REVIEW PAPER ON BIO DIESEL ON NANO PARTICAL

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Abstract

The increasing efficiency of the combustion of fuel and reducing the emission produced by the diesel is the main objectives of the many research. Much research has been taken up on biodiesel as a alternative fuel in CI engine to increase the performance and reduce the emission. One such way of improving the performance and reduce the emission is adding nanoparticles as a fuel additives in biodiesel. Nano particle additives have been utilized in fuels for some time and have been shown to dramatically increase in combustion enthalpies and quality. A review on the latest work on nanoparticles as a fuel additive in biodiesel has been done in this paper.Two different nanoparticle additives, namely MgO and SiO2, were added to biodiesel at the addition dosage of 25 and 50 ppm. Fuel properties, engine performance, and exhaust emission characteristics of obtained modified fuels were examined. As a result of this study, engine emission values NOx and CO were decreased and engine performance values slightly increased with the addition of nanoparticle additives.

Keywords:*Nanoparticle, Fuel additives, Fuel properties, Engine performance, Exhaust emissions,Nano additive, Nano additive.*

Introduction:

The major source of energy comes from fossil fuels which satisfy more than 90% of the world energy demand.

Because of the excessive consumption of fossil fuels that results in greenhouse gas emissions, the mankind is faced with global warming. The current global problem is also limited fossil fuels sources. The experts predict that available sources of fossil fuels will run out by 2050 because their consumption is 105 faster than their natural production while the world energy demand will reach 30 TW . Therefore, the renewable energy sources gain more attention. According to expectations their use will provide the 50% of global energy by 2040 and reduce the greenhouse gas emissions up to 70%.[1]

Among the inexhaustible energizes, biodiesel has a significant position. Not just it tends to be created from across the board BioSource's, for example, vegetable oils, creature fats and algal lipids, yet additionally it is nontoxic and biodegradable and has high flash point, great grease properties and low gas discharge with no sulfur and cancerogenic mixes amid ignition. What's more, utilized and squander oils and fats from families, eateries and nourishment industry can likewise be utilized as crude materials, which add to the decrease of biodiesel generation cost and help comprehending the waste transfer. Biodiesel can be utilized as added substances to non-renewable energy source and as a 100% fuel. Its application as an added substance does not require any modification of the current diesel motor while as a 100% fuel does yet not significant. As per the standard, biodiesel is a blend of unsaturated fat methyl esters acquired by the catalyzed or uncatalyzed response between triacylglycerols (TAGs) or free unsaturated fats (FFAs) and a short chain liquor (mostly methanol or ethanol), which fulfill the endorsed quality specifications. [1,4]

For the catalyzed response, the different kind of impetus can be utilized – homogeneous or heterogeneous impetuses. The right now actualized advances for biodiesel generation depend generally on homogeneous base catalysis. The noncorrosive and naturally amicable nature of heterogeneous impetuses and the likelihood to be effectively isolated from items and reused with or without recovery make them progressively helpful for the biodiesel creation contrasted with homogeneous impetuses.[4,5] Be that as it may, there are a few confinements for their business application like the perplexing strategies for their union and difficulties in taking care of amid application on extensive scale plants.

Calcium oxide (CaO) itself, as cheap, easily available, noncorrosive, environmentally friendly, easy to handle material with low solubility and high basicity that can be regenerated and reused, is one of the most used solid catalyst for transesterification reaction of different feedstocks to biodiesel, which has been already proved as a highly efficient catalyst for biodiesel synthesis. All these advantages draw the attention of many researchers for further investigations of CaO aiming at the improvement of its overall properties. A way to improve the catalytic activity of CaO is to increase its specific surface by preparing it in the Nano–form.

The use of Nano catalysts has recently been the focus of numerous researches related to biodiesel synthesis. Nano catalysts represent the nanomaterials or nanocrystals with the particle size in the range of 1-100 nm. The particularly large specific surface area and high catalytic activity are their favorable properties for application inheterogeneously–catalyzed biodiesel synthesis. Many researchers have tested Nano CaO as a catalyst for biodiesel synthesis.

This paper gives an overview of the preparation of Nano–sized CaO–based catalysts and their application in the biodiesel production as heterogeneous catalysts. In line with this, the paper summarizes the current status of Nano CaO–based catalysts, indicates their promising capability in biodiesel production and identifies the future opportunities in this research area. The main aim of this paper is to estimate the possibility of performing the heterogeneously catalyzed oil alcoholics by Nano CaO–based catalysts through the analysis of the influence of different operating conditions (water and FFA contents in raw materials, catalyst amount, type and concentration of impregnated ion, reaction temperature, type of alcohol, molar ratio of methanol to oil and use of cosolvents) on biodiesel yield. First, the importance of the application of Nano–materials in the catalytic processes is shortly described. After presenting the benefits and drawbacks of biodiesel synthesis over Nano–sized CaO–based catalysts, their preparation and activation are discussed. Then, the application of different forms of Nano CaO catalysts (neat, doped, loaded and waste) in the conversion of various oily feedstocks into biodiesel and the influence of different reaction conditions on biodiesel yield are explained.

Nanoparticles as Fuel Additives

Metal-based additives i.e. nanoparticles with diesel and biodiesel fuel can develop the fuel properties and deal with the problems of imperfect combustion and exhaust emissions.Catalytic effect is the key theory of metal-based additives which act as combustion catalysts to step up the combustion, reduce fuel consumption and emissions for hydrocarbon fuels. [1]

Different metal-based added substances utilized are cerium (Ce), cerium– iron (Ce– Fe), platinum (Pt), platinum– cerium (Pt– Ce), iron (Fe), manganese (Mn), barium, calcium and copper. Metal based added substances, for example, Nano CuO, CuCl2, CoCl2, FeCl3 and CuSO4 are each so every now and again utilized as fuel borne impetuses (FBC) for biodiesel. It was seen that, expansion of FBC in biodiesel have the extraordinary impact on the Brake power, SFC and outflows execution as a result of raised the barrel gas weight and warmth discharge rate with lower start delay at improved working conditions.[1,4]

Metal-based additives are also effective to reduce emission either by mixing with water to create hydroxyl radicals that enhance soot oxidation, or react directly with carbon atoms in the soot, hence falling the oxidation temperature. Whereas, addition of FBC to biodiesel showed a slight increase in NO and CO2 emission at optimized operating conditions.

Material Method

The fuel utilized for the present examination is a biodiesel item (rapeseed methyl ester), got from rapeseed oil. The fuel added substance utilized in this examination is oxygen containing nanoparticles given in the Table 1, as industrially accessible nanoparticle size of 10 to 30 nm. The dosing dimension of the nanoparticle tests (by weight) in the base fuel was 25 and 50 ppm. The required amount of the nanoparticle test required for each dosing dimension was estimated utilizing an accuracy electronic offset and blended with the fuel by methods for a ultrasonic processor, applying a consistent disturbance time of one hour to create a uniform suspension. The modified fuel was used following arrangement, so as to keep any accelerate or for sedimentation to happen.[1,3]

The analysis of test fuels was conducted at the Çukurova University Mechanical Engineering Department Automotive Engineering Laboratories. Fuel properties as density, viscosity, flash point, and pour point of the test fuels were determined accordingtostandardtestmethods.TanakaMPC-102Ltypepour point analyzer with an accuracy of±1◦C for pour point; Tanaka AKV-202 type automatic kinematics viscosity meter with an accuracy of ±0.01 mm2/s for determining the viscosity; Kyoto Electronics DA-130 type density meter with an accuracy of ±0.001 g/cm3 for density measurement, Tanaka APM-7 type flash point analyzer with an accuracy of ±0.5◦C for flash point measurement was used for analyzing the test fuels.

Table 1. Technical Specifications of Test Engine[3]

Brand	Mitsubishi Canter
Model	4D34-2A
Type	Direct injection diesel with glow plug
Displacement	3907 cc
Bore	104 mm
Power	89 kW @ 3200 rpm
Stroke	115 mm
Configuration	In line 4
Oil Cooler	Water cooled
Weight	325 kg
Torque	295 Nm @ 1800 rpm

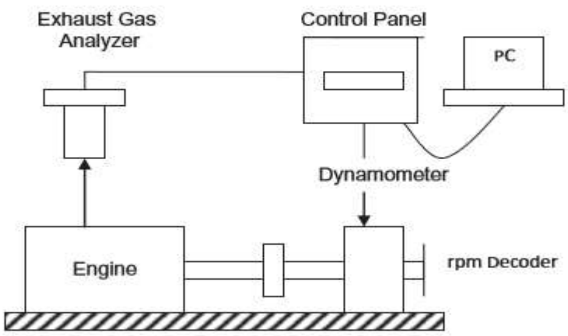

figure.1.Schematic representation of the experimental setup[3]

Engine performance tests were conducted on a commercial fourcylinder,four-stroke,naturallyaspirated,water-cooleddirectinjection compression ignition engine. Technical specifications of engine were presented in Table 1.

ANetrin brand hydraulic dynamometer was used for loading the test engine and TESTO 350 XL gas analyzer was used to measure exhaust gas emissions. Emission data were collected by the help of a computer program.

The automatic calibrated Testo 350-XL has a measurement sensitivity of 1 ppm for CO, 0.1% for CO2, and 1 ppm for NOx. Measurement range of Testo 350-XL gas analyzer is 0–10000 ppm for CO, 0–50% for

CO_2, and 0–4000 ppm for NOx emission. Accuracy of measured data is ±10 ppm for CO, ±0.5 Vol. % for CO_2 and±5 ppm for NOx emission.

Schematic representation of the experimental setup was presented in Figure 1. Before the tests, the engine was operated for enough time with diesel fuel to reach the operation temperature. Test fuels were tested from 1200 to 3200 rpm with an interval of 200 rpm at full load condition.

Results and Discussion

Engine Performance

Brake control versus motor speed of biodiesel and modified biodiesel with various dosing dimensions of the added substance is appeared in Figure 2. Brake control esteems usually expanded with the expansion of SiO_2 and MgO Nano molecule stockpiling methyl ester fuel. The addition is higher at higher motor paces (somewhere in the range of 2000 and 2800 rpm). The most extreme brake control increment as indicated by RME fuel result is 4.2% and 4.8% for the modified energizes at the nanoparticle expansion dose of 25 and 50 ppm SiO_2, 6.8% and 4.4% for the 25 and 50 ppm MgO, individually. The most extreme normal brake control increment is 2.4% as per base fuel (RME fuel) at the expansion measurement of 25 ppm MgO.

Torque versus engine speed of biodiesel and modified biodiesel with different dosing levels of the additive is shown in Figure 3. Torque values mostly increased with the addition of SiO_2 and MgO nanoparticles to rapeseed methyl ester fuel. The maximum torque values for all fuels were obtained at engine speeds of 1800–2000 rpm. The maximum torque increase according to RME fuel result is 3.6% and 4.3% for the modified fuels at the nanoparticle addition dosage of 25 and 50 ppm SiO_2, 5.8% and 4.5% for the 25 and 50 ppm MgO, respectively.The maximum average torque increase is 2.3% according to base fuel (RME fuel) at the addition dosage of 25 ppm MgO.

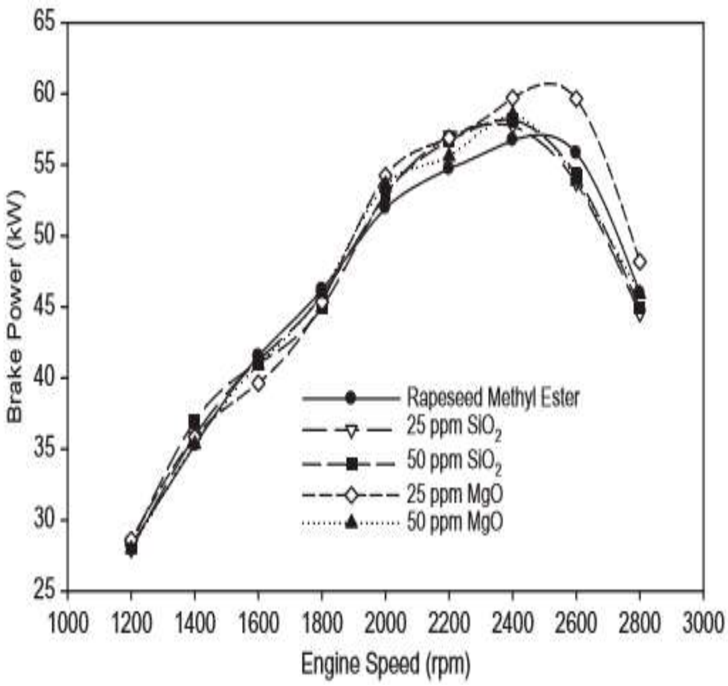

Figure. 2. Brake power versus engine speed of biodiesel and modified biodiesel with different dosing levels of the additive.[3]

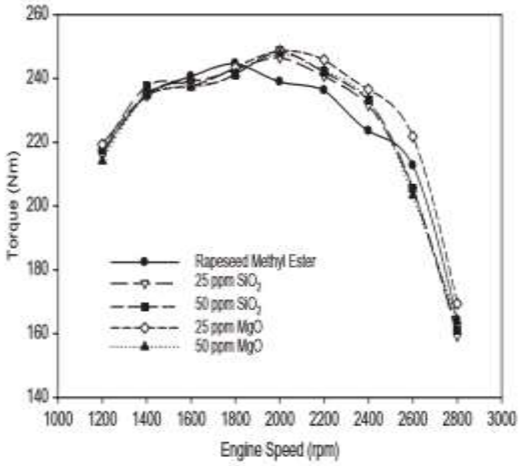

Figure. 3. Torque versus engine speed of biodiesel and modified biodiesel with different dosing levels of the additive.[3]

Fuel Properties

Density,viscosity,flashpoint,pourpointcharacteristicwas tested according to standards. Fuel properties of RME (base fuel) and modified RME fuels were given in Table 3. Also European biodiesel standard EN 14214 was given in Table 2.

Table 2. Fuel Properties of RME and Modified RME Fuel [3]

Property	Density 15◦C	Viscosity at 15◦C	Flash Point	Pour Point
Units	kg /m3	mm ^{2}/s	◦C	◦C
EN 14214	860-900	3.5-5.0	Min 120	Summer < 4.0 Winter < –1.0
RME	896	5.01	>180	–9
25 ppm SiO2	895	4.86	>180	–8
50 ppm SiO2	896	4.84	>180	–8
25 ppm MgO	896	4.87	>180	–8
50 ppm MgO	8.95	4.83	>180	–8

Expansionof various measurements of SiO2 and MgO nanoparticles has no detectable impact on thickness estimation of rapeseed methyl ester (RME) fuel. Consistency of RME fuel was diminished with the expansion of SiO2 and MgO nanoparticles at the measurements of 25 and 50 ppm. Consistency estimation of the RME fuel was diminished with the expansion in the added substance dose of SiO2 and MgO nanoparticles. Thickness affects fuel atomization, the fuel with lower consistency will in general structure littler beads on infusion, which can lead better ignition and diminished fumes discharges. Consistency aftereffects of modified fills are in the adequate scope of European biodiesel standard EN 14214.[3]

The temperature at which precious stone arrangement is broad enough to avert free pouring of fluid is dictated by estimation of its pour point (PP). On the off chance that pour purpose of a fuel isn't low enough, a few worries with putting away, exchanging can happen. Pour purpose of the RME fuel was somewhat expanded with the expansion of SiO2 and MgO nanoparticles. Pour point was recorded as –8◦C for all modified fills. This demonstrates the expansion of SiO2 and MgO nanoparticles little affects the chilly temperature properties of RME fuel.

Conclusion:

The principle objectives of this review was to determine performance and emission characteristic of nanoparticles as fuel additives in biodiesel from the recently available literature. The major findings in this paper are summarized as follows.

1. The use of Nano-additives not only improves the mechanical performance of diesel engine, but also reduces the emission level of all pollutants (NOx, UHC and CO and smoke opacity) in the exhaust gaseous due to its catalytic effect on the fuel combustionprocess, particularly in comparison with the effect of biodiesel-diesel mixture

2. Many of the researcher found that the heat release rate, break thermal efficiency increases with the use of Nano-additives in comparison with the biodiesel diesel mixture.

3. Thermal efficiency, heat release rate increases linearly with increase in the percentage of Nano additive in biodiesel.

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