Characteristics and Thermal Efficiency of Biofuels: Rubber Seed Oil as a Renewable Energy Source

Sundaram Arvind Narayan, Sutha Shobana

Abstract— Biodiesel, Fatty Acid Methyl Esters are alternative diesel fuels. Generally they obtained from renewable bio–sources, chiefly rubber seed oil which is extracted from rubber seeds (Heavea braziliensis) and is the one with significant potential. In this presentation, the fuel characteristics and thermal efficiency of biodiesel (BD100), diesel (BD00) and a blend of five percent biodiesel (BBD5) by volume of diesel were studied with their performance and the emissions of blend of five percent biodiesel (BBD5) which was comparable to diesel. It is a pattern of research, basic for the development of other bio sources as well.

Index Terms— Biodiesel, Heavea braziliensis, Fuel characteristics, Thermal efficiency

I. INTRODUCTION

Many countries have adopted a gradual replacement of diesel by biodiesel; in view of their complete compatibility [1].There are different methods for biodiesel production from vegetable oil or animal fat. The most used one is transesterification, which consists of the reaction between triglycerides and alcohol, usually methanol or ethanol, producing esters and glycerin [2]. Owing to deflecting fossil energy resources, biodiesel is the prominent source for fulfilling today's transport needs. Because of fast depleting reserves of petroleum fuels, we require their substitutes, which are renewable, eco–friendly and commercially competitive. In this way, biodiesel offers attractive promise [3]. Even though, substantial work has been done on the use of esterifies biodiesel. The purpose of this work is to study the fuel characteristics and thermal efficiency of biodiesel (BD100), diesel (BD00) and a blend of five percent biodiesel (BD5) by volume of diesel with their performance and the emissions of blend of five percent biodiesel (BD5) which was comparable to diesel. The major store of energy for direction-finding infrastructural and economic developments both in the developing and the developed countries [4] is biofuels.

II. EXPERIMENTAL METHODS

The fuels used were of biodiesel (BD100), diesel (BD00) and a blend of five percent biodiesel (BD5) by volume of diesel to run the diesel engine to get data for engine performance including exhaust gas emissions. The fuel properties were also compared (Table 1) also from the data found in the literature [5–6], the cetane number of BD100 was significantly higher and confirms the lower level of unsaturations.

Table 1. Biodiesel Characteristics

Parameters	BD100	BD00	BD5
Density(15^{0}C)	864g/cm^3	832g/cm^3	835g/cm^3
Viscosity(40^{o}C)	3.78mm^2/S	2.89 mm^2/S	3.09 mm^2/S
Cetane Number	182	56	----
Total glycerol	0.08%	----	----
Cloud point	10^{0}C	15^{0}C	----

[Worldwide Fuel Charter, Sep.2006]

The engine was made to run till the coolant temperature reached to 85^{0}C, before recording of performance and emission data. The engine was thereafter run at a constant speed of 1500 rpm.

III. RESULTS AND DISCUSSION

Engine Performance

The average % of Brake Specific Fuel Consumption (BSFC) increases after endurance test for the biodiesel (BD100), diesel (BD00) and a blend of five percent biodiesel (BD5). The BSFC of diesel (BD00) was lower than the others which is attributed to higher heating value and lower viscosity consequently a lesser amount of diesel (BD00) is desirable to afford an equivalent amount of energy. Brake Specific Fuel Consumption (BSFC) data versus engine load, measured as Brake Mean Effective Pressure (BMEP) is given in Fig.1.

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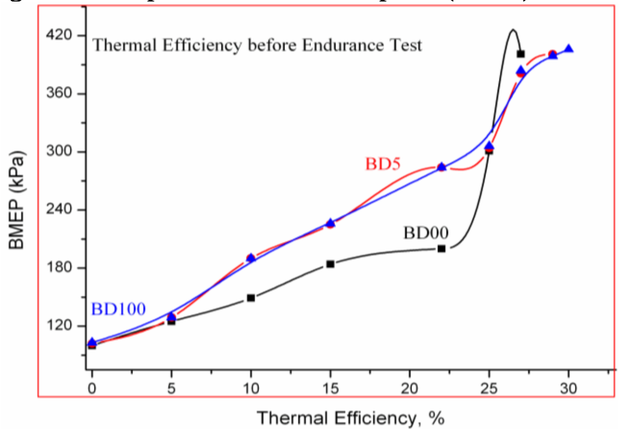
Fig.1. Brake Specific Fuel Consumption (BSFC) at 1500 rp



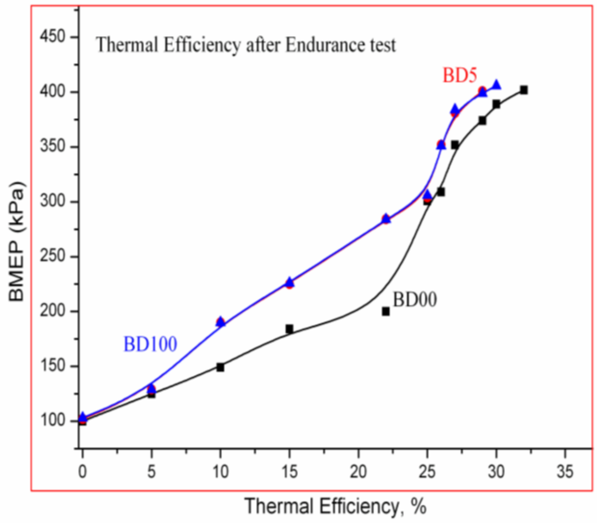
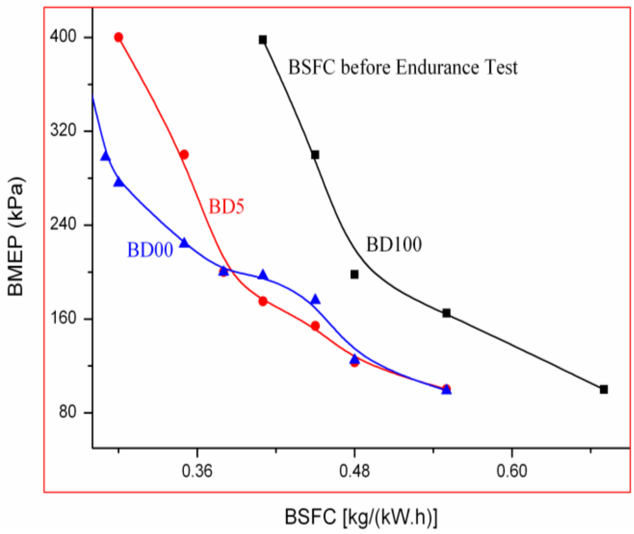
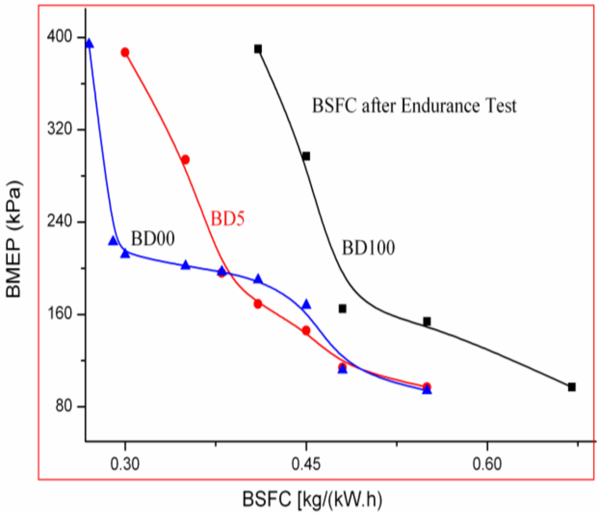


Fig.2. Thermal efficiency at 1500 rpm





Thermal Efficiency

Thermal efficiency is referred to as the inverse of Brake Specific Energy Consumption (BSEC).The thermal efficiencies for biodiesel (BD100), diesel (BD00) and a blend of five percent biodiesel (BD5) before and after endurance tests are shown in Fig.2. There was a significant fall in thermal efficiency was found with BD100 when compared to BD00 which is due to the shoddier combustion owing to higher viscosity. A largest reduction was found for BD5 followed by BD100 and BD00 respectively after the endurance test.

IV. CONCLUSION

The results point out that the biodiesel extracted from rubber seeds (*Heavea braziliensis*) can be used as a fractional substitute for diesel fuel. A blend of five percent biodiesel (BBD5) by volume of diesel can be used to diesel engines providing effective performance, reduced emissions and it has a neutral effect on lubricating oil. There is no noteworthy required modification with the engines. Finally it was found that the fuel characteristics of rubber seed oil congregate both ASTM and SNI standards for biodiesel.

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