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Utilisation of Neat Rice Bran Methyl Ester and it's Blends as Fuel for the CI Engine

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Abstract- **To meet increasing energy requirements, there has been growing interest in alternate fuels like biodiesel to provide a suitable diesel oil substitute for internal combustion engines. Biodiesel offer a very promising alternate to diesel oil since they are renewable and have similar properties. It is an oxygenated fuel and emissions of carbon monoxide are less unlike fossil fuels, the use of biodiesel does not contribute to global warming as CO_2 emitted is once again absorbed by the plants grown for vegetable oil/biodiesel production, thus CO2 balance is maintained. In this paper the Rice bran methyl ester (RBME) in the neat form and various blends is used with pure diesel to study load test of the engine. The performance of the engine under different operating conditions and blends are compared by calculating the brake thermal efficiency, total fuel consumption and brake specific fuel consumption by using pure diesel and adding various blends of Rice bran methyl ester with diesel.**

I. INTRODUCTION

Exhausting of fossil fuels in the near future create a need to search of alternative fuels. Renewable oxygenated sulfur free and biodegradable, Bio-diesels are best alternative for the petro-diesel fuel. Bio-diesel need not required rigorous engine modifications. It can use directly on diesel engines. In the Bio-diesels oxygen is the one of the constituent which causes for complete combustion of the fuel inside the engine cylinder. The Bio degradability is the other advantage, in the case of bursting of storaging tanks, it will not cause for serious harm to the environment. Bio-diesel is a renewable energy resources. Even though Bio-diesels are extracted from the vegetable oils, the vegetable oils are not suitable for the direct usage on the diesel engine. Vegetable oils are having high viscosity and caused for formation of gummy substances at high temperatures and pressures. If the vegetable oils are converted as esters of Methyl (or) Ethyl, then they are suitable for the diesel engine. Transformation of vegetable oils into the Alkyl Esters of fatty acids is known as transesterification. Any vegetable oil can be converted as ester of methyl (or) ethyl. In this paper we present the transesterification of Rice bran oil and load test curves on CI engine and analysis.

II. TRANSESTERIFICATION PROCEDURE

In this experimental work rice bran oil was converted into methyl ester by the two stage process .In the first stage rice bran oil was reacted with methanol (CH_3OH) in presence of an acid catalyst. A specified amount 1000ml of rice bran oil was taken in a conical flask and heated up to 60-65°C.During the heating the oil , continuous stirring required to do. After that the oil is shifted into a separating flask and allow the settlement. In the mean time sodium methoxide is prepared by taking, CH_3OH (200 ml) and sodium hydroxide (NaOH) (7.5 g) and properly mixed until whole NaOH pallets gets dissolved in methanol. Acid treated oil again taken into conical flask and heated upto 40-45^{0}C, at this temperature sodium methoxide added to the oil, again the oil is heated upto 60°C-65^{0}C. Due to this treatment glycerin which is high viscous, separated from the oil. After that the oil shifted to the decanter, hence glycerol settles down at the bottom. Then the glycerol and RBME is separated. In this stage RBME contains Na_2SO_4 salt which can dissolved in the water.Hence the oil is submitted for the water wash to separate the salt, further it is followed by the dehydration to separate water traces in the oil.

Basically vegetable oil and fats are consists of mono, di and triglycerides of fatty acids. Triglycerides are the predominate compounds in the vegetable oil and fats chemical structure is as shown in fig.1 Where R_1, R_2, R_3 are long chain fatty acids.

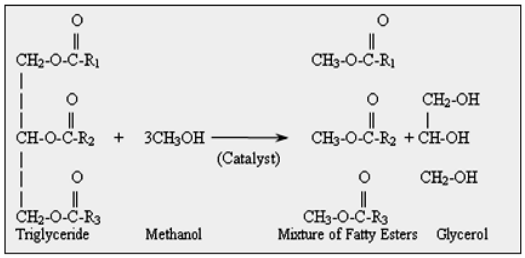


Fig.1 Chemical Equation for the Transesterification

If number of double bonds in the structure increases, it will causes for increase in viscosity. In this, left side structure is glycerin structure and it causes for high viscosity. If these are replaced with methyl (or) ethyl due to reactions with methanol (or) ethanol, Obtained product is the biodiesel.

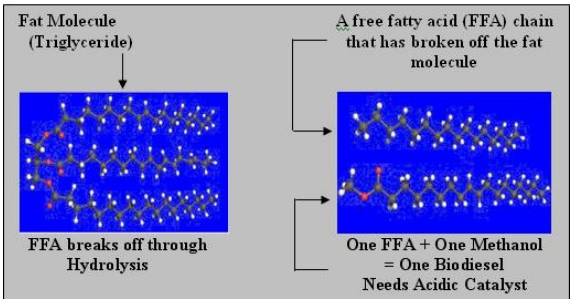


Fig.2. FFA chain Break after acid treatment

Fig.3 Experimental setup for transesterification

After the acid treatment free fatty acid (FFA) chain breaks into simple chain as shown in the fig.2. If We use the methanol the formed ester is methyl ester of fatty acids. If We use the ethanol the formed ester is ethyl ester of fatty acid. For this reaction sodium methoxide, or potassium methoxide used as catalyst . Alkyl ester is less denser than the glycerin and water. So that after completion of the process, if the oil is poured into the separating funnel glycerin settled down and it can separate easily. Experimental Setup is shown in the Fig.3. Properties of RBME & Petro diesel comparison shown in the Table:1

Table:1 Properties of tranesterified rice bran oil

Properties	Rice bran oil Ester	Diesel
Flash point	163^0c	63^0c
Fire point	172^0c	66^0c
Calorific value	41,500 Kj/Kg	43,000Kj/Kg
Viscosity	36sec	32sec

III. EXPERIMENTATION ON THE DIESEL ENGINE

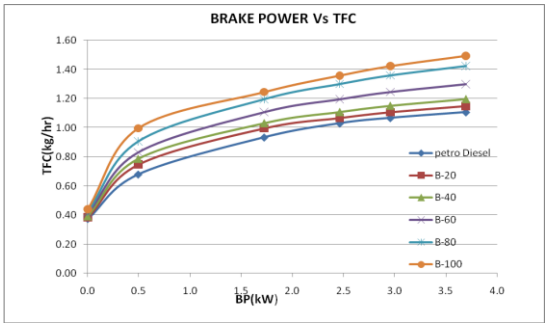
Load test is conducted on DI-Diesel Engine with the different blends of Rice Bran Methyl ester with petro diesel such as B-20, B-40,B-60,B-80 (B-20 means Biodiesel 20% and remaining petro diesel). The engine also tested with 100% RBME which is shown in the graphs as B-100. All the readings are taken after the stabilization of combustion in the cylinder. For each proportion the load test conducted and results are plotted at various loads. At each load speed of the engine maintained as constant. Finally the results are compared with petrol-Diesel. Engine specifications are given in Table:2

Table:2 Engine Specifications

Type of Engines	High speed Diesel Engine
No. of Cylinders	1
Brake power	3.72kW
speed	1500rpm
Engine bore	80mm
Stroke	110mm
Loading type	Mechanical
Brake Drum Diameter	0.315m
Orifice Diameter	25mm

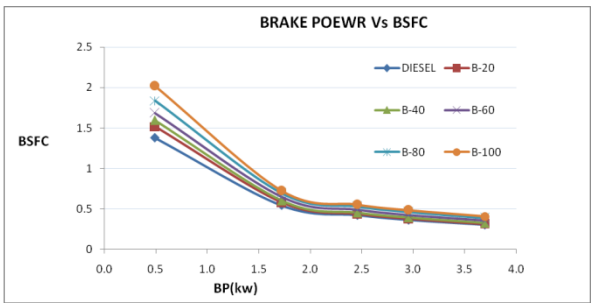
IV. RESULTS AND DISCUSSIONS

- Calorific value of Bio-diesel is less as compare to that of the diesel hence the fuel consumption of Bio-diesel is more (Graph1&Graph 2)
- B-20 graph of bio-diesel is nearer to the diesel so it is suggestible for the use in the engine.



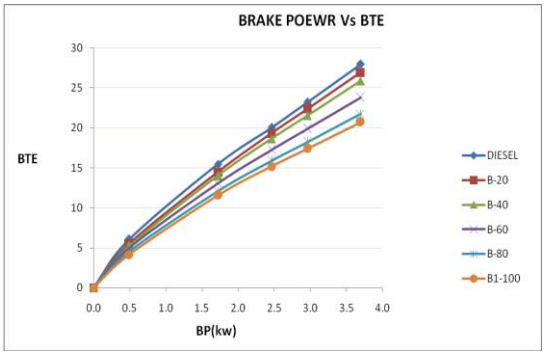
Graph:1 Total fuel consumption Vs Brake Power

- Due to the inertial force and frictional forces the slope of curve in starting is more after that is constant for some times.



Graph 2 : Break Power Vs Brake Specific Fuel Consumption

- In each graph, easterified rice bran results are nearer to the petroleum diesel. When the percentage of estrified rice bran oil increases specific fuel consumption increases, mechanical efficiency decreases, brake thermal efficiency and indicated thermal efficiency decreases.(Graph3)
- The results are not so advantageous than the petroleum diesel, but nearer. So that estrified rice bran oil is preferable as fuel for the diesel engine.
- In India rice is the main crop, there is feasibility of using ricebran oil as biodiesel .



Graph 3: Brake Thermal effieciency Vs Brake Power

V. CONCLUSIONS

From the above results and discussion of the experimental investigations on a single cylinder, four strokes, constant RPM, stationary, air cooled, compression ignition engine run on blends of rice bran oil at different loads the following conclusions may be drawn.

1. Ricebran oil has less calorific value, it is preferable as alternative for the petroleum As the demand for the fuels increases day to day, even though the estrified rice diesel. Due to the oxygen in the vegetable oils bio diesels completely ignites inside the engine cylinder. So that the environmental pollution reduces or in other words it is environmental friendly fuel.
2. RBO has a low free fatty acid content and can be transesterified without pretreatment with an acid and this will reduce the cost of production when produced on industrial scale. The properties of B100 are close to those of diesel fuel hence it can be used as alternative fuel for diesel engines.
3. The rice bran biodiesel and its blends can be used as an alternative fuel in DI diesel engine without compensating in terms of power and brake thermal efficiency. This can be helpful to reduce the usage of a non renewable conventional fuel and also to reduce the environmental pollution as the biodiesel is eco-friendly.
4. As the demand for the fuels increases day to day, eventhough the estrified rice bran oil has less calorific value, it is preferable as alternative for the petroleum.
5. Diesel. Due to the oxygen in the vegetable oils bio diesels completely ignites inside the engine cylinder. So that the environmental pollution reduces or in other words it is environmental friendly fuel.

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