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International Journal of Current Research
Vol. 8, Issue, 12, pp.42806-42808, December, 2016

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

ISSN: 0975-833X

RESEARCH ARTICLE

A BLEND OF PALM AND CASTOR BIODIESEL AN ALTERNATIVE FUEL FOR DIESEL ENGINE

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ARTICLE INFO

Article History:
Received 03[rd] September, 2016
Received in revised form
18[th] October, 2016
Accepted 25[th] November, 2016
Published online 30[th] December, 2016

Key words:

Palm and castor oil biodiesel,
Brake specific fuel consumption,
Brake thermal efficiency,
Smoke density etc.

ABSTRACT

Biodiesel at present, the most widely accepted alternative fuel for diesel engines due to its technical, environmental and strategic advantages. Biodiesel can be used neat or blended in existing diesel engines without significance modification to the engines. This study is devoted to the performance and emission evaluation of automotive diesel engine using blend of palm and castor biodiesel utilization. The concentration of biodiesel in the test was ranged from B0, B20, B40, B60, B80 and B100. The engine performance wasevaluated through brake power, brake thermal efficiency, brake mean effective pressure and brake specific fuel consumption while the emission was evaluated through smoke density and NO_x. The result shows that the blend B40 and B80 has the optimum emission as well as performance characteristics.

Citation: Sumedh S. Ingle, Nandedkar, V. M. and Kalpana G. Joshi, 2016. "A blend of palm and castor biodiesel an alternative fuel for diesel engine", *International Journal of Current Research,* 8, (12), 42806-42808.

INTRODUCTION

Due to the increase in international fluid oil price and global concerns about the effects of fossil fuel used on the environment, in current years, the popularity of biodiesel has improved dramatically in the world. The petroleum supply are getting limited, hence attention has been directed to find out alternative sources of fuels for diesel/ petrol engines. The non-renewable nature and constrained resources of petroleum fuels have become a matter of great concern. All these aspects have pulled the attention to preserve and stretch the oil reserves by conducting alternative energy research. In outlook of this, vegetable oil is an encouraging alternative because it has several advantages such as it is renewability, environment-friendliness. Thus, in current years, absolute efforts have been made to customize vegetable oils as fuel in engines by several researchers. Apparently, the use of non-edible vegetable oils compared to edible oils is very important because of the enormous demand for edible oils as food and they are far too expensive to be used as fuel at current scenario. Vegetable oil esters are having increasing attention as a non-toxic, biodegradable and renewable substitute fuel (diesel). These esters have become known as biodiesel (Yusuf Ali and Hanna, 1994; Agarwal and Das, 2001; Pramanik, 2002; Darnoko and MunirCheryan, 2000). Biodiesel is an alternative diesel fuel obtained from the transesterification process of vegetable oils with plain alcohols to give corresponding mono-alkyl esters. The paper contents the testing of Diesel engine for performance and emission testing using blend of Palm and castor biodiesel with variation of load (Agarwal *et al*., 2003; Can Hasimoglu *et al*., 2007; RoilaAwang and Choo Yuen May, 2007). The properties of Palm and castor biodiesel are given in Table I. (Sumedh Ingle *et al*., 2013; Ingle and Nandedkar, 2012; Kalam and Masjuki, 2002).

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Experimental approach

The present experimentation was carried out to evaluate the emission and performance characteristics of palm and castor biodiesel blend.Palm and castor biodiesel in blends B0(castor biodiesel), B20(20% palm+80% castor), B40, B60, B80, B100(palm Biodiesel)were used fortest. The experiments were conducted on a single cylinder, vertical, 4-stroke cycle, single acting, water-cooled, totally enclosed, high speed compression ignition engine, engine specification as shown in Table II Engine was coupled to an Eddy Current Dynamometer by universal coupling. The dynamometer and engine were mounted on a common bed made from Iron C-Channel which was fastened to the cement foundation. The basic operations in investigating any engine is loading the engine by means of dynamometer.The performance and emission characteristics of the engine were studied at atmospheric temperature and various engine loads (25%, 50%, 75%, 100% and 115% of the load corresponding to the load at maximum power at 1500 rpm as an average engine speed). At every experimentation (each load), the engine was stabilized for 60 minutes and then performance parameters were determined. The different graphs were plotted between BTE and Torque, BSFC and Torque, smoke density and Torque, and also between NOx and Torque.

Table 2. Properties of palm and castor biodiesel

Parameter	Palm Biodiesel	Castor Biodiesel
Density @ (40 ^{O}C), kg/m^3	820	850
Kinematic Viscosity@ (40 ^{O}C) mm^2/s (cSt)	4.71	15.98
Calorific value, kJ/kg	37253.62	37908
Flash point,^{O}C	137	84
Fire point,^{O}C	167	97
Cloud point,^{O}C	16	-23
Pour Point,^{O}C	-12	-45
Cetane Number	52	50
Visual appearance	Dark Brownish	Pale Yellow

Table 2. Engine specifications

Make	Kirloskar
Type	Single-cylinder, four-stroke, compression ignition diesel engine
Compression ratio	16.5:1
Stroke	110 mm
Bore	80 mm
Rated output	3.7 kW
BMEP at rated speed1500 rpm	5.42Bar
Dynamometer	Eddy current, water-cooled with loading unit

RESULTS AND DISCUSSION

Brake Thermal Efficiency

The variation of BTE with load for different blends is shown in Fig.1. In all cases it increases with increase in load up to full load (24 Nm). This is due to a reduction in heat loss and increase in power with increase in load. The maximum Brake Thermal Efficiency of blends is observed for B40at full load.

Brake Specific Fuel Consumption

The variation of brake specific energy consumption is shown in Fig.2. The fuel consumption is the fuel required to develop 1 KW power per hour. For all blends tested, brake-specific Fuel consumption decreases with increase in load up to full load (24 Nm). Brake specific fuel consumption is lowest for B40 and B80 at full load and highest for B60 at 6 Nm.

Smoke Density

The variation of HSU is shown in Fig.3. For all blends tested, HSU increases with increase with increase in load. It is highest for B60 at full loadand lowest for B80at 12Nm.The smoke is formed due to incomplete combustion of fuel.

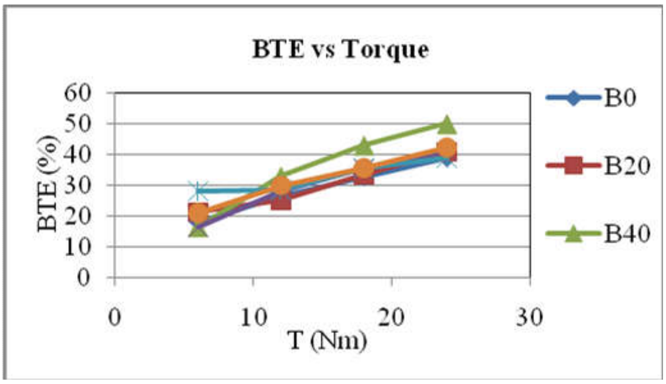

Figure 1. BTE vsTorque

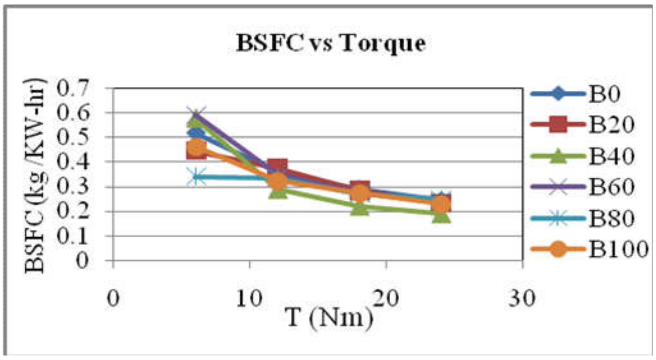

Figure 2. BSFC vs Torque

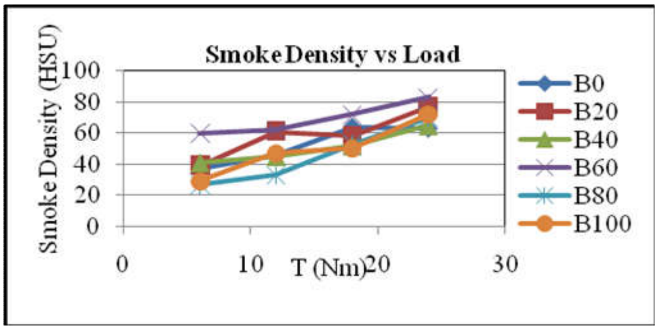

Figure 3. Smoke Density vs Torque

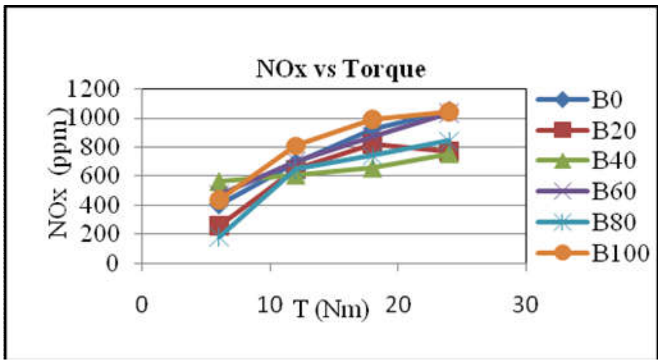

Figure 4. NO_xvs Torque

NO_x Emission

The variation of NO_x with respect to load is shown in Fig. 4. For all blends tested, NO_x increases with decrease in load. Both B0 and B100 at full load shows the highest NO_x. This may be due to chemical composition of castor and palm biodiesel which promotes the combustion process. B80 shows the lowest NO_x at 6 Nm.

Conclusion

Based on experimentation and analysis of performance and emission of diesel engine using Palm and castor biodiesel B40 and B80 blend of palm and castor biodiesel shows an optimized trend in almost all parameters.The use of palm and castor oil creates a need to increase palm and castor oil sources. This in turn will increase the use of waste land productivity and generate rural employment and increase the country's GDP. Local production of biodiesel will save an enormous quantity of foreign exchange. This capital when endowed in country will improve its financial structure.

Abbreviation (for figures)

B0 - Castor Biodiesel 100%
B20 - Palm Biodiesel 20% + Castor Biodiesel 80%
B40 - Palm Biodiesel 40% + Castor Biodiesel 60%
B60 - Palm Biodiesel 60% + Castor Biodiesel 40%
B80 - Palm Biodiesel 80% + Castor Biodiesel 20%
B100- Palm Biodiesel 100%
BSFC - Brake Specific Fuel Consumption (kg/kWh)
Torque – T (Nm)
BTE – Brake thermal efficiency (%)

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