An Experimental Study on Diesel Engine Performances Using Biodiesel from Used Frying Oil

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Abstract: The paper contains study of diesel engine performance using bio-diesel from waste frying oil. Biodiesel is produced from used frying oil which is obtained from local restaurant and hotels by transesterification process. In the present study neat biodiesel as well as blends of varying proportions of bio-diesel and diesel were used to run C.I. engine. It is found that viscosity of bio-diesel was more which affects the performance of diesel engine. Expectable thermal efficiencies and specific fuel consumption (SFC) were achieved with blends without any operational difficulties. In the present work performance of diesel engine using varying blends of biodiesel like B20, B60 and B100 i.e. neat biodiesel is tested.

Keyword: biodiesel, C.I. engine, SFC, transesterification, emission

I. INTRODUCTION

Due to global depletion of world petroleum reserves and the impact of environmental pollution of increasing exhaust emission there is an urgent need for suitable alternative fuel. The various alternative fuel options researched for diesel are mainly biogas producer gas, methanol, ethanol and vegetable oil. Out of this vegetable oil is one of the promising fuels for diesel engine. An idea of using vegetable oil as fuel for diesel engine is very old as Dr. Rudolph Diesel used peanut oil in one of his engine at Paris exposition in the year 1900.The interest in vegetable oil revalued again in 1973 after energy crises situation and much edible oil as well as non edible oil like sunflower, soybean peanuts etc. were tested. But considering fodder value of edible oil the waste frying oil is started testing for its suitability with diesel fuel. There are huge amount of used frying oil from restaurant, hotels that has no proper used. As this oil are available at low cost and using this oil for biodiesel will ensure better use of both money and used fried oil which otherwise going to waste. Research conducted all over the world using biodiesel and biodiesel blends. Diesel engine were fueled with B20, B5o and B100 or neat biodiesel fuel, from all the result it is evident blends with diesel gives better performance related of engine performance as well as exhaust emission. So studies of blends are very important.

II. Experimental Setup

The setup consists of a single cylinder, four strokes, Diesel engine connected to eddy current type dynamometer for loading. Provision is made for interfacing airflow, fuel flow, temperatures, Speed and Torque measurement. The set up has stand-alone panel box consisting of air box, fuel tank, manometer, fuel measuring unit, transmitters for air and fuel flow measurements.

The biodiesel was prepared from used frying oil collected from local restaurants, hotels by transesterification process. The blends used for testing are B20, B60 and B100. Comparison of fuel property between diesel and bio-diesel given in table 1

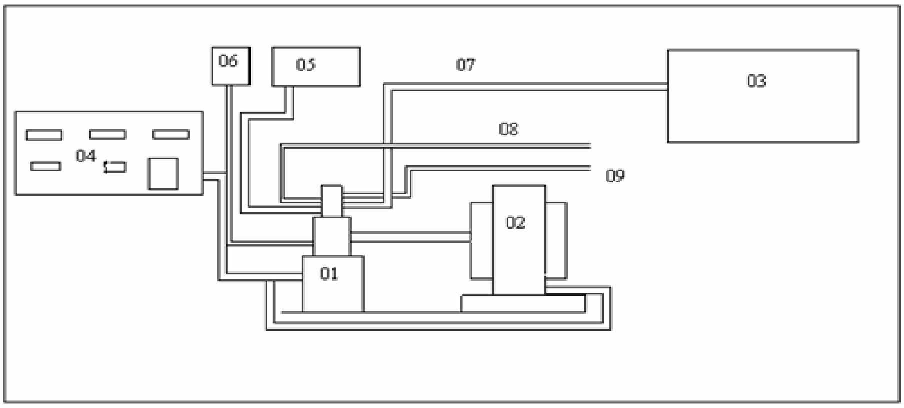

Fig: 1 Experimental setup four stroke single cylinder diesel engine

1: Engine	2: Dynamometer
3: Gas Analyser	4: Digital display of mass of fuel, mass of air, Various Temperature and Dynamometer Control Knob
5: Air Tank	
7: Exhaust Gas Pipe Line	6: Fuel Tank
9 : Water Out	8 : Water In

Table: 1 Comparative analysis of fuel properties using fried oil biodiesel and diesel.

Fuel properties	Diesel	Biodiesel
Density (gm/cc)	0.845	0.9
Viscosity (cSt)	3.0	5.7
Flash point (^{O}C)	32	140
Cetane no.	48	55
Calorific value (KJ/Kg)	42000-46000	38000-42000

Main differences between diesel fuel, ester fuel and vegetable oil are the viscosity, certain number and heat content. The viscosity of diesel is about 3.og/cc and that of fried oil biodiesel is 5.7g/cc. The viscosity of a fuel is important because if affects the atomization of the fuel being injected into the engine instruction chamber. A small fuel drop is desired so complete combustion occurs. A high viscosity fuel, such as raw oil, will produce a larger drop of fuel in an engine combustion chamber, which may not burn as clean as a fuel produces a smaller drop. Unburned oxidized fuel will build up in the engine around valves, injector tips and on piston and ring. Biodiesel has a viscosity much smaller drop, which burns cleaner. Rating varies considerably among the listed fuels, and is a measure of the self-ignition quality of the fuel. Diesel fuel usually has Cetane rating between 45 and 50 while vegetable oil 35 to 45. Biodiesel is usually 50 to 60. The quality affects engine performance, cold starting, warm up and engine combustion roughness. Cetane rating is to the volatility of the fuel where more volatile fuels have higher rating. A high cetane fuel also may lead to combustion and smoke if the fuel ignites too soon by not allowing enough time for the fuel to mix with air for combustion. The energy content of the fuels also varies. Diesel fuel typically contains about 42000-46000 while vegetable oil and biodiesel contain about 38000-42000KJ/Kg.

Test engine:

Test is carried on Kirloskar diesel DM103 heaving compression ratio 17.5:1 rated power of 10 BHP at rated speed of 1500 rpm – The engine is coupled with eddy current dynamometer for loading.

III. Result and Discussion

The CI engine is tested at various loads starting from no load condition to rated load condition the test is conducted at constant speed equal to rated engine speed. The engine did not have any initial starting difficulties during operation using neat biodiesel from waste fried oil and its blend with diesel.

Engine performance:

Brake Thermal Efficiency:

Fig. 2 shows the engine performance at various load starting from no load to full load. There is a small deviation in break thermal efficiency for biodiesel that with diesel. The brake power developed is reduced in biodiesel as compared to diesel. The brake thermal efficiency decreases slightly. As the amount of biodiesel increases, the brake thermal efficiency decreases. This happened due to higher viscosity & lower heat content of biodiesel.

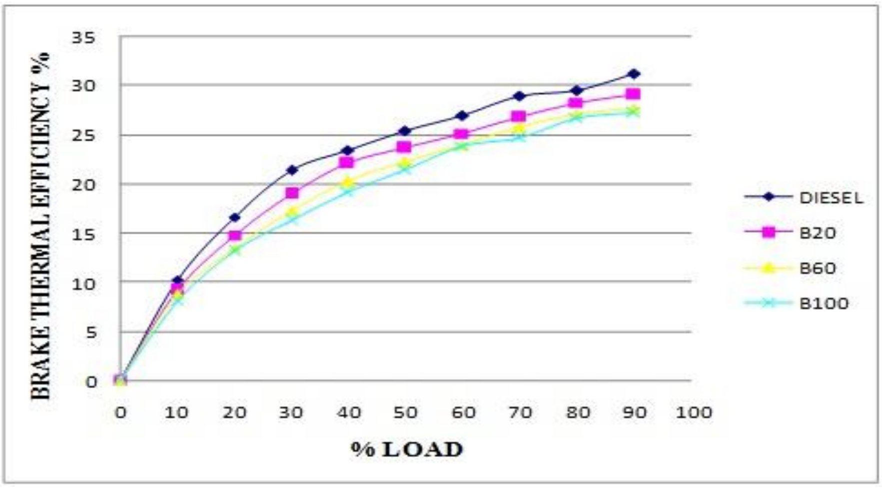

Fig. 2 BTE v/s Load

Break Sp. Fuel consumption:

Fig.3 shows brake specific fuel consumption of the engine against load. The Sp. Fuel consumption is higher in biodiesel; as compared to diesel. The reason is that fuel has lower calorific value. As a result to produce the same amount of energy, more amount of biodiesel is consumed. As the percentage of biodiesel in blend increases the BSFC increases.

IV. CONCLUSION

The exhaust performance characteristics of waste fried oil biodiesel and its blends with diesel have been compared with diesel performance. The results of study are as follows.

i) The properties of biodiesel from waste fried oil are comparable with diesel fuel.

ii) The waste fried oil biodiesel shows similar trends for brake thermal efficiency with slight reduction in the brake thermal efficiency. For B20 it is very close to that for diesel.

iii) Brake specific fuel consumption (BSFC) for biodiesel from waste fried oil is higher because of lower heating values. The Sp. Fuel consumption increases with blending proportion for waste fried oil.

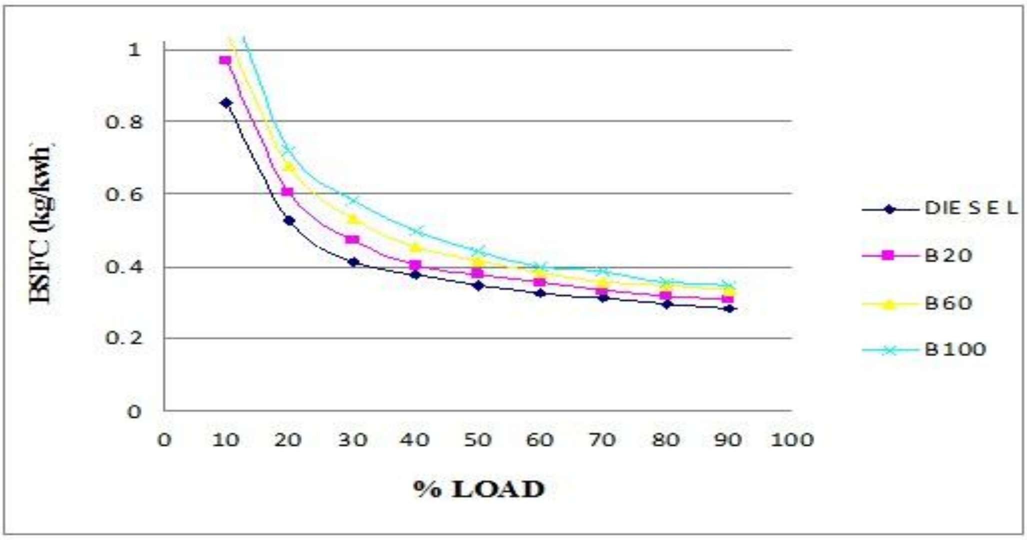

Fig 3 BSFC v/s Load (%)

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