Performance and properties analysis of waste cooking oil emulsion as a fuel for C I Engine

Dr.L.Ranganathan

Professor, Department of Mechanical Engineering, Jeppiaar Engineering College
Rajiv Gandhi salai, Chennai, Tamil Nadu, India.

Abstract

This work reports use of waste cooking oil (WCO) for internal combustion engine. A stable emulsion of WCO is prepared which consist of base fuel as WCO and proportions of water, surfactant. Micro-explosion is a process which occurs during the combustion of this emulsified fuel when used in a fuel engine. Micro-explosion improves the combustion efficiency and reduces NO_X emissions. This work focuses on studying the stability of prepared WCO emulsion and performance properties of fuel engine with the WCO emulsion as fuel. We found the efficiency of WCO with the proportion of 98.5% of WCO, 1% of span 80, 0.5% of water for sample-1, 98% of WCO,1% of span 80, 1% of water for Sample-2 & 97.5% WCO, 1% of span 80, 1.5% of water for sample -3

Keywords Bio fuel, Transesterification, emulsion, specific fuel consumption, brakes thermal efficiency.

INTRODUCTION

Fuel engines are mainly used in marine, aeronautical, commercial, economical applications due to their high performance and acceptability [1]. However, they release large amount of smoke and oxides emissions. The prices of fuel is increased, less amount, more strict governmental regulations on exhaust gas and the fast depletion of petroleum all around the world reserves provide a encouragement to the search for alternative fuels [2]. In recent years, the reduction in sculpture content is the most notable restriction [3]. Due to reducing fossil fuel available and more strict emissions limits, biofuel has yet again become popular [4] .While a liter of petro fuel contains about 46 MJ, a litre of B100 contains approximately 33 MJ[5]. The difference for small blends is not a big change. Most users fuelling at with a relatively higher B20 blend do not care about the small effect on engine power, torque or fuel economy, which is as little as 1% [6]. This paper looks at the effects of bio fuel blending on the properties.

METHODOLOGY

WCO emulsion is prepared from WCO & distilled water by emulsification process. To prepare a stable emulsion, correct proportion of WCO, Distilled water, surfactant and co-surfactant is found out by trial methods. Using correct proportion required amount of emulsion is prepared by mechanical stirring process.

ENGINE SPECIFICATIONS

MODEL	: Kirloskar- 8
TYPE	: Four stroke single cylinder Slow speed diesel engine
POWER	: 8 hp
SPEED	: 850 rpm
TYPE OF COOLING	: Water Cooling
LUBRICATION OIL	: SAE-30

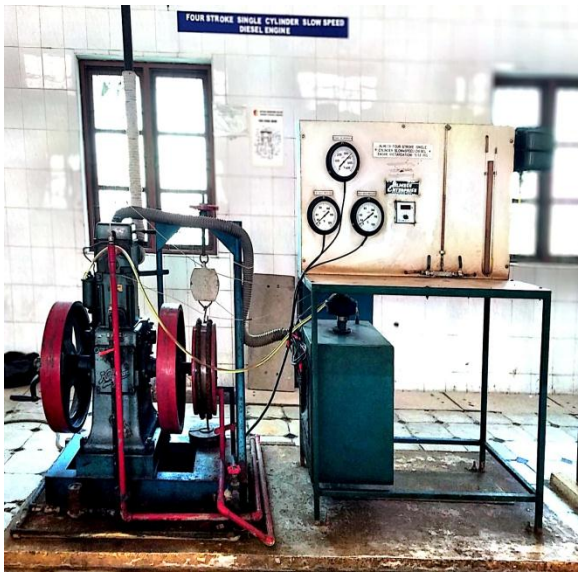

Figure 1: Experimental engine test rig

COMPOSITION

WCD0.5 - This blend of WCO consists proportion of 985ml (98.5%) of waste cookingoil, 10ml (1%) of span 80, 5ml (0.5%) of Distilled water.

WCD1.0 - This blend of WCO consists proportion of 980ml (98%) of waste Cooking oil, 10ml (1%) of span 80, 10ml (1%) of Distilled water.

WCD1.5 - This blend of WCO consists proportion of 975ml (97.5%) waste cookingoil, 10ml (1%) of span 80, 15ml (1.5%) of Distilled water.

PERFORMANCE TEST ON WCD SAMPLES WITH COMPARISON TO DIESEL

Specific fuel consumption

Table 1: Specific fuel consumption (SFC)

LOAD (kg)	DIESEL (SFC)Kg/Kw-hr	WCD0.5 (SFC) Kg/Kw-hr	WCD1 (SFC) Kg/Kw-hr	WCD1.5 (SFC) Kg/Kw-hr
3.8	0.55	3.142	3.203	3.498
5.6	0.408	2.372	2.432	2.379
7.4	0.344	1.883	1.694	1.888
9.2	0.307	1.75	1.794	1.768
11	0.248	1.599	1.603	1.699

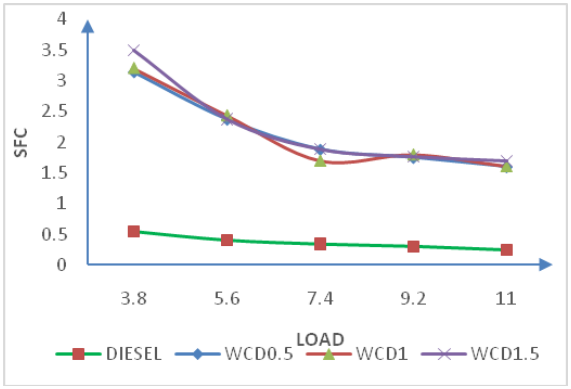

Figure 2: Load (kg) Vs Specific fuel consumption(kg/KWhr)

The calorific value of the diesel fuel is more compared with the fuel blends namely WCD.5, WCD1 & WCD1.5. So the Specific fuel consumption is higher than the diesel fuel due to lower calorific value of the transesterficated fuels.

Brake thermal efficiency

Table 2: Brake thermal efficiency

LOAD (kg)	DIESEL (BTE) (%)	WCD0.5 (BTE) (%)	WCD1 (BTE) (%)	WCD1.5 (BTE) (%)
3.8	8.38	12.37	12.37	11.49
5.6	8.47	16.3	12.29	15.47
7.4	8.57	20.5	21.54	18.56
9.2	9.37	22.5	20.14	18.88
11	10.37	24.2	22	20.96

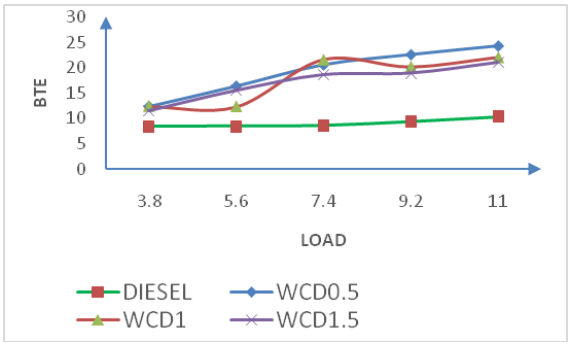

Figure 3: load (kg) Vs Brake thermal efficiency(%)

At a constant speed, an increase in load leads to a proportionate decrease in the developed torque and an increase in the fuel volume flow rate. These result in a decrease in the brake power and consequently a decrease in the brake thermal efficiency for WCD1.5 when compared to other WCD0.5 & WCD1 respectively.

RESULT AND DISCUSSION

From the above Experiment, the following conclusions are drawn.

- The calorific values is lower and characteristics of density, viscosity, flash point, and fire point of WCO is higher than diesel.

- The blends WCD0.5,WCD1 & WCD1.5 have lower calorific value, so SFC of the blends are higher than the diesel fuel due to (The fuel consumption for diesel is 0.322(kg/kWh) whereas WCD1.5 is 3.124(kg/kWh) at maximum load.

- The BTE of WCOs decreases as compared with Diesel at full load condition

The above result shows very clearly that the performance of I.C. engine using WCO as a fuel are almost matching with the diesel mode of operation.

This says that the steps made to use WCD as a fuel in the I.C. engine is very effective and can be used as an alternative fuel without altering the design of engine.

Because of the lower calorific value of the WCD1.5 it is found that the thermal efficiency of the engine is found to be slightly lesser and the specific fuel consumption is higher when compared to Diesel.

CONCLUSION

The properties of diesel and WCO emulsion with CI engine using as fuel is checked. The performance and properities obtained were compared. The following conclusions were made obtained.

The result shows the reduce in the brake power and consequently reduce in the brake thermal efficiency for WCD1.5 when compared to other WCD0.5 & WCD1 respectively.

At a constant speed, an increase in load leads to a proportionate decrease in the developed torque and an increase in the fuel volume flow rate.

- The fuel blends has less calorific value compared with the diesel fuel. The fuel blends namely WCD0.5, WCD1 & WCD1.5. So the Specific fuel consumption is higher than the diesel fuel due to lower calorific value of the transterterficated fuels.

1. Using WCO emulsion as CI engine fuel instead of conventional diesel is more economic and also the source for preparing this emulsion is a renewable source. So it is the more economical way of running a CI engine.
2. Although it is advantageous it has some disadvantages too. Using these emulsion decreases the efficiency of the engine and fuel consumption is high

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