International Journal of Applied Engineering Research ISSN 0973-4562 Volume 13, Number 14 (2018) pp. 11589-11592

Experimental Investigation on Compression Ignition Engine Runs on Different Blends of Rice Bran Oil

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Abstract

While finding alternative solution of fossil fuels, research in the area of renewable sources like edible and non edible vegetable oil, waste cooking oil takes a charge. In this study rice bran Oil & kerosene mixture will be used as fuel in 10 H.P. Diesel Engine to examine the performance and feasibility without changing any design. To make rice bran oil more volatile kerosene is mixed and makes the mixture easy to burn. Experiment was conducted with three different proportions of B20, B40 & B60 of rice bran oil to kerosene. During the trail run it was clearly seen of decreasing in mechanical efficiency with increased load for the entire trail runs. B20 found most promising blends among all other blends and having better performance than others.

Keywords: Fossil fuels, rice bran oil

INTRODUCTION

Recently crude price has increased about doubled from 30 USD per barrel to 65 USD per barrel with that demand of such fossil fuels is increasing day by day. Due to import of crude from gulf countries, India loosing foreign exchange which cause major issues for our developing country. Middle class and farmers facing major issues when price of petrol diesel rise day by day. So now the demand of research in the area of alternative fuel is much needed. India is agriculture based country and so as production of many edible and non edible sources of alternative oil crop can be grown professionally on our agriculture land. Rice production in India increased day by day. Due to advancement of scientific farming has increased yield capacity of rice production 2400 kg/hectare from 668 kg/hectare in 1951. This advancement has chances of gaining profits from byproduct of rice crop. In India production of electricity is from various sources like thermal, hydro, nuclear, solar, wind and tidal power plant. But major electricity is produced by thermal power plant only. So the demand of non renewable coal is too high. Researchers and many agency has tried to replace coal from Bio coal, waste cooking oil and other flammable substances and hence rice husk based power plants are taking shapes in many countries like India, Indonesia and South Korea.

Rice is a plant. The external layer of the grain (bran) and the oil produced using the grain is utilized for pharmaceutical. Rice grain oil is well known as "Healthy Oil" in Japan, Asia, and especially India. Be mindful so as not to mistake rice grain for different types of wheat, for example, oat and wheat.

Rice wheat is utilized for treating diabetes, hypertension, elevated cholesterol, liquor addiction, corpulence, and AIDS for avoiding stomach and colon malignancy; for counteracting heart and vein (cardiovascular) malady; for reinforcing the invulnerable framework; for expanding vitality and enhancing athletic execution; for enhancing liver capacity; and as a cancer prevention agent. Rice grain oil is additionally utilized for elevated cholesterol. A few people apply rice grain specifically to the skin for a hypersensitive skin rash called skin inflammation (ectopic dermatitis).

Bran, otherwise called mill operator's bran is the hard external layers of oat grain. It comprises of the consolidated aleurone and pericarp. Along with germ, it is a basic piece of entire grains, and is regularly created as a result of processing in the generation of refined grains. At the point when bran is expelled from grains, the grains lose a part of their wholesome esteem. Bran is available in and might be processed from any oat grain, including rice, corn (maize), wheat, oats, grain and millet. Bran ought not be mistaken for debris, which is coarser flaky material encompassing the grain, yet not shaping piece of the grain itself.

Bran is especially wealthy in dietary fiber and basic unsaturated fats and contains noteworthy amounts of starch, protein, vitamins, dietary minerals and phytic corrosive, which is a subterranean insect supplement that counteracts supplement retention.

The high oil substance of bran makes it subject to rancidification, one reason that usually isolated from the grain before capacity or further handling. The bran itself can be warm treated to build its life span.

Rice bran is a result of the rice processing process (the change of darker rice to white rice), and it contains different cell reinforcements that bestow useful impacts on human wellbeing. A noteworthy rice bran portion contains 12%-13% oil and profoundly unsaponifiable segments (4.3%). This part contains tocotrienols (a type of vitamin E), gamma-oryzanol and beta-sit sterol; every one of these constituents may add to the bringing down of the plasma levels of the different parameters of the lipid profile.
Rice bran additionally contains an abnormal state of dietary strands (beta-glucan, gelatin and gum). What's more, it additionally contains ferulic corrosive, which is likewise a segment of the structure of non lignified cell dividers. In any case, some exploration recommends there are levels of inorganic arsenic (a poison and cancer-causing agent) display in rice bran. One investigation observed the levels to be 20%

higher than in drinking water. Different sorts of bran (got from wheat, oat or grain) contain less arsenic than rice bran, and are similarly as supplement rich.

Table I. Composition of Rice Bran

Nutrients (%)	Wheat	Rye	Oat	Rice	Barley
Carbohydrates w/o starch	45–50	50–70	16–34	18–23	70–80
Starch	13–18	12–15	18–45	18–30	8–11
Proteins	15–18	8–9	13–20	15–18	11–15
Fats	4–5	4–5	6–11	18–23	1–2

Table III. Sample Information (approx per 100 gm)

Rice Bran Oil at 30°	
Density	0.860 gm/cc
Calorific Value	372.5kcal
Energy Value	900Kcal
Fats	100gm
Saturated fatty acids	24gm
Poly Saturated fatty acids	34gm
Mono Saturated fatty acids	42gm
Vitamin E	50mg

A. Blending of Rice Bran Oil with Kerosene

Bio fuel can be used either directly in to the CI engine or it can be blended with petrol, diesel or in kerosene in different proportions. B100 is 100% bio fuel. The B20 (20 % bio fuel and 80 % petrol/diesel/kerosene fuel

Factors affecting the performance of Diesel engine when using bio-diesel blend as fuel.

For this experiment trial B20, B40 & B60 composition of Rice Bran Oil and Kerosene will be used.

Properties of fuel, Nozzle size and hole number, Injection pressure, compression ratio and injection timing, Droplet size, spray cone angle and spray tip penetration (spray characteristics) & Temperature

EXPERIMENT SETUP AND TEST PROCEDURE

Experimental setup consists of a 10 HP single cylinder Pitter type C.I. Engine which is connected to rope break dynamometer for variable loading. Engine runs at 1500 rpm rated speed and take the readings of time for consumption of 10 ml of different blends.

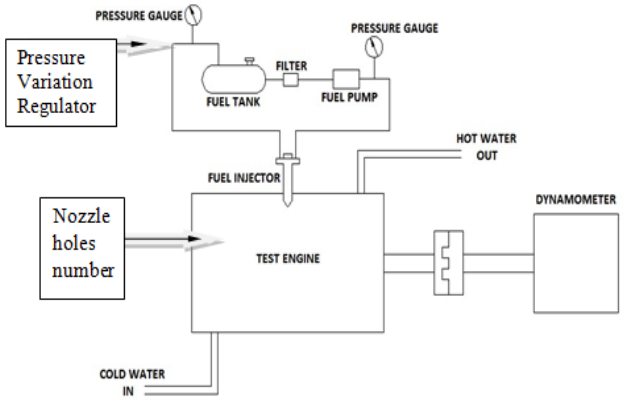

Figure 1. Experiment Set Up Line Diagram

Table IIIII. Engine Specification

Make & Model	PITER Type Engine 54A
General Details	Four Stroke Single Cylinder Diesel Engine
Bore	102 mm
Stroke	110 mm
Capacity	898 cm^3
Compression Ratio	15:1
Type	Water Cooled
Specific fuel consumption	251 g/kWh
Maximum H.P.	10HP

Before we start the engine some preliminaries has to follow as a part of experiment like checking of fuel level, checking of lubricating oil, checking of three way cock for continue flow of water during experiment and at last checking of water level. Soon after this to remove air trapping between cylinder and piston decompression lever is to be pressed. Now to start the engine, hand crank lever is to be attached on crank shaft and rotate it at sufficient speed. As engine takes its rated speed, check by putting tachometer and allow engine to run on 1500 rpm. Record the time taken for 10cc fuel consumption at no load and check the rpm by digital tachometer. Then the engine pulley is loaded by rope wound on pulley attached with different loads and take readings of time taken for 10cc of fuel consumption. Repeat this experiment at different loads of 25%, 50%, 75% and full load 100%. Change the blends and repeat this procedure for the B20, B40 & B60 and note the readings.

RESULT OF TEST TRAIL

Table IVV. Engine Trial Result by B-20 blend

Sr. No.	Fuel Sample Quantity (cc)	Time for 10 cc Fuel Consumption (t) (sec)	Speed (N) (RPM)	Brake Load (L) (kg)	Brake Power (BP) (kW)	Brake Thermal Efficiency (BTE) (%)	Brake Specific Fuel Consumption (BSFC) (kg/kW-hr)	Brake Specific Energy Consumption (BSEC) (MJ/kW-hr)	Indicated Thermal Efficiency(ITE) (%)	Mechanical Efficiency (%)
1	10	36	1500	11.2	1.69	16.85	0.49	21.36	53.74	31.35
2	10	31	1500	16.8	3.59	29.84	0.27	11.68	62.60	49.25
3	10	21	1500	23	5.81	35.40	0.24	10.65	55.31	61.09
4	10	18	1500	28	7.13	37.52	0.23	10.13	53.99	65.83

Table V. Engine Trial Result at B-40 BLEND

Sr. No.	Fuel Sample Quantity (cc)	Time for 10 cc Fuel Consumption (t) (sec)	Speed (N) (RPM)	Brake Load (L) (kg)	Brake Power (BP) (kW)	Brake Thermal Efficiency (BTE) (%)	Brake Specific Fuel Consumption (BSFC) (kg/kW-hr)	Brake Specific Energy Consumption (BSEC) (MJ/kW-hr)	Indicated Thermal Efficiency(ITE) (%)	Mechanical Efficiency (%)
1	10	36	1500	11.2	1.69	16.81	0.51	21.42	55.60	30.23
2	10	30	1500	16.8	3.59	30.76	0.29	12.09	62.10	47.94
3	10	22	1500	23	5.81	33.71	0.25	10.09	59.02	59.83
4	10	19	1500	28	7.13	35.46	0.23	9.62	57.90	64.64

Table VI. Engine Trial Result at B-60 blend

Sr. No.	Fuel Sample Quantity (cc)	Time for 10 cc Fuel Consumption (t) (sec)	Speed (N) (RPM)	Brake Load (L) (kg)	Brake Power (BP) (kW)	Brake Thermal Efficiency (BTE) (%)	Brake Specific Fuel Consumption (BSFC) (kg/kW-hr)	Brake Specific Energy Consumption (BSEC) (MJ/kW-hr)	Indicated Thermal Efficiency(ITE) (%)	Mechanical Efficiency (%)
1	10	40	1500	11.2	1.69	18.72	0.44	19.23	59.71	28.21
2	10	29	1500	16.8	3.59	28.85	0.29	12.48	58.56	45.51
3	10	24	1500	23	5.81	38.62	0.21	9.32	63.21	57.47
4	10	20	1500	28	7.13	39.49	0.21	9.12	59.99	62.38

A. Break Thermal Efficiency (BTE)

Brake thermal efficiency is the ratio of brake power to the heat supplied by the engine. For better performance of the engine, Brake thermal efficiency should be higher. From the result it was clearly seen that B20 blend having excellent efficiency of 39.49 %

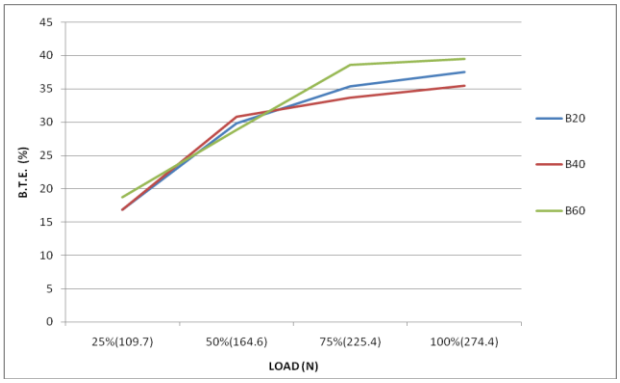

Figure 2. Variation of Load and Break Thermal Efficiency

B. Break Specific Fuel Consumption (BSFC)

Brake specific fuel consumption is the mass of fuel consumed by the engine per unit brake power. For better engine performance, Brake specific fuel consumption should be min. From the result it was clearly seen that B20 & B40 blend has least amount of fuel consumption of 0.23 kg/kW-hr

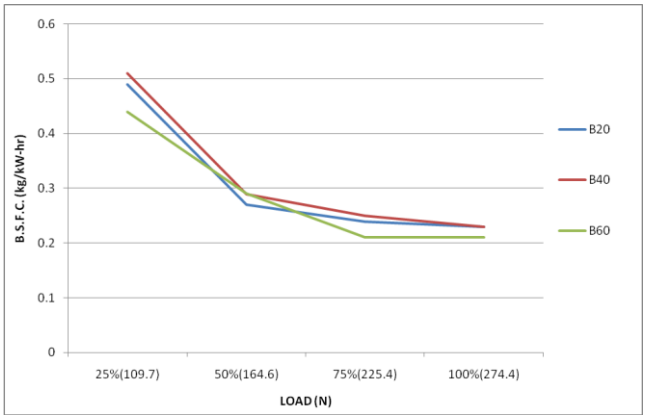

Figure 3. Variation of Load and Break Specific Fuel Consumption

C. Mechanical Efficiency (ME)

Mechanical efficiency is the ratio of Brake power produced by engine to Indicated power of the engine. For better performance of the engine, Mechanical efficiency should be higher. From the result it was clearly seen that B20 blend has excellent Mechanical Efficiency (M.E.) of 65.38 %

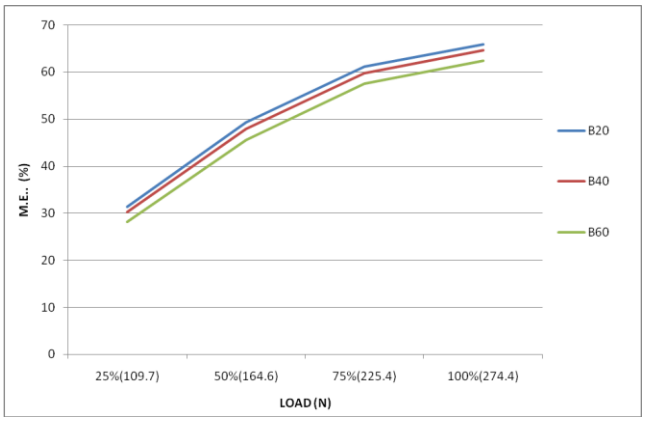

Figure 4. Variation of Load and Mechanical Efficiency

CONCLUSION

It was clearly seen in the result of experimental analysis that B20 blend of Rice Bran- Kerosene is most promising blend where we found two major performance parameters like Break Specific Fuel Consumption and Mechanical Efficiency were excellent where as Break Thermal Efficiency is moderate.

B60 blend is most appropriate for highest Break Thermal Efficiency but for other two performance parameters it was far away worst than two other blends.

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