COMBINED EFFECT OF EGR AND ALUMINA WITH BIO-DIESEL BLEND ON THE OUTPUT OF CI ENGINE

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ABSTRACT

Exploratory examination was finished by utilizing Mahwa bio-diesel mix with the Al_2O_3 nano added substance and fumes gas distribution on the diesel motor to dissect the exhibition, ignition & exhaust discharge qualities. The bio-diesel mix MBD25 was arranged by including 25 % Mahwa bio-fuel mixed with 75 % of diesel fuel and MBD25AONP mix was set up by adding a 100 ppm of nano-particles (Alumina) to MBD25 fuel mix by volumetric premise. The perceptions shows that, there is an expansion of 5.52 % brake warm productivity with the utilization of Al_2O_3 added substance with MBD25 mix, and 3.3% expansion with alumina & 20% of EGR contrasted with the MBD25 mix. For the fuel mix MBD25AONP+ 20% of EGR, Brake specific fuel consumption BSFC was diminished by 2.37% contrasted with MBD25 fuel mix. The NOx emanations development was decreased by 14.3% and outflows like HC, CO, and smoke were expanded by 10%, 12.6%, 9.1% utilizing the fuel mix MBD25AONP+20% of EGR contrasted with MBD25AONP fuel mix without EGR.

KEYWORDS: Mahwa Oil, Alumina, EGR, Additive, Emissions & Performance

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1. INTRODUCTION

Humans life and the worldwide condition have been influenced by natural contamination brought about by the ignition of petroleum products. Because of the expanded populace and vehicle use, the current vitality request doesn't ready to meet by regular powers. Air contamination was made by the emanations tossed into the earth from the diesel motors. The bio-diesels are presented for decrease of outflows and decrease of an Earth-wide temperature boost, as the utilization of nano-particles as additives, improves the ignition of bio-diesel be accomplished and decrease of discharges. Creation and utilization of it's requirement for vitality and ecological concern. Compression Ignition motor could be run effectively utilizing distinctive bio-diesels like Mahwa, Rubber, tobacco & Kharanja seed oils and so forth to get astounding execution and the emanations could be regulated. Experimentally explored on diesel motor with Mahwa bio-diesel mixes and inferred that the use of bio-diesel brings down the Particulate Matter (PM), Carbon dioxide (CO_2), UHC emissions and CO outflows and raised the fuel utilization and NOx emissions. The possibility of Mahwa seeds to deliver the bio-fuel utilizing pyrolysis strategy was verified and further portrayed the items genuinely & Chemically. They uncovered that Mahwa seed bio-fuel is to be a Promising bio-fuel can be utilized as hydro-carbon fuel to get great results. The impact of affixing 10% & 20% of Octanol in Mahwa oil was studied and found critical decrease in discharges. With the higher extent of the Octanol at full burden, 5.2% of CO discharges, 5.2% of HC emanations, 4.6% of NOx and 2.3% of smoke outflows decrease contrasted with flawless Mahwa oil bio-diesel. The impact of alumina (Al_2O_3) & Cerium oxide (CeO_2) particles expansion to the diesel was investigated and contrasted the outcomes and perfect diesel. They recognized a

noteworthy reduction in NO_x and CO discharges upto 13% & 20.5%. The outcomes demonstrated decrease in explicit fuel utilization and improvement in brake power. The impact of Cerium oxide (CeO₂) and Alumina nano-particles expansion to the Jathropa bio-diesel in various extents was investigated and watched the decrease in smoke outflows, Nitric oxide (NO), unburned. Hydrocarbons (UHC) and Carbon imonoxide (CO). Impact of the expansion of alumina particles to the Kharanja emulsified bio-diesel in various extents was verified. They investigated that, emulsified KBD fuel with Alumina particles improves. brake power and lessens the outflows contrasted with KBD emulsified fuel. 40ppm TiO₂ particles was mixed with Calopyllum Inopyllum bio-diesel and tried on diesel motor. The CO emanations were diminished for the fuel and remaining discharges are increased. The increment in power at a pace of 1.0% & 3.18% with the expansion of the CuO particles & Al₂O₃ expansion of 50ppm to perfect diesel, SFC decreased by 0.6% & 1.1% with Al₂O₃ & CuO, outflows is decreased with the doping of nano particles. The mix of EGR & Nano Emulsified Lemon Grass oil with an additive of DEE, lessens BSFC by 8.7%, NO_x emanations by 30.4%, smoke emanations by 15.48%, CO outflows by 2.33%, and HC outflows by 21.3% than that of Lemon Grass bio-diesel mix utilized in DI diesel motor. Mahwa bio-diesel fuel mixes in various rates tried on a Kirloskar engine, TV1 model diesel motor & MB25 mix was picked as the best mix for additional investigations to decrease NO_x emanations. At full burden, Hot EGR gives most minimal explicit fuel utilization, iHydrocarbon outflows and better warmth discharge rate. The altered diesel motor with EGR and diminishing fuel injector spout gap measurement utilizing 20% Mahwa bio-diesel mix as fuel was investigated. With their observations, suggested 10% halfway cooled iEGR for the proposed motor changes for better outcomes.

In this paper, the impact of alumina (Al₂O₃) nano particles expansion to Mahwa bio-diesel (MBD25) mix with EGR on the discharges, burning and execution qualities of diesel motor is accounted for.

2. EXPERIMENTAL SETUP

The SEM image of Alumina nano-particles are shown in figure. 1. And the photographic image of Engine test rig is represented in figure 2. The tests were conducted on TV1 Kirloskar Type, CI engine and Exhaust emissions were observed by using gas analyser (Model AVL Digas 444N) and smoke meter (Model AVL, 437C).

Figure 1: SEM Image of Alumina (Al₂O₃) Nano-Particles.

Figure 2: Engine Tested, Smoke Meter & Exhaust Gas Analyzer.

The overall uncertainty of different parameters is calculated and is $\pm 2.18\%$ by using the Square Root-square Sum method, shown below.

$$= \sqrt{\{(0.2)^2 + (0.1)^2 + (1.5)^2 + (0.3)^2 + (0.1)^2 + (0.2)^2 + (1)^2 + (1.1)^2 + (0.2)^2\}}$$

$$= \pm 2.18\%$$

3. METHOD OF EXHAUST IGAS RECIRCULATION, (EGR)

EGR is the most broadly utilized strategy to diminish the arrangement of NO_x outflows in diesel motor by recycling some division of fumes gases to bay complex. The stream pace of fumes gas distribution was constrained by utilizing a manometer linked to control valve at 0 to 10% of the EGR into the engine at the time of induction stroke. The level of EGR is characterized as the mass level of re-circled fumes gas in the complete admission blend.

4. RESULTS & DISCUSSIONS

The performance, combustion & emissions characteristics of 1-cylinder diesel engine was tested by using diesel, MBD25, MBD25AONP, MBD25+20% of EGR, MBD25AONP+20% of EGR fuels at varying loads and the results were discussed.

4.1 Engine Performance

4.1. a. BTE

Figure 3 represents the variations of BTE with the variation of load for the diesel, MBD25, MBD25AONP, MBD25+20% of EGR and MBD25AONP+20% of EGR. As the load on the engine increases, BTE of the engine increases to all the tested fuels. BTE of the MBD25 fuel is lower than the diesel fuel due to low heating value than the diesel fuel.

Figure 3: Variations in Brake Thermal Efficiency with Change in Load %.

With the inclusion of nano-particles as additive to MBD25 fuel test, BTE is expanded than ithe diesel and MBD25 fuel. This is because of the expanded oxygen accessibility to the inclusion of Alumina particles with the bio-diesel mix. Brake thermal proficiency of MBD25 with 20% of EGR was diminished by 7.8% contrasted with the MBD25fuel test because of the lower oxygen content noticeable all around causes decrease in brake warm effectiveness. For MBS25AONP with 20% of EGR, .fuel BTE is decreased by 7.2% and 2.6% than the MBD25AONP fuel and diesel sample fuel tests and expanded by 3.3% than MBD25 fuel sample.

4.1.b. BSFC

Figure 4 illustrates the variations in Brake specific .fuel Consumption (BSFC) with Change in load for the diesel fuel, MBD25 fuel, MBD25AONP fuel, MBD25 with 20% of EGR and MBD25AONP with 20% of EGR fuel sample. BSFC of the MBD25 fuel sample is increased by 4.5% in comparison to the diesel fuel due to low heating value and the higher viscosity. BSFC of the MBD25AONP fuel is reduced by 6.24% in comparison to that of MBD25 fuel. Mixing iof nano additive particles to bio-diesel blend, promotes combustion with the effect of catalytic reaction. For MBD25 fuel .blend with 20% of EGR mode, the BSFC is increased by 5.3% to that of MBD25 fuel blend. With the modification of EGR, less oxygen availability in the induced air causes to reduction in the combustion quantity of fuel. For the fuel sample MBD25AONP + 20% of EGR, the BSFC is raised by 4.2% & 8.5% to that of MBD25AONP fuel & diesel fuel .respectively at Max load condition.

Figure 4: Variations of Bsec with Varying Load %.

4.2. Engine Emission Analysis

4.2. a. CO in Exhaust Gases

Figure 5 represents the Change in CO emissions with the varying loads for diesel, MBD25, MBD25AONP, MBD25 with 20% of EGR and MBD25AONP with 20% of EGR. Due to the affluent oxygen content in MBD25 bio-diesel fuel CO emissions were lower than that of diesel sample. With the insertion of alumina nano additive to the bio-diesel blend, the ignition delay diminishes and the combustion process improves. By the addition of alumina particles to the MBD25 bio-diesel blend, the CO emissions were diminished by 10.1% in comparison to MBD25 fuel sample. It is also identified that the CO emissions are raised by 13% with the cause of EGR mode for the MBD25 fuel. In addition to that, CO emissions were raised by 4% & 11.2% for MBD25 fuel & MBD25AONP fuel samples and decreases by 5.3% for the MBD25 with 20% of EGR fuel in comparison to the MBD25AONP with 20% of EGR fuel.

Figure 5: Variations of CO Emissions with Change in Load %.

4.2. b. HC in Exhaust Gases

Figure 6 illustrates the changes in HC emissions with the change in load. With the cause of higher cetane number for the MBD25 bio-diesel blend leads to better combustion, It is noticed that the HC emission was lowered to that of diesel fuel. The UHC emissions was reduced by 9.3% with the doped alumina nano-particles to the MBD25 bio-diesel in comparison to the MBD25 bio-diesel fuel blend due to the less carbon molecules activated temperatures and enhances the combustion. With the use of EGR modification, the oxygen presence is less and caused poor combustion & it leads to the formation of Hydro Carbon emissions. By the insertion of alumina particles as additives to the bio-diesel blend & using EGR mode the HC Emissions are increased for MBD25 fuel sample, MBD25AONP, & MBD25 + 20% EGR fuel samples.

Figure 6: Variations of the HC Emissions by Changing in Load %.

4.2. c. NOx

Figure 7 exhibits the variations in NO_x emissions by varying loads for diesel fuel, MBD25 fuel, MBD25ANP fuel, MBD25 with 20% EGR, MBD25AONP with 20% of EGR. The iNO_x emissions by using all the tested fuels were increased with a rise in the load because of improvement in the Combustion temperature at Maximum loads conditions.

Figure 7: Variations .of NO_x Emission with Varying Load %.

It is observed that the development of the NO_x emissions for the MBD25 bio-diesel blend is greater than the Diesel fuel sample due to the high flame temperature. The insertion of alumina particles to MBD25 fuel NO_x Emissions were raised by 4.5% bio-diesel than the MBD25 fuel because of added catalytic reaction by the nano-particles additive. The NO_x emission was increased by 12.5% by the use of EGR to the MBD25 fuel compared to that of MBD25 fuel.

4.2.4. Smoke Opacity

Figure 8 illustrates the variations in Smoke opacity with changing in load. For MBD25 fuel sample the smoke opacity was less than the diesel fuel due to the more availability of oxygen contents in bio-diesel and results in enhanced combustion. The smoke emissions were reduced by 5.1% with the blending of Alumina particles to MBD25 fuel in comparison to the MBD25 fuel. The shorter delay in the first phase of combustion and the prominent air- fuel mixing with the association of nano-particles leads to improved combustion and it causes reduced smoke opacity. Smoke emissions are raised by 4.2% with the use of EGR mode to the MBD25 fuel in comparison to the MBD25 fuel without the modification of engine with EGRi. For MBD25AONP fuel with 20% of EGR, the Smoke emissions were increased by 2.7%, 7.5% & 9.1% in comparison to the MBD25 fuel, MBD25 with 20% EGR, and MBD25AONP fuel, respectively.

Figure 8: Variations of Brake Thermal Efficiency(BTE) with Varying Load %.

5. CONCLUSIONS

The results obtained with the experimentation on a diesel engine using different fuel samples and the EGR modification are listed below:

- BTE for the fuel MBD25AONP is raised by 5.3 % and 7.5% compared to the MBD25 and MBD25AONP + 20% of EGR fuels, respectively. The BSFC of MBD25AONP fuel decreases by 6.25 % and increased by 4.1% compared to the MBD25 fuel and MBD25AONP with 20% of EGR.
- CO emissions for the engine were decreased for the MBD25AONP sample by 6.5% in comparison to the MBD25

fuel sample& the HC emissions also decreased, compared to that of MBD25 fuel usage.

- NO_x emissions from the engine were downed by 7.36% for the fuel sample MBD25AONP to that of MBD25 fuel. For fuel MBD25AONP +EGR., the NO_x emissions were 8.9% downed in comparison to the MBD25 fuel.
- Smoke opacity emissions were reduced for the MBD25AONP fuel by 6.5% to that of MBD25 fuel. And for the fuel MBD25AONP with the use of EGR smoke was increased by 2.7% to that of MBD25 fuel.

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