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Production of Biodiesel using Mustard oil and its Performance evaluation in CI engine

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Abstract - Research works are going in India for suitable alternative fuels that are environmental friendly. As an alternative, the renewable sulphur free Biodiesel is receiving increasing attention. On the other hand research on mixture of two different grades of Biodiesel is in increasing making it imperative. In this work experimental investigations are carried on CI engines with the use of neat diesel fuel, calophullum inophyllum and dairy scum oil methyl esters mixture in various proportions.

From literature review it is found that the engine experimental results of Biodiesel used showed that brake thermal efficiency of engine using diesel fuel is about 37%, NOx emission for Biodiesel fuel is significantly lower than that of diesel fuel [6]. The maximum in-cylinder pressure is obtained for diesel fuel and next being B20. This could be due to different mixture of air and fuel, more calorific value, lesser density and lower viscosity of diesel fuel. Therefore higher brake thermal efficiency, lesser carbon monoxide, higher carbon dioxide, lesser HC emissions and more NOx were observed for diesel fuel.

Key Words: *Calorific Value, Flash and Fire Point, Total Fuel Consumption, Brake Power, Brake Specific Fuel Consumption, Mechanical Efficiency, Brake Thermal Efficiency.*

1. INTRODUCTION

Strength is taken into consideration as a vital issue for monetary boom, social improvement and human welfare. due to the fact that their exploration, the fossil fuels persevered because the principal traditional strength supply with increasing trend of modernization and industrialization, the world strength demand is likewise growing at faster charge [7]. To manage up the increasing energy demand, majority of the developing nations import crude oil aside from their indigenous production. This puts more burdens on their domestic economy. Therefore, it is utmost essential that the options for substitution of petroleum fuels be explored to control the burden of import invoice.

There are restricted reserves of the fossil fuels and the sector has already faced the power crisis of 1970s concerning uncertainties in their deliver. Fossil fuels are currently the dominant global supply of CO2 emissions and their combustion is stronger risk to smooth environment. increasing industrialization, growing strength demand, restricted reserves of fossil fuels and growing environmental pollutants have together necessitating the exploring of a few opportunity to the conventional liquid fuels, vegetable oils were considered as suitable alternatives to the traditional liquid fuels, vegetable oils were considered as appropriate alternative because of their ordinary fuel properties. It changed into notion of as feasible option pretty earlier. but in spite of the technical feasibility, vegetable oils as gas could not get popularity, as they have been extra high-priced than petroleum fuels. This brought about the retardation in scientific efforts to research the in addition acceptability of vegetable oils as change fuels. Later, because of several factors as said above created resumed hobby of researchers in vegetable oils as substitute gasoline for diesel engines. In view of the potential houses, huge variety of research has been performed internationally within the area of vegetable oils as trade fuels.

2. METHODOLOGY

The Vegetable oils are extracted from crude oil. There crude oil usually consists of loose fatty acids (FFA), water, sterols, phospholipids, odorants and impurities. Its can reason numerous troubles in diesel engines. It also extended viscosity, low volatility and poor bloodless waft residences [1]. They lead to excessive engine deposits, injector coking, piston ring sticking and so forth. Bio-diesel may be produced by way of following 4 ways: Paralysis, Micro emulsification, Dilution and Transesterification.

In this painting Transesterification manner is used to prepare bio-diesel from mustard oil. it's far the method of using an alcohol (e.g. methanol, ethanol or butanol), in the presence of a catalyst, along with sodium hydroxide or potassium hydroxide, to break the molecule of the uncooked renewable oil chemically into methyl or ethyl esters of the renewable oil, with glycerol as a byproduct.
Transesterification, also known as alcoholysis is the displacement of alcohol from an ester by means of some other alcohol in a technique just like hydrolysis except that an alcohol is used instead of water. This has been broadly used to reduce the viscosity of the triglycerides.

For the transesterification of mustard oil, Dr. Peeper's fashion has been followed in our work [8]. First 250 ml (ninety% natural) methanol become blended with a hundred and fifty ml (1 N) NaOH. This mixture was swirled in a tumbler container until NaOH is completely dissolved in methanol. As that is an exothermic response, so the aggregate would get hot. This answer is referred to as methoxide, which is an effective corrosive base and is dangerous for human skin. So, safety precautions must be taken to avoid pores and skin contamination at some point of methoxide producing. The top more transparent layer is a hundred% bio-diesel and the lower concentrated layer is glycerol. The heavier layer is then eliminated both with the aid of gravity separation or with a centrifuge. In a few instances if the mustard oil consists of impurities, then a skinny white layer is formed in between the 2 layers. This skinny layer composes soap and different impurities. Bio-diesel produced in the above process consists of moisture (vaporization temperature one hundred degree Celsius) and methanol (vaporization temperature 60 diploma Celsius.) and typically some cleaning soap. If the soap degree is low enough (three hundred-500 ppm), the methanol can be removed by way of vaporization and the methanol will generally be dry enough to immediately recycle returned to the reaction. Methanol fashion to behave as a co-solvent for soap in biodiesel; so at better soap stages the cleaning soap will precipitate as a viscous sludge whilst the methanol is eliminated. Anyway, heating the biodiesel at temp. Above a hundred diplomas Celsius would motive the elimination of each the moisture and methanol as well. Any other process is to add directly mustard oil [9] to the diesel gasoline without transesterification process and blends of various share named B10, B20 and B30.

Fig -1: Transesterification Reaction

Fig -2: Separation of glycerol

Fig -3: Water Wash of Biodiesel

Table -1: Fuel Properties of Different Blends and Diesel

		B10	B20	B30	Diesel
Density	Kg/m^3				
Specific Gravity		0.826	0.831	0.836	0.82
Kinematic Viscosity	mm^2/sec	4.34	5.59	11.53	3.91
Dynamic Viscosity	cp	3.82	4.69	9.69	3.22
Calorific Value	MJ/kg	44.88	44.38	43.82	45.5
Flash Point	^0C	68	73	77	62
Fire Point	^0C	75	80	87	69

Fig -4: Test Engine

Table -2: Engine Specifications

SL NO	ENGINE PARAMETERS	SPECIFICTION
01	Machine supplier	KIRLOSKAR OIL ENGINES LTD
02	Engine Type	TAF-1(Kirloskar, Four Stroke)
03	Number of cylinders	Single Cylinder
04	Number of strokes	Four-Stroke
05	Rated power	4.4KW (6HP) @1500RPM
06	Bore	87.5mm
07	Stroke	110mm
08	Cubic Capacity	661.5cc
09	Compression ratio	17.5:1
10	Rated Speed	1500 RPM
11	Dynamometer	Eddy current dynamometer, make Benz systems
12	Type of cooling	Air cooling
13	Fuel injection Pressure	200 bar
14	Fuel	Diesel
15	Load Measurement	Strain gauge load cell
16	Speed Measurement	Rotary encoder
17	Temperature Indicator	Digital
18	Cylinder Pressure Measurement	AVL Pressure Transducer GH12D,range 250bar

3. RESULT

The present study investigates the performance of mustard oil biodiesel, measuring the fuel properties and conducting experimental analysisload characteristics of produced oil on vertical single cylinder diesel engine, model TAF 1 produced by Kirloskar Oil Engines. This engine has a compression ratio of 17.5:1. It has a power rating of 3.7 KW at 1200 rpm, 4 KW at 1500rpm, 5.7 KW at 1800rpm and 6.2 KW at 2000rpm.For varying loads and various blends of biodiesels with compression ratio (17.5:1) and injection pressure of 200 bar.

Brake Power: BHP is amount of force generated by a motor without taking into consideration of any of the various components that may slow down the actual speed of motor. As load increased BHP increased to the maximum and then decreased for fuel samples [3]. As per our experiment we can conclude that B30 can be recommended for use in diesel engines without any engine modification.

Brake Specific Fuel Consumption: Specific fuel consumption is one of the important parameters of engine and is defined as the consumption per unit of power in a time unit[5]. It was observed that as the load increases BSFC decreases. It was found that BSFC was minimum for B30 compared to other blends.

Brake Thermal Efficiency: thermal efficiency is the measure of effectiveness and complex combustion of fuel more specifically the ratio of the output or work done by substance in the cylinder in a given time to the input or heat energy of fuel supplied during the same time [3]. The increase in thermal efficiency means that a larger portion of combustion heat has been converted into work .It was noticed that BTE for b30 was more or less equal to the diesel.

Mechanical Efficiency: Mechanical efficiency is the parameter that gives the effectiveness of an engine in transforming its input energy to output energy. For an internal combustion engine, it is the ratio between the brake work and indicated work. By experiment, we found that B30 has high mechanical efficiency compared to other blends and is suitable for use in engine without engine modification.

4. DISCUSSION

Biodiesel is a renewable, biodegradable and environment friendly fuel with low emission profiles and its combustion properties are similar to petroleum based diesel. Biodiesel obtained from fats by transesterification was found to be suitable for use in engines when added in proper proportions with diesel. Several investigations have been carried out to evaluate the engine performance of different biodiesel blends [4].Our results on an analysis of engine performance indicated that when mixed in proper concentrations with commercial diesel, biodiesel can be efficiently used in engines. It was observed that in blend B30, in which biodiesel was added in the ratio of 30:70 with normal diesel, engine performance was similar to diesel used alone in terms of torque, brake horsepower, and specific fuel consumption. These results indicated that mixing up to 30% of biodiesel with diesel can be efficiently used in IC engines without affecting the performance of engines.

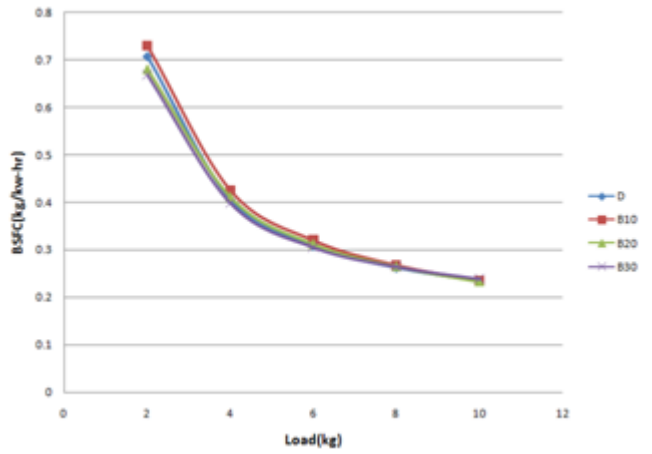

Chart -1: Load v/s Brake Specific Fuel Consumption

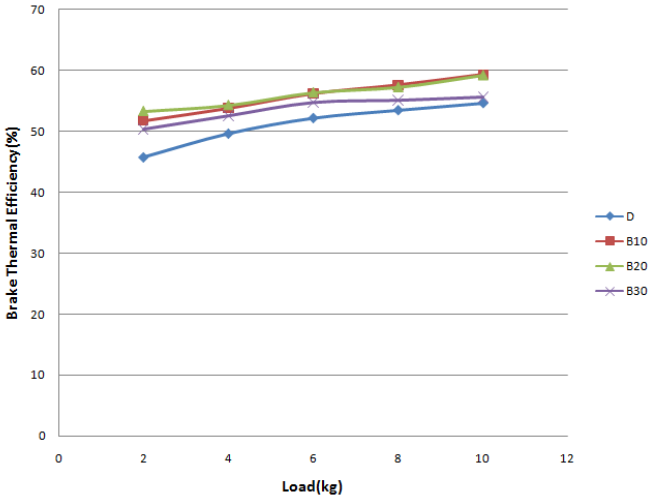

Chart -2: Load v/s Brake Thermal Efficiency

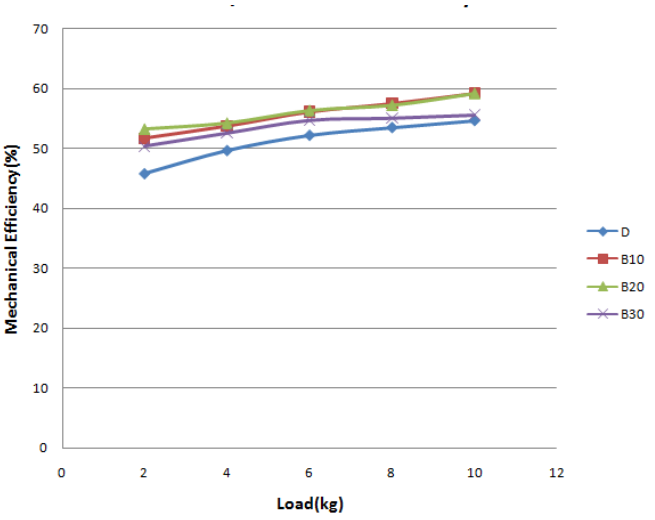

Chart -3: Load v/s Mechanical Efficiency

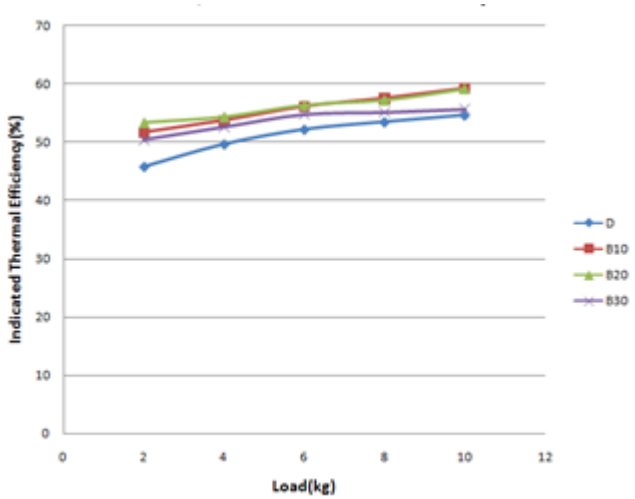

Chart -4: Load v/s Indicated Thermal Efficiency

CONCLUSION

The following conclusions are drawn from this investigation.

- ✓ Produced bio diesel satisfies the important fuel properties as per ASTM specification of Biodiesel.
- ✓ The existing diesel engine performs satisfactorily on biodiesel fuel without any significant engine modifications.
- ✓ Engine performance with biodiesel does not differ greatly from that of diesel fuel. The B30 shows good brake thermal efficiency in comparison with diesel. A little change in fuel consumption is often encountered due to the lower calorific value of the biodiesel.

Among the blends, B30 showed the better performance and emission characteristics at various loading conditions.

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