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A Review on Compression Ignition Engine fuelled with Biodiesel-nanoparticles

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Abstract: *Fossil Fuel crises and rise of prices of crude fossil oil has alarmed the various researches to find need for alternate fuel. To the current situation Biodiesel serves a promising alternative fuel which possesses the characteristics of fossil Diesel. In Current paper the enhancement in performance and emission standards of CI engine using Biodiesel-nanoparticles is discussed. Nano technology in plays an important role in such operations of enhancement where the particles own high surface area to volume ratio.*

Key Words: Nanoparticles, Diesel Engine, Performance, Emissions, Biodiesel

1. INTRODUCTION

Biodiesel is a possible alternative fuel to diesel engine having renewable nature. Biodiesel is basically oxygenated oil comprising 10–15% oxygen (weight basis). Various investigators have found that combustion of biodiesel in CI engines has lesser emissions like Carbon Monoxide (CO) and unburned hydrocarbons (HC) when compared to fossil diesel. It is also found combustion of biodiesel in CI Engine shoots the values of Brake Specific fuel consumption and Oxides of Nitrogen (NOx) emission [12, 13, and 14]. Also, this alternate fuel bears lesser calorific value in comparison to diesel. In order to enhance the performance characteristics and reduce emission a new level of research has come up where diesel-biodiesel blends are mixed with nanofuels additives. These nanofuels additives are found to enhance engine performance, combustion characteristics and also improve fuel properties which indirectly improve the engine's combustion characteristics. These nanofuels sponsors complete combustion by greater evaporation rates, flame temperatures and flame sustenance. This results in improved Brake thermal efficiency and reduced brake specific fuel consumption [10].Also inculcation of nanofuels especially nanometal oxides provide catalytic effect in reducing combustion product of hydrocarbons. Also these oxides change the cetane values affecting the burning process inside the combustion chamber [11].

1.1 Nanotechnology in diesel engine

The Nanoparticle have high surface to volume ratio due to which high possibility to be used in compression ignition engines as a partial mixture. As biodiesel is promising alternative to CI engine, Nanoparticles can be embedded in fuel to enhance thermo physical properties. Basically, Nano particles are to be converted to emulsion/fluid form where the use of surfactant and solvent is necessary. The use of Surfactant brings stability and solvent to dissolve the Nano particles. The derived mixture is checked for Miscibility test and later poured for performance and emission testing. These Nano-fuel acts a secondary atomization media in promoting combustion of alcoholic esters. These nano fuels also increment evaporation rates, retards ignition delay and improves net heating value

with bio-diesel reduces all types of pollutions and fuel consumption with increasing the power of the diesel engine. It does not harm the fuel system of the engine because it becomes homogenous mixer in fuel. Diesel engine does not require any change in the engine This reduces the amount of pollution caused by the combustion.

2. Literature Survey

K. Srinivasa Rao et al. [1] premeditated the performance of diesel engine using diesel and biodiesel mixture in Addition of cerium oxide nanoparticles. These nanoparticles were added to the bio-diesel (B20) and pure diesel and were mixed at different concentration of 20, 40 and 60 ppm to the B20 biodiesel. It was detected that BTE was increased with all the nanofuels from B20. Results concluded that cerium oxide acted as oxygen buffer and decreases the both CO and NOx emissions.

Yu Ma et al. [2] investigated the results of test performed on single cylinder four stroke compression ignition diesel engine at 2800 rpm and 3200 rpm engine speeds. The results were schemed against the BMEP. Results determined that 3.7% BSFC decreased at 3200 rpm and 0.14 MPa BMEP for FTC-D than reference diesel. Using pi-crate solution maximum reduction observed of 21.1%, 39.5% and 13.1 in case of emissions of CO and Particulate matters and UHC. But there is no positive effect in NOx emissions but the little increment in NOx emission.

Ajay Kumar et al. [3] accounted that without compromising with performance characteristics of diesel engine water/diesel emulsion decreases the emissions. Nanofluid was studied for cracking the problem next generation fuel. By use of nanofluid for cylinder four stroke diesel engine combustion efficiency, fuel properties and ignition delay were improved. He had stated that cerium oxide nanoparticles can also be used with water /diesel emulsion to improve the efficiency of diesel engine.

Gurinder Singh et al. [4] enactment of an emission characteristics of the of CI engine using bio-diesel with additives of nano fluid were studied. There is no improvement in performance were observed, but shown decreased emission factors, especially in Sox, CO and CO2 excluding NOx. Nanoparticle added fuel to improve the emissions and performance of CI engine due to the optimistic effect of Nano fuels on the fuel properties. Dosing of nanoparticles to diesel and diesel-bio-diesel blends improve the calorific values and provides complete combustion due to higher evaporation rates, less ignition delay, higher flame temperatures and prolonged flame provisions.

Hani Chotai et al. [5] analyzed the performance and emission characteristics of diesel-ester blends on Single cylinder DI VCR CI engine. Author highlights effect of compression ratio on BTHE, SFC, CO, smoke emission and EGT. Results showed that BSFC was higher at lower CR. They concluded that BTHE increased as load was increased on the engine. Exhaust gas temperature increased with increase in compression ratio.

Mehardad Mirzajanzadeh et al. [6] performed experiments at 1000 rpm, 1200 rpm, 1400 rpm, 1500 rpm, 1600 rpm, 1800 rpm, 2000 rpm and 2200 rpm bearing full load condition. They observed 1500 rpm offers maximum torque. Experiments were done using two bio-diesel blends B5 and B20 with 30ppm, 60ppm, and 90 ppm concentrations were added to the blends. Performance, results showed that power and torque was upgraded by 7.81% and 4.91% respectively for the B20 with 90 ppm absorption when compared to B20. The fuel consumption cut to 4.50% for the B20 with 90 ppm blend compared to B20. CO, NOx, soot and HC were reduced by up to 38.8%, 18.9%, 71.4% and 26.3% in B20 with 90 ppm as compared to pure B20.

C. Syed Aalam et al. [7] 25 % zizipus jujube methyl ester mixed with diesel and inspected fuel for performance. Further Aluminum oxide nanoparticles also supplied by using mechanical Homogenizer at concentration of 25 ppm and 50 ppm. After the test found that HC emissions were decreased from 13.459 g/kWh and smoke from 79 HSU to 8.599 g/kWh and 49 HSU with the accumulation of aluminum oxide nano-particles.

V. Arul Mozhi Selvan et al. [8] analyzed the burning, performance and emission individuals of VCR engine using Cerium Oxide Nano fuel and Carbon Nanotubes which were mixed with Diesterol, at 25 ppm, 50 ppm and 100 ppm each. Bio diesel used for study was Castor oil bio-diesel and the bridging agent for Diesel and Ethanol. Optimum Results were obtained at CR=19:1, After performance results revealed Carbon Nanotubes decreases ignition delay and advances the ultimate heat discharge rate whereas Cerium Oxide donates oxygen molecules helping oxidation and reduction of CO and NOx respectively. It is also found that Cerium Oxide delivers extra energy to burn off carbon deposits inside cylinder.

G. R. kannan et al. [9] inspected the use of ferric chloride (FeCl3) as a fuel borne catalyst (FBC) to waste cooking palm oil based bio-diesel. Some metal based additive were mixed with bio-diesel for experiment the amount of dosage was 20µmol/L. To study the effect of ferric chloride added to bio-diesel on performance, emission and combustion characteristics experiment were perform on a direct injection diesel engine at 1500 rpm at different working condition showed reduced BSFC of 8.6% whiles BTE improved by 6.3%. new fuel shows lesser NOx emission and slightly greater CO2 emission as compared to diesel CO

3. CONCLUSIONS

Biodiesel being a possible source to power CI engine has to adhere to the performance, Emission and combustion phenomenon of Diesel fuel. The basic area of concentration while using biodiesel/Methyl ester being the Thermal efficiency and Nitrous Oxide Emission. Introduction of Nano Technology brings the required changes making some changes in the emission and performance standards of biodiesel. As Nanoparticles are immiscible in Oxygenated esters, surfactant promotes the mixing of Nano Sized particles in Biodiesel. These so called Nano fuel-Biodiesel blends are found to enhance the Brake thermal efficiency. Inclusion of particle reduces the Specific Fuel Consumption, Carbon monoxide and Unburnt Hydrocarbon emission. It is also found that the Oxides of nitrogen emission are found to shoot up a little bit which can in future reduced by after-cylinder treatment like EGR, SCR etc. Usage of Nanotechnology in Biodiesel Blends increments cylinder combustion pressures which is an indication of secondary atomization. Also the Heat Release Rate found during in-cylinder burning is recorded to be high.

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