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FULL LENGTH ARTICLE

Analysis of performance and emission on compression ignition engine fuelled with blends of neem biodiesel

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KEYWORDS

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Transesterification;
Diesel engine;
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Neem blends

Abstract As the fossil fuels are depleting and green house gases are increasing usage of biodiesel came into existence. Biodiesel is a renewable, clean-burning diesel which can be produced from vegetable oils. This project deals with study of emission and performance characteristics on diesel engine with blends of Neem oil as biodiesel. Biodiesel is prepared from Neem oil by transesterification process followed by adding 1% v/v H_2SO_4. The tests were performed with B10, B20, B30 blends on a single cylinder, 4-stroke, diesel engine. The result shows lower emissions and higher performance for B10 than the other blends and diesel. The brake thermal efficiency is higher than the diesel and CO, HC and NO_X emissions were 23%, 8.5%, and 22% lesser than that of diesel.

1. Introduction

In the past few decades extensive use of petroleum has led to depletion of fossil fuel. Increasing human population and industrialisation has led to scarcity of petroleum reserves. This has made alternate energy resources more attractive. The alternative energy resources should be renewable, sustainable, efficient and cost effective. Biodiesel is considered as one of the promising alternative resources for diesel engine, especially from non-edible oil feedstock as well as its potential to be a part of a sustainable energy mix in the future. [1] Biodiesel can be produced from non-edible seed oil like Pongamia, Karanja, Neem etc. These oils cannot be directly used in the engine due their high viscosity and density, and low calorific value. The glycerol component should be removed by transesterification reaction. Biodiesels with edible and non-edible oils are widely investigated with respect to their performance, emissions and their impact on environment. Blends of biodiesel can be directly used without much alteration in existing diesel engine. Liaquat et al. [2] investigated performance and emissions of coconut biodiesel with CB5 and CB15 sample against

Abbreviations NaOH, sodium hydroxide; H_2SO_4, sulphuric acid; B.P, brake power; S.F.C, specific fuel consumption; B.T.E, brake thermal efficiency; CO, carbon monoxide; HC, hydrocarbons; CO_2, carbon dioxide; O_2, oxygen; NO_X, nitrogen oxide emissions; KW, kilowatts; Kg, kilograms; Kg/kwhr, kilogram per kilowatt-hour; PPM, parts per million; % vol, percentage of volume

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neat diesel at 100% load with varying speeds of 1500–2400 rpm at an interval of 100 rpm. The average torque reduction compared to net diesel fuel was found as 0.69% for CB5 and 2.58% for CB15 respectively.

Dawody et al. [3] investigated performance and emissions of soybean biodiesel (20%SME, 40%SME, 100%SME) on diesel engine at various loads and constant speed of 1500 rpm. The brake specific fuel consumption for all the blends was noted less than the No.2 diesel. Mallikappaet al. [4] conducted tests on a double cylinder, direct injection, compression ignition engine with B10, B15, B20, B25. It was observed that brake thermal efficiency increases with higher brake power and emission levels (HC, CO, NO_X) were nominal up to 20% blends. The Carbon monoxide increases slightly more after 20% blends. Swarup et al. [5] tested biodiesel from neat Mahua oil via base catalysed transesterification and mixed the biodiesel with a suitable additive (dimethyl carbonate) in varying volume proportions (B100, B95, B90, and B85). NO_X emissions were the highest for pure biodiesel. Mohd Hafizil et al. [6] tests were carried out on Mitsubishi 4D68 4 inline multi cylinder compression ignition (CI) engine with various engine speeds fuelled with diesel and B5 (5% palm methyl ester + 95% diesel) blended fuel. Results showed that at all engine speeds, torque and power outputs for B5 fuel were quite similar to neat petroleum diesel fuel. NO_X emission reduced significantly for both fuels but the rest emission contents were decreased with engine speed.

Table 1 Specifications of the engine.

Sr. No	Parameters	Specifications
1.	Engine type	Kirloskar 4 stroke, single cylinder, constant speed, diesel engine
2.	Power rating	3.50 KW at 1500 rpm
3.	Stroke	110 mm
4.	Bore	87.5 mm
5.	Capacity	661 cc
6.	Compression ratio	12:1–18:1
7.	Dynamometer	Eddy current type
8.	Calorimeter	Type pipe in pipe

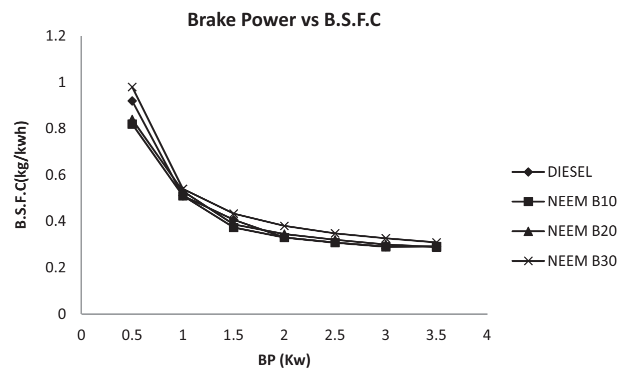

Fig. 4.1.1 Variation of B.P vs B.S.F.C of biodiesel blends and diesel.

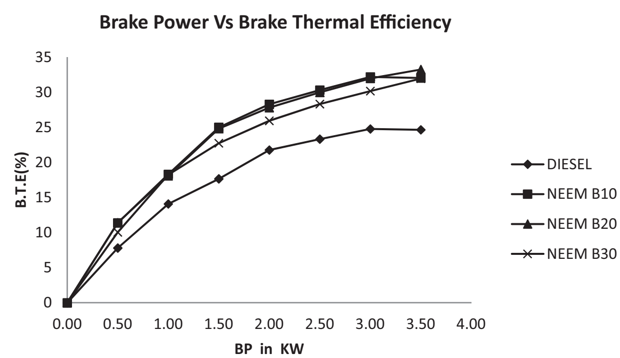

Fig. 4.1.2 Variation of B.T.E vs B.P of biodiesel blends and diesel.

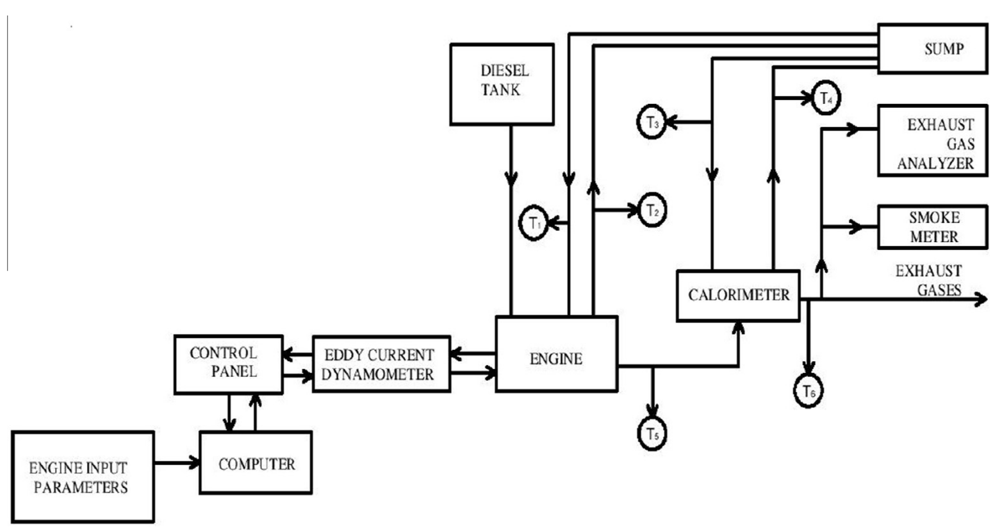

Fig. 3.1 Schematic diagram of experimental setup. T_1-Engine coolant inlet temperature. T_2-Engine coolant outlet temperature. T_3-Calorimeter coolant inlet temperature. T_4-Calorimeter coolant outlet temperature. T_5-Engine exhaust gases outlet temperature. T_6-Exhaust gases outlet temperature from calorimeter.