Viscosity Reduction of Karanja Oil Using Peltier Element and Analysing the Performance Characteristics of the Engine with the Blended Oil

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ABSTRACT

The concept for reducing the viscosity of the bio diesel (Karanja oil) by preheating the bio diesel has been adopted in this work. Preheating the bio diesel is done by using the Peltier element. The Peltier also has an ability to produce heat when the voltage is supplied. The Peltier elements are placed in such a way that one element gains heat energy and the other element liberates heat energy. Thus the heat which is produced from the Peltier is used to heat the biodiesel. Karanja oil which has a viscosity of 4.7cSt has to be reduced to a viscosity of 4cSt as a mineral diesel by heating to blend it with diesel and use it for the experiment.

Keywords: Engine, Karanja oil, Peltier element, viscosity, Preheating

I. INTRODUCTION

The Research was initiated by Rudolph et al in the year 1893 where he used pea nut oil as a source of bio diesel[1].Later in the upcoming years the researchers started focusing on the vegetable oils as a n altenative for the diesel fuel.Oil production, oil seed processing and extraction also were considered in this meeting [2]. Vegetable oils hold promise as alternative fuels for diesel engines [3,4]. But their high viscosities, low volatilities and poor cold flow properties have led to the investigation of various derivatives. Fatty acid methyl esters, known as Biodiesel, derived from triglycerides by transesterification with methanol have received the most attention [5,6]. The automobile is a very important requirement for the current scenario. Diesel engines are predominately used because of its high persistence and thermal efficiency that uses conventional diesel as its fuel. The problem is fossil fuels are non-renewable. There is a great deal of information and enthusiasm about the development and increased production of our global energy needs from alternative energy sources. Solar energy, wind power and moving water are all traditional sources of alternative energy that are making progress. The main reason for this is due to depletion of fossil fuels, and the another parameter is increasing demands for diesels and uncertainty in their availability is considered to be the important trigger for many initiatives to search for the alternative source of energy, which can supplement or replace fossil fuelsThey are limited in supply and will one day be depleted. There is no escaping this conclusion. The experimental setup consists mainly of a diesel engine, two Peltier elements, a battery and a blend of Karanja oil nd diesel. The peltier element is used as a waste heat recovery medium in this experiment. The battery is used to store the electrical energy which is obtained from the Peltier element.

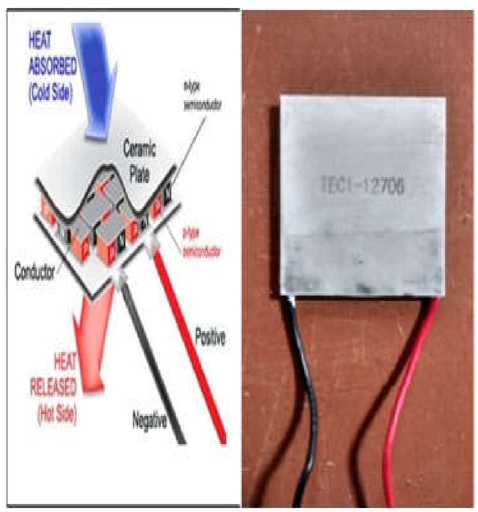
The blend is done in such a way that 60% of Karanja oil and 40% of diesel is mixed. Initially, one Peltier element is placed over the exhaust pipe of the diesel engine, which extracts the heat at its one side and produces electricity (i.e.; D.C current) in the form of voltage at. This D.C voltage is stored in the battery for later use

2. Engine Specifications

An experimental set-up has been developed to conduct tests on four stroke single cylinder, vertical, air- cooled, diesel engine. Necessary instruments were used after inspection and calibration to evaluate performances, emissions and engine parameters at different operating conditions. The specification of the engine used is as follows

2.1Specification of Peltier Element

Peltier is an element working on the basic principle of Thermoelectricity (TE). It is one of the simplest technologies available to convert energy. Small pieces of thermoelectric material (TE elements) are connected as shown in figure to form a Peltier couple. One element is of p-type, the other one is of n-type; they are connected in series electrically, but thermally in parallel. Multiple couples form a TE-module. When two different temperatures act on the both side of the module (i.e. one at low temperature and the other at high temperature), a voltage difference ΔV is created between the cold and hot plates that can induce a current I in an external circuit. The Peltier couple acts as an electric generator.



2.1 Peltier Element Diagram

3. SYNTHESIS OF THE KARANJA OIL

In this trans Esterification process is carried out to extract the oil. This process removes the glycerin from the waste cooking oil or fat and the byproducts left behind include ethyl esters and glycerin. Biodiesel fuel is free from such substances as sulphur and aromatics, which are found in traditional fuels. At this stage of biodiesel fuel production, biodiesel attains combustion properties which are very similar to those of petroleum diesel**.** The waste oil is taken in a three-necked flask. The condenser tub,thermometer, stirrer respectively. Ethanol was used as the raw material and ionic liquid butyl-methyl imidazolium hydrogensulfate (BMIMHSO4) as the catalyst for transesterification. The oil is mixed with the mixture ethanol and BMIMHSO4, in order to carry out transesterification process.

The amount of ethanol and potassium hydroxide to be mixed is found by titrating lime water against 10ml 91%isopropyl alcohol and 1ml of waste cooking oil, phenolphthalein is used as the indicator. It was found that the normality was 2, and we added 9 grams of ionic liquid butyl-methyl imidazolium hydrogensulfate (BMIMHSO4). Before Transesterification reaction, suspended food particles and residual carbon in waste cooking oil is filtered using fine filters. The filtered waste cooking oil was poured into the chemical reactor and then heated to 60^0C. From titration the value of BMIMHSO4 to be dissolved in ethanol is found and the solution poured into the reactor containing waste cooking oil at 60^0C. The mixture was stirred continuously for about 1 hour and 30 minutes while maintaining the temperature with the help of temperature monitors. After transesterification, the mixture was allowed to settle for about 8 hours. The esterification product was taken into a glass vessel, the upper liquid is biodiesel and the bottom liquid is glycerol. Then the biodiesel was separated from glycerol by separating funnel and finally washed with 5% water followed by drying under the sun to remove the residual water content. Then the raw biodiesel was washed in hot water remove soap and catalyst before drying. The liquid was light yellow transparent oily liquid with ester flavor.

4. ENGINE SPECIFICATION

KILOSKAR ENGINE	
Type	Four stroke, single cylinder vertical air cooled diesel engine
Rated power	4.4 KW
Rated speed	1500 rpm
Bore diameter (D)	87.5 mm
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Stroke (L)	110 mm
Compression ratio	17.5:1
Orifice diameter	29.6mm
Coefficient of discharge (C_d)	0.6
Calorific value of fuel	42,500 KJ/Kg
Density of diesel	860 kg/m^3

5. RESULTS AND DISCUSSION:

5.1. Properties of the prepared biodiesel

The properties of waste cooking oil Bio diesel Viscosity, Density, Flash point, Fire Point and calorific value is given below.

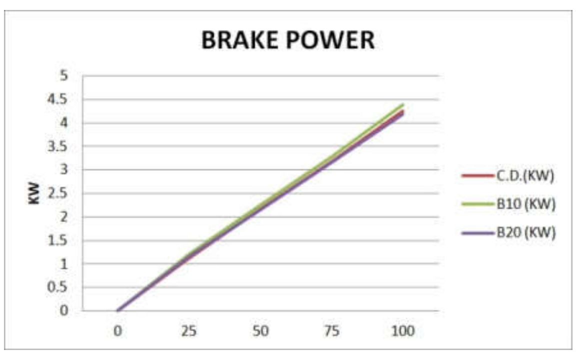
Parameter	Value
Calorific value	36,640.63 KJ/Kg
Density	920 Kg/m^3
Viscosity	4.4 cstokes
Flash point	175 ^{o}c
Fire point	178 ^{o}c

5.2 Performance properties of the diesel engine

The various performance properties such as brake power, indicated power, total fuel consumption, specific fuel consumption, mechanical efficiency and brake thermal efficiency are discussed below.

5.2.1 Brake power (KW)

Brake power of the engine without considering loss in power caused by the gearbox, generator, differential, water pump and other auxiliaries.

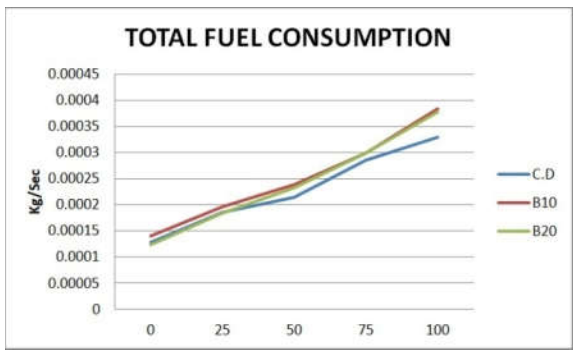


5.2.2 Indicator power (KW)

Indicator power is the power obtained at the output shaft, considering the losses in the engine by driving the rotating masses of the engine.

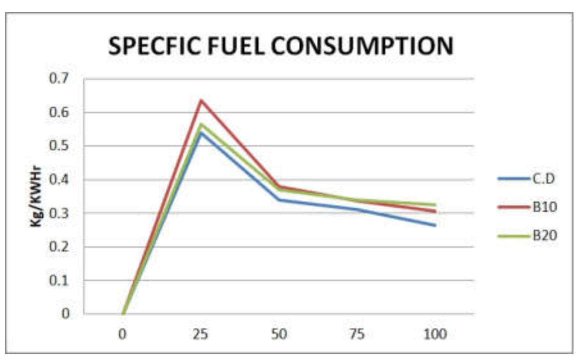
5.2.3 Total fuel consumption

Total fuel consumption is the amount of fuel consumed for travelling certain distance



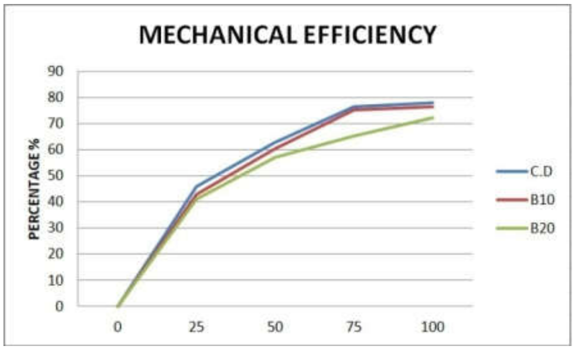
5.2.4 Specific fuel consumption

Specific fuel consumption is the fuel efficiency of the engine with respect to thrust output



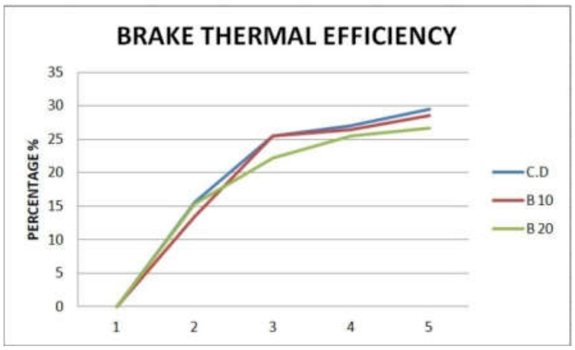
5.2.5 Mechanical efficiency

Mechanical efficiency measures the efficiency of a machine in transforming the input energy to output power.



5.2.6 Brake thermal efficiency

Brake Thermal Efficiency is defined as break power of a heat engine as a function of the thermal input from the fuel. It is commonly used to evaluate effectiveness of an engine which converts the heat from a fuel to mechanical energy.



6. CONCLUSIONS

The preheating of Karanja oil for reducing its viscosity has been done using Peltier element. Thus the waste heat exhibited from the exhaust valve has been recovered successfully and it has been used for heating the Karanja oil to reduce its viscosity to a considerable amount. The performance analysis of diesel and diesel-Karanja oil blend was also made and the respective graphs were drawn. Thus it is clear that the identified blend is more or less on par with the already used commercial fuel (i.e diesel).

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