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Performance and emissions characteristics of biodiesel in diesel engine

The climate and fuel supply have been problematic emphasis on alternative fuels for combustion engines. Different research studies tested various alternative fuels. In this connection, biodiesel is the most promising diesel fuel based on a literature survey. In this paper, the prospects and potential for the use of biodiesel and increasing biodiesel-diesel blending are studied by a fixed compression ratio, Optimum blending and enhanced performance engine parameter and pollution control should be proposed based on experiments. Experiments for a set compression ratio (17:1) undertaken utilising biodiesel cotton seed oil (CSME) diesel blends, i.e. B0, B10, B20, B30, without full loading rates, compared to the base cases (e.g. diesel engine fuel). The parameters may evaluate the fuel consumption and thermal efficiency of the brakes, Unburned hydrocarbons, and nitrogen oxides in emission of carbon monoxide. The results concluded that, B20 (20% biodiesel and 80% diesel) is the most efficient compared to other mixtures.

Keywords: Biodiesel, diesel engine, performance, emissions.

1.0 Introduction

The transport sector contributes for the biggest proportion (63%) of the overall world oil and other liquid fuels consumption growth between 2010 and 2040[1]. Alternative fuel is particularly important to the transport industry since this area emits more GHG emissions and helps the global demand for oil rapidly grow. Recently, more cleaner alternative fuels are being developed from renewable sources with a view to minimising harmful air emissions and reducing dependency on the petro-diesel fuel [1, 2]. Depleting fossil-fuel reserves; dwindling resources, leading to geopolitical conflict; and climate change resulting from increasing atmospheric CO_2 concentration [3]. A solution is required to limit the oxidation of nitrogen and diesel particles to take advantage of a greater fuel economy and reduced emissions of carbon dioxide (CO_2). As a result, several alternative energy sources are being explored and applied, including solar energy, hydroelectric power, geothermal energy, wind, and biocarburants [4]. Biodiesel is almost like diesel fuel, making it an exciting alternative to diesel fuel. Biodiesel has several advantages such as biodegradable, non-toxic, a low emission profile and renewable resources (including possible carcinogens). Further, it does not contribute to the growth in atmospheric carbon dioxide levels, thereby minimising the greenhouse effect's intensity [5]. A best technique to use these products by means of diesel engines is to convert them to biodiesel [6]. Conducted a review on oil extraction and biofuels production from various materials. Biofuels can be produced with the help of various materials through different extraction methods and conversion processes [7], reviewed on different generation of biofuels. First generation biofuels utilize edible biomass, which sparked controversy because it competes with global food needs [8]. Experimental analysis of diesel-fuel combustion, performance, and emission analyses of high alcohol (butanol, octanol, and heptanol)/diesel mixtures were undertaken. The results show that practically all the higher alcohol/diesel mixtures tested were enhanced by bsfc and BTE [9]. The study focuses on B20 cotton seed oil methyl ester (CSME) advancement in biofuel technology in recent time. The most effective way is to improve the engine performance and reduce emission qualities to other mixtures according to the literary survey B20 (20 per cent biodiesel and 80 per cent diesel). But the generation of NO_x in B20 is likewise smaller.

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2. Fuel preparation with silicon oxide

2.1. Preparation of Biodiesel Blends

Biodiesel is mainly blended into cotton through the sonicisation process (Fig.1). The ultrasonic mixing promotes mass transmission and kinetic response and leads to quicker transesterification. The various B10, B20 and B30 combination ratios were blended and examined by a sonication technique. Table 1 indicates that biodiesel in different quantities is mixed. The parameters of cotton seed



Fig.1: Sonicating machine

biodiesel are summarized in Table 2 utilizing an ultrasonic metre for equitable biodiesel distribution.

2.2. Experimental set up

The engine was run on diesel until a constant working state was reached in order to do testing utilizing biodiesel blends. The fuel was then converted into a blend of biodiesel. The data collection has begun to ensure the elimination of residual diesel in the combustible line after the consumption of enough blend fuel. For all blends, same method was followed. The test included fossil diesel fuel (B0), diesel oil methyl ester (B10) of 10% cottonseed, diesel methyl ester of 20% cottonseed oil (B20) and diesel oil ester of 30% cotton (B30). The engine operated at 1500 rpm between no load and maximum load. The measurements of performance and emissions have tripled. In the diesel experiment, baseline readings were taken and four other carburants were used to examine the results and to run the engine from 0% to 100%. The engine specification is as described in Figs.2 and 3.

Table 1: Contains blended biodiesel at various proportions

	Diesel	Cotton seed oil
1	90%	10%
2	80%	20%
3	70%	30%
4	60%	40%

Table 2: The properties of cotton seed biodiesel is tabulated

Parameters	Diesel	B10	B20	B30
Calorific value (kj/kg)	44800	42434	42012	41534
Flash point (°C)	51	104	106	110
Kinematic viscosity at 40°C (cSt)	3.12	3.45	4.87	5.05
FFA (%)	0.02	0.09	0.08	0.073
Density at 15°C (g/CC)	0.831	0.843	0.852	0.862

3.0 Result and discussions

3.1. Brake thermal efficiency

Fig.3 shows the variation in the brake thermal efficiency of the load-based test fuels. As the pressure increases, the thermal efficiency of all test fuels increases. This can be explained by the increase of load, the development of suction pressure, which could have led to an efficient combustion.



Fig.2: The engine setup

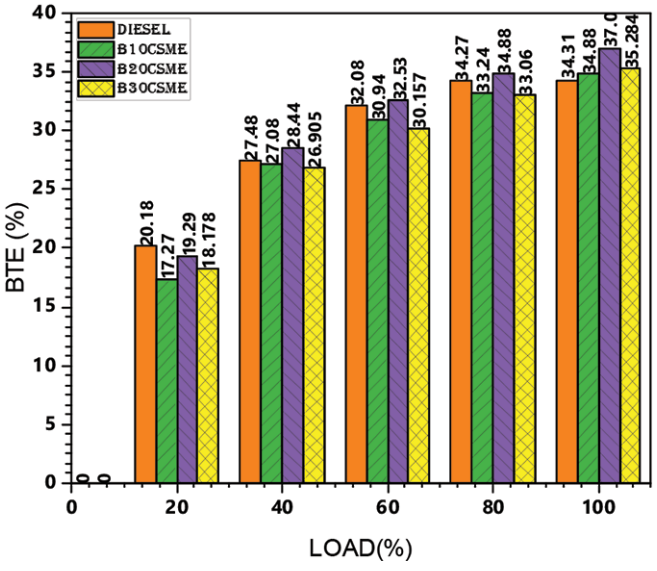


Fig.3: Brake thermal efficiency against load

The same trend was observed in cotton esters, however instead of an improvement in brake thermal efficiency was observed in ethyl esters of vegetable oil waste, this rise could be related to an increased esters' lubricity.

3.2 Brake specific Energy consumption

Test fuels at different loads indicate BSEC in Fig.4. With increased load, BSEC dropped. B20 is performing better than B0 in all mixtures. Similar results were seen in blends that exhibit similar profiles with higher esters of seed oil diesel mixtures. Because biodiesel is lower in heat than diesel and its mixtures more fuel is necessary to produce the same power supply.

3.4 CO emission

Fig.5 shows the carbon monoxide emission fluctuation for testing combustibles at various loads. CO is frequently generated if the fuel is not oxidised by adequate O_2. With increasing loads CO dropped. B20 performs better than B0 from the different blends. The combined effect of their oxygen content and higher CN may be ascribed to lower CO emissions. A higher CN has a shorter ignition time and a longer combustion time. The oxygen concentration of biodiesel then occurs, enhancing the process of combustion.

3.5 HC emission

Fig.6 illustrates the fluctuation in the emissions of hydrocarbon by load. Depending on the engine load, the concentration of HC in diesel exhaust varies between a few ppm and thousands ppm. In the diesel exhaust, hydrocarbons are made of the combustion mixture of a large amount of hydrocarbons in the fuel supplied by the engine. Compared to diesel, HC emissions are lower. This drop was due to the increased gas temperature and the higher number of cetane biodiesel and mixes.

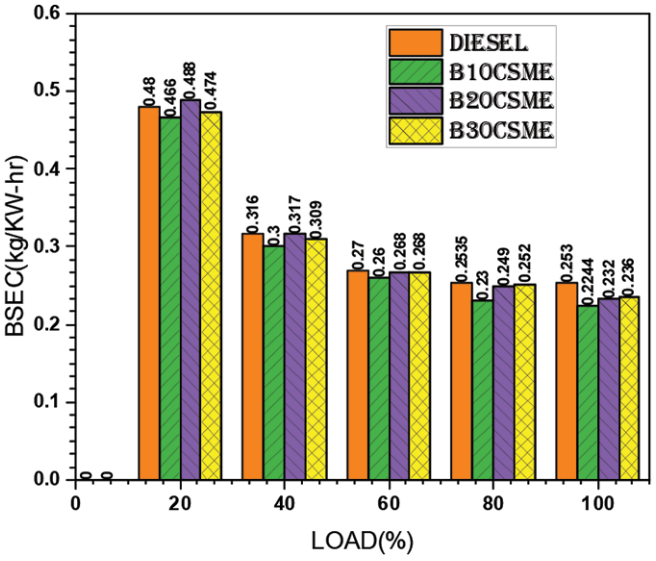


Fig.4: Brake specific energy consumption against load

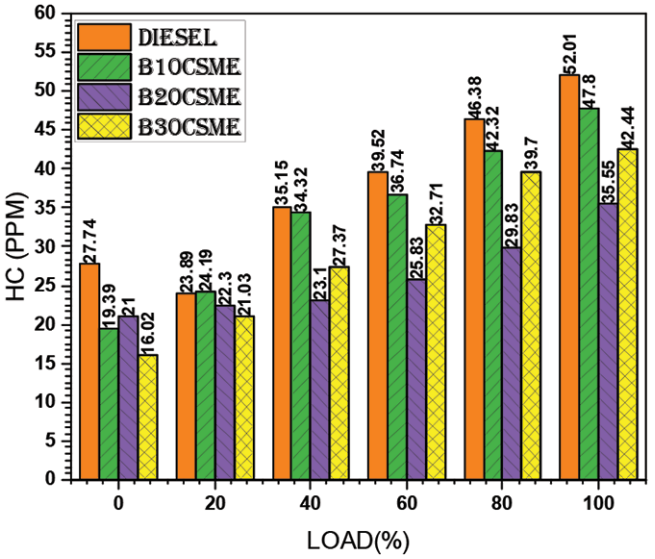


Fig.6: Hydrocarbon against load

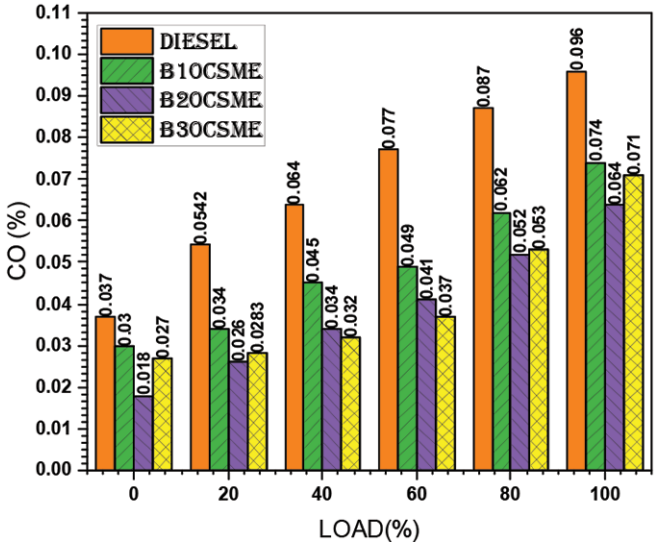


Fig.5: Carbon monoxide against load

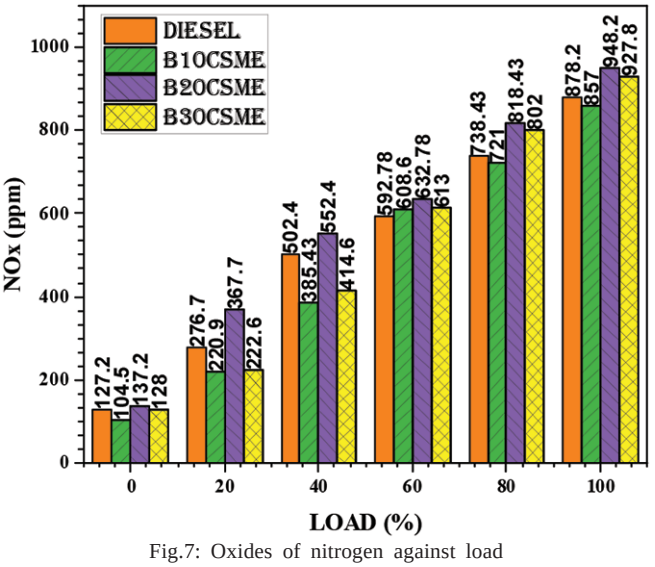


Fig.7: Oxides of nitrogen against load

TABLE 3: THE SPECIFICATION OF ENGINE

Description	Parameter/values
Engine	Make Kirloskar, power 3.5 kW at 1500 rpm, stroke 110 mm bore 87.5mm. CR17.5
Dynamometer	Type eddy current, water-cooled
Load indicator	Digital, Range 0–50 Kg, Supply 230VAC
Load sensor	Load cell, type strain gauge, range 0–50 Kg
Rotameter	Engine cooling 40–400 LPH; Calorimeter 25–250 LPH
Overall dimensions	W 2000 × D 2500 × H 1500 mm

3.3 NO_x EMISSION

The addition of biodiesel to Fig.7 showed that during the combustion process it could lower hydroxyl-radical (OH) growth. This decrease in OH radicals lowers the oxidation of the CO and HC within the combustion chamber, resulting in low temperatures and high NO_x emissions for all biodiesel products.

4.0 Conclusions

The investigation of the performance and emission parameter of cottonseed oil mixed with fuel in the engine the following experimental conclusions are arrived:

(1) Biodiesel manufactured with cotton oil has enhanced its calorific value, flash point and fire point.

(2) The combustion of cotton seed oil optimises thermal efficiency (BTE) and fuel specific energy consumption (SEC).

(3) Compare for other mixes is less for hydrocarbons (HC) and carbon monoxide (CO) emissions.

(4) The nitrogen content is enhanced because the oxygen presence of cottonseed oil in biodiesel fuel increases the combustion rate.

(5) The performance of B20 and B30 biodiesel mixtures is reasonable in comparison with diesel

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