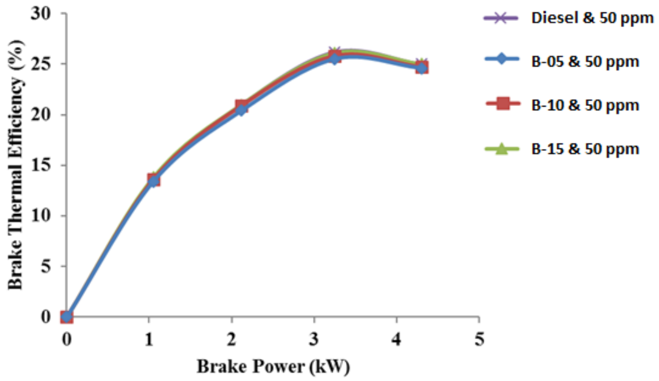

Figure 12 Comparison of Brake thermal efficiency with Brake Power for diesel and aqueous cerium oxide nanoparticle additive in diesel and Methanol blends

The variation of Brake thermal efficiency for B-05+50 ppm , B-10+50 ppm and B-15+50 ppm is shown in Figure 12 it is observed that the Brake thermal efficiency increased for the B-10+50 ppm fuel blends as compared with that of diesel fuel. This might be due to low boiling point and higher vaporization of Methanol and addition of cerium oxide nanoparticles higher the surface to volume ratio enhances the combustion.

Hydrocarbons

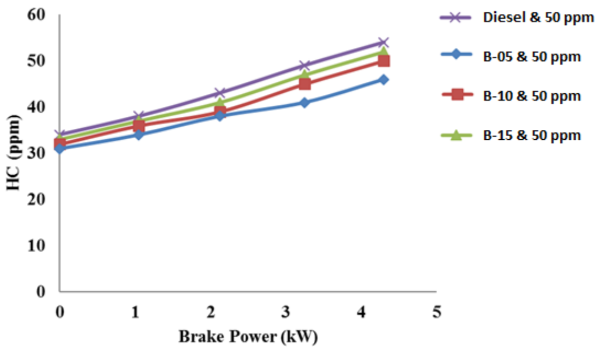

Figure 5.10 Comparison of HC with Brake Power for diesel and aqueous cerium oxide nanoparticle additive in diesel Methanol.

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