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PERFORMANCE AND EMISSION ANALYSIS OF RICE BRAN METHYL ESTER BLEND WITH DIESEL AND ETHANOL ADDITIVE

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ABSTRACT

Rising petroleum prices, increasing threat to the environment from exhaust emissions and global warming have generated an intense international interest in developing alternative non-petroleum fuels for engines. The two alarming situations in front of the engineers worldwide are to reduce the load on conventional fuels and to reduce the ever increasing environmental pollution. This study is aimed to investigate experimentally the performance and exhaust emission characteristics of a diesel engine when fuelled with blends of rice bran oil and ethanol, over the entire range of load on the engine. The experiments were conducted on widely used diesel engine without major modifications. Experiment results shows that at full load condition, the BD10, BD20 and BD30 blends produce 2%, 5%, and 8% higher brake thermal efficiency than sole Diesel respectively. The level of CO decreases with 26% at full load conditions with BD30. The % of hydrocarbons and carbon dioxide emissions decrease with compare to diesel with adding of ethanol. The use of rice bran oil as fuel in diesel engine is recommended for the use in diesel engine with ethanol blends on the basis of the results obtained from the study.

1. INTRODUCTION

Biodiesel is defined as mixture of monoalkyl esters of long chain fatty acid derived from a renewable lipid feedstock, such as vegetable oil or animal fat. Oxygenated bio-fuels like bio-diesel and Methanol in combination with Diesel can effectively substitute diesel fuels and reduce emission from in use diesel vehicles. Biodiesel is the best substitute for diesel fuel in diesel engines. Recently the increases in crude oil prices, limited resources of fossil oil and environmental concerns, there has been a renewed focus on vegetable oils and animal fats to make biodiesel fuels. Due to the depletion of the world's petroleum reserves and the increasing Environmental concerns, there is a great demand for alternative sources of petroleum based fuel, including diesel and gasoline fuels. Biodiesel, a clean renewable fuel, has recently been considered as the best candidate for a diesel fuel substitution.

Since the commencement of industrial revolution in the late 18th and early 19th century, energy has become an indispensable factor for mankind to preserve economic growth and maintain standard of living. The most of global primary energy production derives from fossil energy. Fossil fuels accounted for 88% of the primary energy consumption, with oil (35%), coal (29%), natural gas (24%) as the major fuels, while nuclear energy and hydroelectricity account for 5% and 6% of total primary energy

consumption, respectively.

However, due to the limited traditional fossil energy resources and increased environmental concerns, a requirement for alternative energy sources has been paid a great attention in recent years. Developing alternative energy is an inevitable choice for sustainable economic growth in human society. In addition, it is also important for the harmonious coexistence of human and environment as well as for the sustainable development. Considerable attention was focused on the development of biofuel, with particular referring to the biodiesel

1.1 ADVANTAGES OF BIODIESEL

Vegetable oil produced domestically which helps to reduce costly petroleumimports.

- It is bio-degradable, nontoxic and contains lower aromatics.
- It is a renewable fuel that can be made from agricultural cropsand other feedstock that are considered as waste.
- It has the reasonable cetane number and hence process possesses less knocking tendency.
- Low Sulphur content and hence environmental friendly.
- Personal safety is improved.

2. RICE BRAN OIL AND ETHANOL

Rice Bran Oil is a unique vegetable oil produced from the outer brown layer of rice which is removed in the form of rice bran during the polishing process of the rice milling industry. Besides having an almost ideally balanced fatty acid profile, it is rich in natural anti-oxidants. A number of scientific studies conducted in India & abroad have well documented the better cholesterol lowering properties of rice bran oil as compared to other conventional vegetable oils. All these studies have attributed these properties of the oil to the presence of unique nutraceuticals in this oil known as oryzanol & tocotrienols. Rice bran oil is the world's healthiest edible oil, containing vitamins, antioxidants and nutrients. It is not just delicate and flavourful; but also helps to lower cholesterol, fight diseases, enhance the immune system, and fight free radicals. It contains highest amount of all natural vitamin-E and contains unique component oryzanol which is linked with increase in good cholesterol and lowering down the bad cholesterol and triglycerides. Rice Bran Oil is extensively used in Japan, Korea, China, Taiwan and Thailand as premium edible oil. It is the conventional & the most favourite cooking medium of the Japanese and is popularly known as "Heart Oil" in Japan. It has acquired the status of a "Functional Food" or a "Health Food" in Western Countries.

India is the second largest producer of rice in the world next to China, having potential to produce about 13.04 lakh MT of Rice Bran Oil per annum. India produces 140 Million MT of paddy and 93 Million MT of rice. Currently, the industry is processing about 44 lakh MT of Rice Bran producing about 8.30 lakh MT of Rice Bran Oil per annum, out of which 8.0 lakh MT are of edible grade and the balance

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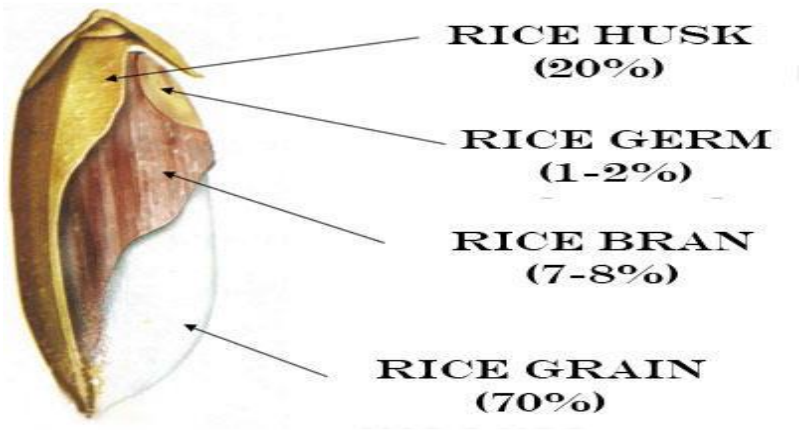
0.30 lakh MT is of non edible grade . India has substantial reserves of non-traditional oil seeds and oil-bearing materials.

At present, merely half of this potential is realized; yet India is the largest producer of rice bran

Fig. 1 Structure of Rice with different layers



RBO has the ideal ratio of saturated, monounsaturated and poly-unsaturated fatty acids and is the closest to World Health Organization recommendation. The tocotrienol present in RBO has anti-thrombotic and anti-Cancer properties and good for skin. It contains squalene which improves skin tone and delays wrinkle formation. It has 4 hydroxy 3 methoxy cinnamic acid which stimulates hormonal secretion and rejuvenates health. Rice bran oil is a superior salad, cooking, and frying oil which leaves no lingering after taste. The high smoke point prevents fatty acid breakdown at high temperatures. Its light viscosity, allows less oil to be absorbed in cooking, reducing overall calories. It mixes better in salad dressings and improves the taste of baked goods.

RBO is commercially available in the market from the different processing methodology. There are still unexplored areas like storage stability of RBO and RBO based blended oil and the quantification of RBO in the blended oil. Moreover, the frying characteristics of the foods consisting of different ranges of moisture content and the effect of microwave cooking are the aspects, required immediate attention. The proposed work was therefore aimed to explore the following objectives:

- Enzymatic degumming of crude rice bran oil.

- Effect of packaging materials on the storage stability of physically refined rice bran oil and its blends.

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- Quantification of rice bran oil in the blended oils.

- Thermal oxidation of rice bran oil during oven test and microwave heating.

- Effect of frying conditions on the physic-chemical properties of rice bran oil and its blended oil.

3. CONCLUSIVE DECISION ON RICE BRAN OIL

India is an agricultural country. India is the second largest country in the world producing paddy. The oil extracted from paddy can be used for cooking. But all the amount of oil is not used for cooking purpose. Remaining oil which is available can be used for production of biodiesel. The cost of oil is also less when compare to other edible oil. So I have taken this oil for production of biodiesel. In this work oil is heated up to 50-55℃.Then 25ml ofmethanol (for 100ml of oil) and 1% wt. of catalyst is used for production of biodiesel.

EXPERIMENTAL SETUP

MATERIALS USED

The following materials are used for production of biodiesel.

1. Refined rice bran oil.
2. Methanol.
3. Sodium hydroxide (NaOH)-catalyst.
4. Separating funnel.
5. Magnetic stirrer with hot plate.

To prepare biodiesel from refined rice bran oil and do the engine test. Performance, emission and combustion characteristics of diesel engine and its calculation were done.

4. BIODIESEL PREPARATION

500ml of refined rice bran oil is taken in round bottom flask of 500cm^3 of batch reactor. By the use of magnetic stirrer and hot plate the oil sample was heated between the temperature 50-55˚c.Add methanol 125ml and catalyst (NaOH) pellets (1% wt of oil sample) to the preheated oil. The mixture was heated to 1hr constant stirring at a constant temperature of 50-55 ˚c.After the reaction was completed, the mixture was transfered into a separating funnel and wait for 12hrs for separation of biodiesel and glycerol to settle down (yield 94%). The methyl esters were separated from separating funnel and it was washed with hot water for purification. Then the biodiesel was heated to 108℃ to remove water particles.

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RICE BRAN OIL

Fig .2 .heating of rice bran oil

Fig 3 Separation of biodiesel from glycerol

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FATTY ACID COMPOSITION OF RICE BRAN OIL

Sl.NO	FATTY ACID COMPOSITION OF RICE BRAN OIL	COMPOSITION (%)
1	Meristic acid	0.34
2	Palmitic acid	19.5
3	Stearic acid	2.3
4	Oleir acid	43
5	Linolic acid	32
6	Linolenic acid	1.6
7	Arechidic acid	0.7
8	Higher fatty acid	0.6

RESULT DISCUSSION

Comparison of diesel 88%,75%,62% rice bran methyl ester 10% ,20% ,30%,2%,5%,8% additive (kerosene), are made. The performance and Emission characteristics are assumed. Based on the previous study performance characteristics of engine using rice bran oil with kerosene additives were assumed and expected outcome was drawn as graph.

CONCLUSION

By using 2% additive with biodiesel, fuel consumption decreases per Kg of Load
By using 8% additive (E) with biodiesel, brake thermal efficiency increases by 4% when compared to diesel. In emission HC increases by adding additive BD30%, D 62 %, 8%E. CO decreases by adding 8% additive than biodiesel. NOx also decreases by 4.382% by adding additive (8%E) than biodiesel. The blend of 20% ethanol with rice bran oil has great impact on smoke emission and other gases, and also the performance parameters are almost similar to diesel fuel. The conclusions from the research completed thus far lead to recommendations for the use of BD30%,D62%,E8% blends are without affecting the performance and emissions of the engine.

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FUTURE WORK

Study on the long term stability of the studied biodiesel blends in cars, tractors, trucks etc. should be done. Further investigation can be carried out for the production of ester of crude rice bran oil from different alcoholic groups to conduct various engine tests. Experimental investigation on heavy load engines like trucks can be done to figure out an optimum compression ratio for its improved performance along with effects of injection advance and kinetics of emission in CI engine with biodiesel. The viscosity of RBOME was within the recommended limit. Blending the RBOME with diesel oil further brought the properties closer to those of diesel oil. RBOME may be blended with diesel oil because the blends seem to have some of the major fuel characteristics, such as viscosity, and heat of combustion were close to those of diesel oil. The use of blend of diesel with RBOME may be restricted to lower proportions of RBOME as the higher proportions of RBOME tend to deviate further from diesel in their properties.

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