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PERFORMANCE AND EMISSION EFFECT OF NANOFUEL ADDITIVES FOR BOIDIESEL-DIESEL IN DIESEL ENGINE – A REVIEW STUDY

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Abstract: This article is a literature review of the effect of different fuel additives on performance and emission characteristic of CI engine fuelled with blend of nanoparticles and diesel. This study is based on the reports of researchers who published their researches. It was reported that metal based additives improves emission and performance of a diesel fuel depending upon rate of additives. Use of multifunction additives for diesel will lead better fuel conservation and emission control takes place. Engine performance values changes little bit, but exhaust emission profile was improved. The addition of cerium oxide nanoparticles, with the modified biodiesel at different dosing levels of the additives showed an improvement in the efficiency of the engine. HC emission and NOx emission were reduced with the use of fuel based additives.

1. Introduction

Nanofuel is a renewable and eco friendly alternative diesel fuel for CI engine. Nanofuel has higher viscosity, density, pour point, flash point and cetane number than diesel fuel. Using optimised blend of nanoparticles and diesel can help to reduce some significant percentage of the worlds dependence on fossil fuels without modification of CI engine. Moreover additives are an essential part of today fuels, together with the carefully formulated fuels composition. They contribute to efficiency reliability and long life of an engine Such as using optimised blend of nanoparticles and diesel instead of conventional diesel fuel significantly reduces emission of particulate matters (PM), carbon monoxide (CO), sulphur oxides (SOx), and unburned hydrocarbons (HC). With the use of fuel additives in the blend of nanoparticles and diesel improves performance, combustion and also improves fuel properties which enhance the combustion characteristics.

2. Effect Of Nanoparticles On The Performance And Emission Characteristics Of The Engine.

2.1 Engine Performance.

Researchers and scientist have used different nanoparticles additives in diesel fuelled in CI engine. A brief study of the effect of these fuel additives is presented here. Many researchers have reported that the performance of the mixture of nanoparticles and diesel is higher when additive is used. Ajin C. et al [1] investigated that the use of cerium oxide nanoparticles in diesel engine. A single cylinder four stroke water cooled CI engine was used in test. The researchers found that the flash point decreases in volatility of fuel with addition of nanoparticles. Higher flash point temperatures are desirable for safer handling of fuel. Addition of catalytic nanoparticles in fuel increases its flash point. Nanoparticle added fuel inherently safer to handle as compared to its base diesel. BTH increases by 6% on addition of cerium oxide nanoparticles. Kinematic viscosity increases with catalytic nanoparticles addition in fuel. S. Karthikeyan et al [2] investigated that the use of ZnO nanoparticles Grape seed oil methyl ester. A single cylinder vertical air cooled diesel engine is used in the test. In this test researchers found that BSFC values of fuel decreases with increase in load. As ZnO proportion is increased BSFC of fuel decreased at each load. Also reduction in ignition delay period is observed. Because of high surface to volume ratio BTH of fuel is enhanced. Nishant Mohan et al [3] observed the use of aluminium in base diesel. The test is carried out on single cylinder four stroke constant speed DI diesel engine. They found that the drop in SFC at higher loads when engine was fuelled with nanofuel. Reduced ignition delay and high CV of nanofuel further generate same work intensity with low consumption of fuel than diesel. It shows better thermal efficiency at higher loads. Nanoparticles addition not only enhances the CV but also promotes complete combustion due to high evaporation rates, reduced ignition delay, higher flame temperature and prolonged flame sustainance. All these factors support increase in BTH. At high loads enhancement of 9% in BTH has been observed. C. Syed et al [4] investigated the use of Aluminium nanoparticles in

Mahua biodiesel. The test is carried on single cylinder four stroke diesel engine. They found the reduction in SFC at maximum load by 7.66%. A gain of 1.58% and 7.34% in BTH was recorded. R. Sathiyamoorthi et al [5] investigated the use of BN20 and CeO2 blended BN20 (biodiesel from neem oil). The test is carried on single cylinder direct injection diesel engine. They found that because of lower CV of BN20 increase in BSFC for BN20 fuel blend. BSFC for CeO2 added BN20 is increased than BN20 fuel. It is due to lower CV of biodiesel blends. S. Karthikeyan et al [6] investigated the use of doped nano additives methyl ester nanocatalyst prosopis juliflora seed oil. A single cylinder four stroke air cooled direct injection diesel engine is used in the test. In this study for nanoparticles short delay period is observed. Improved combustion seemed in the engine. L. Jeryrajkumar et al [7] investigated the performance of calophyllum inophyllum methyl ester with additives like B100Co3O4 and B100TiO2 and the test is carried on single cylinder four stroke diesel engine. They found that the Co3O4 and TiO2 nanoparticles upgrades the BTH. they showed 7% increase in BTH. While the BSFC of the fuel seemed lower with nanoparticles at all loads. Co3O4 with biodiesel resulted 4% reduction in BSFC and TiO2 showed 2% reduction.

2.2 Emission Characteristics

Ajin C. et al [1] observed that HC emissions were decreased on addition of catalytic nanoparticles by 40% to 45%. It also showed increase in reduction of HC with increased concentration of CeO2. CeO2 as an oxidation catalyst also lowers the carbon combustion activation temperature and thus enhanced HC oxidation. At higher loads CeO2 showed decrease in NOx emission by 30%. S. Karthikeyan et al [2] observed the decrease in CO emission, improves air fuel mixture. It considerably showed increase in NOx emission due to cylinder peak pressure, short delay period. Smoke emission is decreased due to quick delay period, quick evaporation rate. Nishant Mohan et al [3] investigated the lean combustion of fuel leads a drop of 8% in HC emission with nanofuel at high loads. NOx emission increases at higher loads when engine is fuelled with nanofuel, it is caused due to higher loads, burning temperatures in combustion chamber increased with load. NOx emission increased by 5%. C. Syed et al [4] investigated that due to use of Aluminium nanoparticles additives CO emission increases. CO decrements about 26% and 48% is observed. R. Sathiyamoorthi et al [5d] investigated that CO emission is reduced for all blends of biodiesel from neem oil. It is reduced by 3.4% for CeO2 added BN20. HC emission for CeO2 nanoparticles added biodiesel decreased by 2.7% than BN20. While NOx reduction by 8.4% is observed by use of CeO2. S. Karthikeyan et al [6] investigated that HC emission was lower than B20. Smoke emission was less than base diesel. L. Jeryrajkumar et al [7] observed that Co3O4 showed 30% reduction in CO at initial load. TiO2 showed 25% increase in CO emission at full load. HC emission of pure biodiesel decreased on addition of nanoparticles at all loads.

3. Conclusions

From the study of additives in CI engine it is found that, there is benefit of adding nanoparticles in diesel fuel. It showed improved Brake power, BSFC, BTH and reduced emission of CI engine. It also showed the reduction in harmful exhaust such as particulate matter (PM), hydrocarbon (HC), carbon monoxide (CO), sulphur oxide (SOx). From this review indicate that there is further scope in experimental investigation in direction of improvement of performance, reduced emission characteristics and it saves large amount of fossil fuels.

4. Abbreviation

CI – Compressed Ignition

PM- Particulate Matter

HC- Hydrocarbon

CO- Carbon Monoxide

CeO2- Cerium Oxide

BTH- Brake Thermal Efficiency

SFC- Specific Fuel Consumption

BSFC- Brake Specific Fuel Consumption

CV- Calorific Value of Fuel

BN20- Biodiesel from Neem Oil

Co3O4- Cobalt Oxide

TiO2- Titanium Dioxide

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