Performance Evaluation of A Diesel Engine with Tamuna Bio Fuel

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ABSTRACT

Alternate fuels can be produced from vegetable oils and also from animal fats these comes under Bio-Diesel category. Alternate fuels are mono-alkyl-ester of long chain fatty acids derived from vegetable oils and waste oils by trans esterification process. The present challenge in automotive engine technology is the improvement of thermal efficiency and hence the fuel economy and lower emission levels. The aim of my work is to evaluate the performance of a fixed compression ratio engine in terms of specific fuel consumption with respect to break thermal efficiency, mechanical efficiency, and volumetric efficiency, with mixtures of different proportions of esterified Tamanu Oil and diesel fuel and comparing the results with 100% diesel fuel.

Keywords: Biofuel, Trans esterification Process, Thermal Efficiency, Emissions.

1. INTRODUCTION

1.1 Introduction to Tamanu Oil

Bio-diesel and also in some cases it is used as skin care oil. Tamanu Oil or Calophyllum Inophyllum has traditionally been used as a unique and significant skin healing agent, environmental pressures for renewable energy has created an ever-growing demand for bio fuel in the form of biodiesel produced from vegetable oils. Tamanu oil is prepared from Tamanu seeds by trans esterification process.

1.2 Production of Tamanu Oil

Single-phase method if the percentage of FFA present in the raw vegetable oil is less than 4%, the trans esterification process by single-phase method has to be chosen. In this method, a measured amount of methanol (CH_3OH) and sodium hydroxide ($NaOH$) has to be mixed thoroughly with a measured amount of vegetable oil. The mixture is heated and maintained at 65°C for 2 h, and then, it undergoes natural cooling. Glycerol will deposit at the bottom of the flask, and it is separated out using a separating funnel. The remnants in the flask are the esterified vegetable oil. Another commercial name for esterified vegetable oil is biodiesel.

Two-phase method if the percentage of FFA present in the raw vegetable oil is more than 4%, then we have to choose the two-phase method. In this method, the oil has to undergo esterification. Measured quantity of sulphuric acid and methanol has to be taken and mixed thoroughly and added with a measured amount of vegetable oil. The mixture is heated and maintained at 65°C for 2 h. The fatty ester is separated after natural cooling. At second level, the separated oil from the separating funnel has to undergo trans esterification. Methoxide (methanol + sodium hydroxide) is added with the above ester and heated to 65°C. The same temperature is maintained for 2 h with continuous stirring, and then, it undergoes natural cooling for 8 h. Glycerol will deposit at the bottom of the flask, and it is separated out by a separating funnel. The remnants in the flask are the esterified vegetable oil (biodiesel).

1.3 Tamanu Oil Properties

Table No: 1 Properties of Tamanu Oil

Density	896 Kg / m^3	Fire Point	114 ^{0}C
Specific Gravity	0.86	Calorific Value	44000 KJ./Kg -K
Viscosity	9.1 Cst	Carbon content	1.14 %
Flash Point	108 ^{0}C	Hydro Carbons	2450

Fig No: 1 Seeds of Tamanu

Fig No: 2 Samples of Tamanu

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2. 0 EXPERIMENTATION

2.1 Experimental set up

Table No: 2 Specifications of Engine

Engine Make	Kirloskar
BHP	5HP
RPM	1500
Bore	80 mm
Length	110 mm
Working Cycle	4 Stroke
Method of Cooling	Water
Method of Ignition	Compression Ignition
Compression Ratio	16.5:1
Dynamometry	Mechanical
Capacity	661 cc
Orifice Plate Dia	15 mm
Brake Drum Dia	300 mm
Rope Dia	15mm
Weight of Rope	1 Kg
Weight's	1, 2,4 Kgs

Fig No: 3 Diesel Engine Set up

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2.2 Description of Engine

The engine is loaded by the mechanical dynamometry (brake drum). The brake drum is directly coupled to engine flywheel and rope is wounded round the drum. Top end of the rope is connected to spring balance and bottom end of the rope is connected to weight platform. On adding the slotted weights can vary the load on the engine. The suction side of the engine is connected to an air tank, thorough which atmospheric air is drawn into the engine cylinder. Manometers were provided to measure the pressure drop across the engine, orifice is provided in the tank to calculate the volume of the air drawn into the cylinder.

2.3 Results

Table No: 3 Composition vs. Heat Supplied when speed = 1500 RPM

Composition	$Q_{Supplied}$ at 2 Kg load (KJ/ min)	$Q_{Supplied}$ at 4 Kg load (KJ/ min)	$Q_{Supplied}$ at 6 Kg load (KJ/ min)
100% Diesel	309.46	418.73	497.2
95%+5%	380.196	540	603.185
90%+10%	290.87	363.6	565.6
85%+15%	297.69	422.19	596.08

Table No: 4 Composition vs. Heat Equivalent to BP when speed = 1500 RPM

Composition	Heat Equivalent to BP at 2 Kg load (KJ/Min)	Heat equivalent to BP at 4 Kg load (KJ/Min)	Heat equivalent to BP at 6 Kg load (KJ/Min)
100% Diesel	22.08	44.26	88.5
95%+5%	33.198	71.1	135.96
90%+10%	25.296	88.5	151.74
85%+15%	33.198	96.42	167.58

Table No: 5 Composition vs. Heat Loss Due to Exhaust Gases when speed = 1500 RPM

Composition	Heat loss due to Exhaust gases at 2 Kg load (KJ/Min)	Heat loss due to Exhaust gases at 4 Kg load (KJ/Min)	Heat loss due to Exhaust gases at 6 Kg load (KJ/Min)
100% Diesel	158.16	239.8	294.66
95%+5%	192.15	283.89	317.85
90%+10%	143.52	167	263.65
85%+15%	141	197.83	279.3

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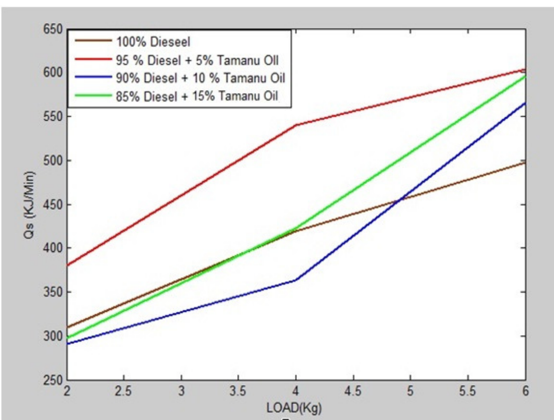
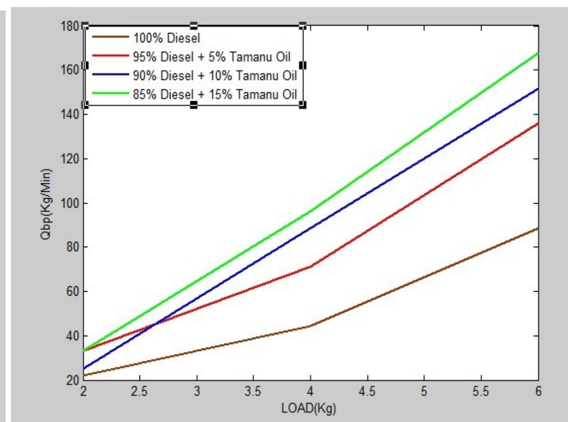
Table No: 6 Composition vs. Heat Loss by Cooling Water when speed = 1500 RPM

Composition	Heat loss due to cooling water at 2 Kg load (KJ/Min)	Heat loss due to cooling water at 4 Kg load (KJ/Min)	Heat loss due to cooling water at 6 Kg load (KJ/Min)
100% Diesel	70.22	90.28	100.32
95%+5%	50.16	60.192	80.256
90%+10%	70.224	70.224	90.288
85%+15%	60.192	80.256	100.32

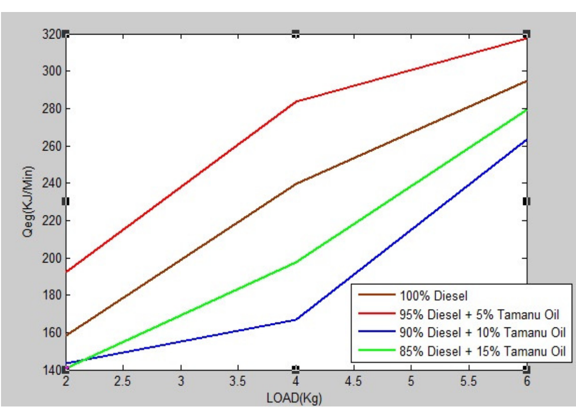
2.4 Graphs



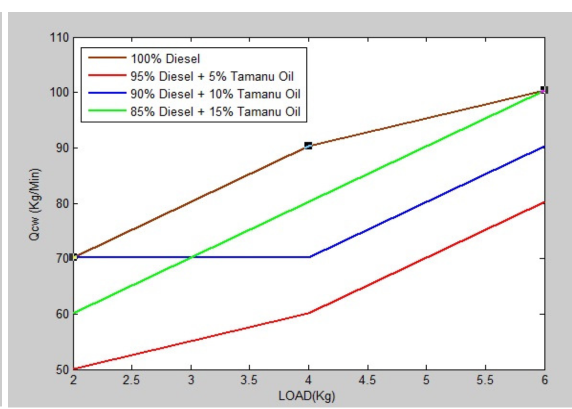
Graph No: 1 Load vs. $Q_{Supplied}$



Graph No: 2 Load vs. Q_{BP}



Graph No: 3 Load vs. $Q_{Exhaust\ gases}$



Graph No: 4 Load vs. $Q_{cooling\ water}$

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3. CONCLUSIONS

Tamanu oil mixed with diesel at different compositions is used as alternative fuel in CI engines. There is improvement in break power at different loads when % of Tamanu oil is increased (5% to 15%). The flash point of Tamanu oil is much higher than that of diesel, so they are much safer to store than diesel. Even they may be slighter increase in carbon monoxides (CO) by using mixture of Tamanu oil and diesel, but hydrocarbons (HC) are decreased to greater extent. Since Tamanu oil is a vegetable oil it has good ignition quality, high flash point and cetane number. Thus the combustion quality and temperature increases at higher load conditions, so there by unaccounted losses are reduced considerably. Thus Tamanu oil can also be used as alternative fuel.

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