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Investigation of grape seed oil biodiesel with cerium oxide nanoparticle in CI engine

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ABSTRACT

Because of increasing automobiles, power plants and factories, increasing of this automobiles, power plants produce the more emissions like CO, HC and NOx. So that the world is searching for the alternative fuel, which will not create any harm to the environment and also it would be less in cost. Biodiesel is one of the main solutions to the global energy crisis. In this present work studied the performances and emission characteristics of Grape Seed Oil Bio-diesel (GSO). Use of additives for better combustion characteristics to the biodiesel. The blends of Grape Seed oil (GSO) with the additives Aluminum oxide are B10 + 20 PPM CeO_2, B20 + 20PPM CeO_2, B30 + 20 PPM CeO_2. This blends were analyzed and their performance and emissions characteristics compared with performance and emission characteristics of diesel. Tests were carried out over entire range of engine operation at varying conditions of load. The engine exhaust gas emissions are reduced with increase biodiesel concentration.

Selection and peer-review under responsibility of the scientific committee of the International Conference on Newer Trends and Innovation in Mechanical Engineering: Materials Science.

1. Introduction

In the context of fast depletion of fossil fuels and ever increasing diesel vehicle population, use of renewable fuels like vegetable oils has become pertinent steady with the estimation the International Energy Agency, by 2025 global energy utilization will increase by about 42%. Many research works are going on to substitute the diesel fuel with appropriate alternative fuel such as bio diesel. Bio diesel are best alternative for the diesel vehicle and it is easy to produce from the seeds and flowers.

It has made an endeavor to discover the appropriateness of Trans esterified mahua oil as a fuel in C.I. motor. Trial work was done on 7B.H.P single chamber four stroke and vertical, water cooled Kirloskar diesel motor at evaluated speed of 1500 rpm various mixes of trans esterified mahua oil with diesel were tried at 200 bar infusion pressure. Slight increment in brake warm productivity and diminishing in explicit fuel utilization is seen on account of esterified mahua oil (all mixes particularly 75% mahua oil) contrasted with that of diesel [1–3]. Talked about the non-sustainable power sources are draining at higher way so there is more vitality request. Biodiesel is a trade for diesel fuel in packed start motors because of its noteworthy natural advantages. The utilization of biodiesel prompts decreases in PM, HC and CO discharges and the expansion in fuel utilization and the increment in NOx emanation on diesel motors with no change. The expansion of nano particles in biodiesel builds the warm proficiency and diminishes the NOx outflow [4–6]. assessed the impact of added substances (diethyl ether) and nano added substances (cerium oxide) in the mango seed oil methyl ester (MSME) biodiesel on motor execution, ignition and emanation attributes of four stroke direct infusion diesel motor. The brake thermal efficiency (BTHE) is improved with expansion of diethyl ether and cerium oxide. The brake explicit fuel utilization (BSFC) and fumes gas temperatures (EGT) are diminished.

[7] Explored the impact of Alumina Metal Oxide (Al2O3) Nano Particles as added substance for Palm Stearin Methyl Ester Biodiesel (B 100) and their mixes as a substitute fuel in four stroke single chamber water cooled, direct infusion diesel motor. The NOX outflows were diminished by 9.70% for 50 ppm alumina nano molecule mixed with palm stearin methyl ester contrasted with diesel [8]. Discussed about the effect of mahua oil on diesel engines since diesel engines are major contributors of many air polluting exhaust gasses such as carbon monoxide, unburned hydrocarbons, oxides

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of nitrogen and other harmful compounds [9]. Developed enthusiasm for biodiesel owing to the closeness in its properties in contrast with those of diesel energizes. There is a little improvement in results using the blends and the emissions are also low compared to the diesel.

[10] assessed the exhibition and emanation attributes of a single cylinder direct injection constant speed diesel engine with Soapnut oil. Soapnut oil, a nonedible straight vegetable oil was mixed with oil diesel in different extents to assess the presentation and discharge qualities of a single cylinder direct injection consistent speed diesel Engine. [11–14] talked about cleanser nut oil, cotton seed oil methyl ester and diesel were mixed in the extent of 10:15:75 by volume to shape a bio diesel mix of B25. It has been seen that the calorific worth is lower and consistency is higher for B25 when contrasted with diesel [15,16]. Pongamia as biodiesel were tested for their performance in diesel engines. The biodiesel for various proportions like 5%, 10%, 15% and 20% and the effect on diesel engine performance is studied. The effect of use of biodiesel on engine power, consumption of fuel and heat loss involved are collected and analyzed with that of conventional diesel [17]. talked about the objective of the current work is to audit the writing with respect to the basic parts of burning clamor radiation during transient activity of normally suctioned and turbocharged diesel engine [19].

2. Preparation of biodiesel sample

The Nano particles bio diesel fuel is set up by blending the Cerium oxide nano particles in the grape seed oil with the guide of aultrasonicator. The ultrasonicator procedure is the most appropriate technique to scatter the nano particles in base fuel (grape seed oil), as it encourages conceivable agglomerate nanoparticles back to nanometer go. Nano particles are for the most part having higher surface territory and henceforth surface vitality will be high and it will in general agglomerate to frame a smaller scale atom and begins to silt [18]. So as to make nano molecule to be steady in a base liquid, it ought to be developed to surface adjustment. Consequently, the molecule sedimentation was controlled. So as to scatter the nano molecule to base liquid ultra-sonication system was followed. A known amount of (state 20 mg) added substance were gauged and poured in the biodiesel and ultrasonicated for 60 min. Then it forms a stable nano fluid.

3. Experimental setup

A 5HP (5.2 kW) 4-Stroke direct injection research diesel engine was chosen to investigate the performance and combustion characteristics. The air flow rate into the engine was measured by mass flow sensor and the fuel consumption was measured by burette method. Loading was applied on the engine with the help of eddy current dynamometer. The experiment was carried at different loads. Various sensors were utilized during the experiment to collect, store and analyze the data by computerized data acquisition system (IC engine soft). An exhaust gas analyzer (AIRREX HG-540, 4Gas analyzer) was employed to measure HC, CO, CO2 and NOX emissions. The performance, combustion and emission results obtained were tabulated. The engine setup is shown in Fig. 3.1

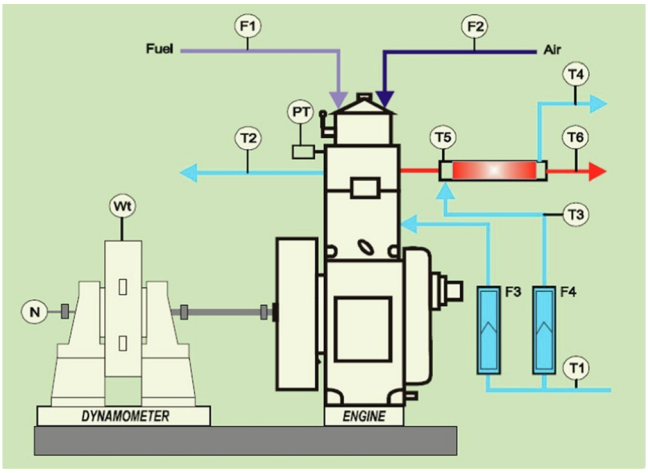

Fig. 3.1. Experimental setup.

4. Results and discussion

4.1. Brake thermal efficiency

The brake thermal efficiency improved with improve in brake power. Fig. 4.1 shows the variation of BTHE with BP for grape seed oil at various combinations nano additives comparing with diesel.

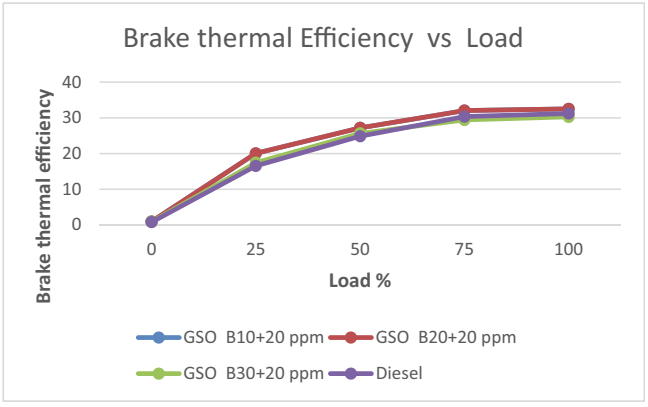

Fig. 4.1. Brake thermal efficiency vs load.

B30 + 20 ppm aluminum oxide (24.5%) shows BTHE similar to that of neat diesel (27.80%) at full load. The oxides of metal nano particles present in the biodiesel blend promote the complete combustion, while compared to the individual biodiesel blend

4.2. Specific fuel consumption

The variation of SFC with BP of GSO modified biodiesel with different dosage level of Nano additives comparing with diesel. Corresponding to BP is shown in Fig. 4.2, SFC is decreasing while

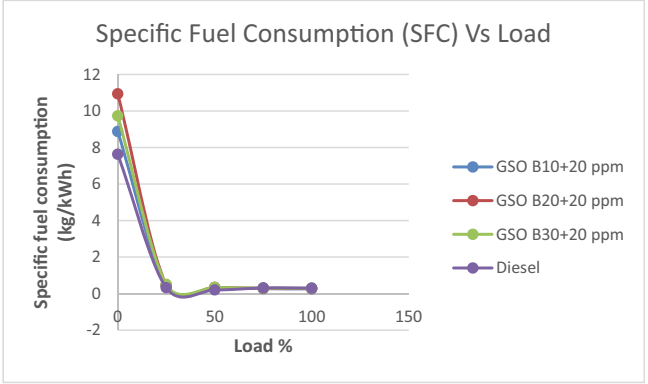

Fig. 4.2. Specific fuel consumption vs load.

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increasing the BP. At full load, SFC is higher for B30 (0.24 kg/kWh) adding with Nano particles but it attains 8% lower value for diesel (0.28 kg/kWh). CONP, oxidize the carbon deposits in the engine cylinder to reduced fuel consumption.

4.3. Hydrocarbon (HC)

The variation of HC with Load for B10, B20, B30 and modified blends is shown in Fig. 4.3. The HC increases with Load for all the blends. However, HC emissions are found to be considerably reduced with the addition high ppm of nano particles. Fundamentally, the oxygen content of fuel is the main reason for hydro carbon emissions reduction.

4.4. Carbon monoxide

The influence of additives to biodiesel on carbon monoxide emissions is shown in Fig. 4.4 CO emissions are increasing while increasing the Load for all the blends. Hence CO emissions shows lower values for B10, B20, and B30 blend adding CeO_2 additives. This may be combustion improvement due to adding CeO_2. Because of incomplete combustion causes CO emissions.

4.5. Nitrogen oxides (NOx)

The variation of nitrogen oxides with load for different blends of biodiesel is illustrated in Fig.4.5. Nitrogen oxides are mainly formed due to high temperatures. NO_X is increasing with Load however diesel values are lower than all blends having nano particles.

5. Conclusion

The experiment was conducted to investigate the effects of Cerium oxide (CeO_2) Nano particle as an additive for Grape seed oil on Performance, combustion and emission characteristics of CI engine, based on the experiments the following conclusions are drawn:

- The brake thermal efficiency was almost same for diesel and Grape seed oil blended with Aluminum oxide (20 ppm)
- By using Grape seed oil blended with Cerium oxide (20 ppm) the carbon monoxide (Co) emission were decreased compared to diesel.
- Grape seed oil blended with Cerium oxide (20 ppm) has higher NOx emissions
- NOx emissions of Grape seed oil methyl ester blended with Cerium oxide (150 ppm) has lesser Nox emission compared with other blends
- On the whole it is concluded that 150 ppm of Cerium oxide can be used as additive which showed reduction in emissions as well as compatible performance and combustion characteristics with Grape seed oil biodiesel.

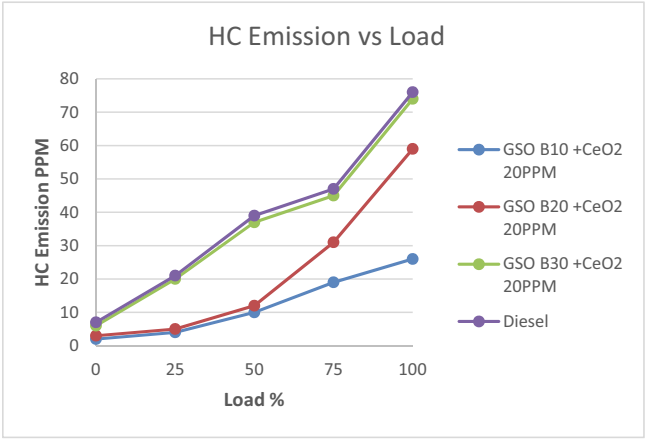

Fig. 4.3. Hydrocarbon vs load.

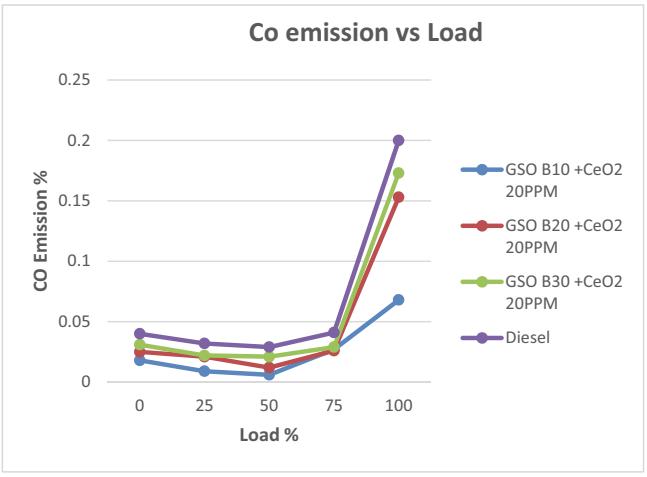

Fig. 4.4. Carbon monoxide vs load.

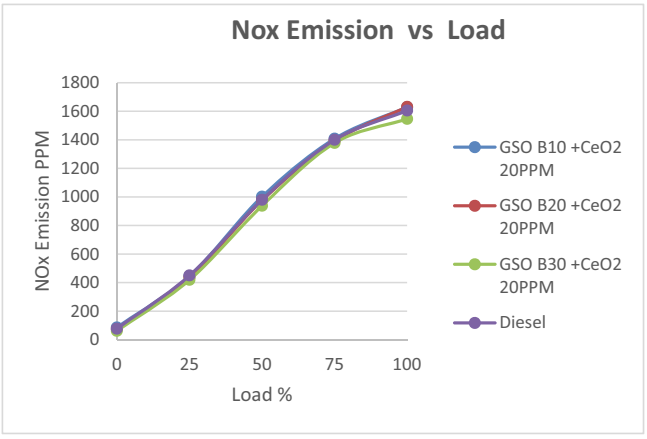

Fig. 4.5. Nitrogen oxides vs load.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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