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Performance Test on Diesel Engine by Using Mahua Oil Blend Mixtures

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Abstract: The steadily escalating gasoline prices, increased environmental concerns, and poor international politics have sparked new interests for alternatively fueled vehicles. There are numerous alternative fuel technologies including gasoline-hybrids, diesels, full electrics, as well as hydrogen and ethanol. These technologies are changing rapidly and consumers are having difficulty trying to decipher which type of vehicle is the most worthy investment. In the current energy scene of fossil fuel, renewable energy sources such as biodiesel, bio-ethanol, bio methane, and biomass from wastes or hydrogen have become the subjects of great interest. These fuels contribute to the reduction of dependence on fossil fuels. In addition, energy sources such as these could partially replace the use of those fuels which are responsible for environmental pollution and may be scarce in the future. For these reasons they are known as "alternative fuels". Vegetable oil cannot be directly used in the diesel engine for its high viscosity, high density, high flash point and lower calorific value. So it needs to be converted into biofuel to make it consistent with fuel properties of fuel. Biofuel production is a valuable process which needs a continued study and optimization process. Mahwa seeds, karanja oil and neem oil in India can be possibly a alternate approach in making a fuel for internal combustion engines and we also compare the above fuels by blending with diesel.
Keywords: Mahua blends, Bio diesel, Brake power, fuel efficiency, performnace, 4-stroke diesel Enginer, Mechanical efficiency

I. INTRODUCTION

An alternative fuel vehicle is a vehicle that runs on a fuel other than "traditional" petroleum fuels (petrol or diesel); and also refers to any technology of powering an engine that does not involve solely petroleum (e.g. electric car, hybrid electric vehicles, solar powered). Because of a combination of factors, such as environmental concerns, high oil prices and the potential for peak oil, development of cleaner alternative fuels and advanced power systems for vehicles has become a high priority for many governments and vehicle manufacturers around the world.

Murugan et al. [1] carried out to evaluate the performance and emission characteristics of a single cylinder direct injection diesel engine fuelled by 10, 30 and 50 percent blends of Tyre pyrolysis oil (TPO) with diesel fuel (DF).Results showed that the brake thermal efficiency of the engine fuelled by TPO-DF blends increased with increase in blend concentration and higher than Diesel. NOx, HC, CO and Smoke emissions were found to be higher at higher loads due to high aromatic content and longer ignition delay. Pugazhvadivu et al. [2] used mahua oil as an alternative fixel for diesel engine. Roy et al. conducted experiments on the recycling of scrap tyres to oil and carbon black by vacuum pyrolysis. In this work a step-bystep approach has been used ,from bench-scale system, to a process development unit and finally a pilot plant, to experiment and develop vacuum pyrolysis of used tyres. It was reported that the yield is 55% oil, 25% carbon black, 9% steel, 5% fiber and 6% gas. The maximum recovery of oil is obtained at 415 deg. C below an absolute pressure of 2KPa.The specific gravity of this was 0.95 and its gross heating value was 43 MJ/Kg and total sulphar content about 0.8%.It was rich in benzyl and other petrochemical components..The engine performance improved and smoke, CO and HC emissions decreased while the engine was running with preheated mahua oil. A marginal increase in NOx emission was noted. M. Mani et al [3] conducted performance test on diesel engine by using waste plastic oil as alternate fiiel. The experimental results have showed stable performance with brake "thermal efficiency similar to that of diesel. Carbon dioxide and unburned hydrocarbons were marginally higher than that of the diesel baseline. The toxic gas CO emission of waste plastic oil was higher than diesel. Smoke reduced by about 40% to 50% using waste plastic oil at all loads. From the literature it is concluded that alternate fuels can be used as substitute for diesel by evaluating its properties and blending them with diesel in small proportions can improved performance parameters and reduce emissions without modifying the engine design.

The mahuwa flower is edible and is a food item for tribals. They are used to make syrup for medicinal purposes. They are also fermented to produce the alcoholic drinkmahuwa, country liquor. Tribals of Bastar in Chhattisgarh and Orissa, Santhals of Santhal Paraganas (Jharkhand), Koyatribals of North-East Andhra Pradesh (vippasara) and tribals of North Maharashtra consider the tree and the mahuwa drink as part of their cultural heritage. Mahuwa is an essential drink for tribal men and women during celebrations. The main ingredients used for making it are chhowagud (granular molasses) and dried mahuwa flowers. The liquor produced from the

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flowers is largely colourless, with a whitish tinge and not very strong. The taste is reminiscent of Sake with a distinctive smell of mahua flowers. It is inexpensive and the production is largely done in home stills. Mahua flowers are also used to manufacture jam, which is being made by tribal cooperatives in the Gadchiroli district of Maharashtra.

Refractive index: 1.452, Fatty acid composition (acid, %): palmitic (c16:0):24.5, stearic (c18:0): 22.7, oleic (c18:1): 37.0, linoleic (c18:2): 14.3Trifed, a web site of the Ministry of Tribal Affairs, Government of India reports: "Mahuwa oil has emollient properties and is used in skin disease, rheumatism andheadache. It is also a laxative and considered useful inhabitual constipation, piles and haemorrhoids and as anemetic. Tribals also used it as an illuminant and hair fixer." It has also been used as biodiesel.

II. EXPERIMENTAL METHOD AND PROCEDURE

A. Experimental Procedure (Single Cylinder Engine) as Follows

1) The engine is started and run for at least 15 minutes for warming up. Motor for circulating the water is simultaneously started. Then, under no load condition, the time taken for the consumption of 10cc of fuel, the load applied, the speed and manometer readings are recorded.
2) The load is increased and allowed to run for 10 minutes. Then, the time taken for the consumption of 10cc of fuel, the load applied, the speed and manometer readings are recorded.
3) The load is further increased in approximately four equal steps up to the rated value and readings are noted as in earlier steps.
4) In addition, the temperature of cooling water at the inlet and outlet, temperature of exhaust gas and discharge of water are required at every load.
5) The engine is then stopped taking suitable precautions.

B. Experimental Works were Carried out at

1) B0(Pure Diesel)
2) B10 (10% Soya bean Oil and 90% Pure Diesel)
3) B20(20% mahua Oil and 80% Pure Diesel)
4) B30(30% Ethanol Oil and 70% Pure Diesel)

Single cylinder diesel engine has been used to carry out the experiments as shown in Fig. 1. The testing procedure is carried by mixing the specimen samples with diesel in calculated proportions as shown in Fig.2. The mixture of specimen sample and diesel is used in single cylinder diesel engine and several tests are conducted under controlled atmospheric conditions.

Fig. 1. Single cylinder diesel engine.

a) *Step 1:* Take bio diesel blend say ethanol B10, the composition contains 100 ml of ethanol and 900 ml of diesel, as ethanol is very dangerous proper atmospheric condition are to be maintain, water is used as the cooling agent in the experiment when the fuel is added to engine and cranking is done. Calculated proportions are taken and constant atmospheric conditions are maintained.
b) *Step 2:* load to be added to engine to engine and increased simultaneously with the help of the electrical loading and the mean difference of the two gauges are calculated to fine the exact torque applied on engine

Loads are added in ascending order. The adding of load the rpm of the engine will be changing simultaneously that will be displayed on the digital meter. All this testing will give the performance of the fuel used in the engine and will be used in calculating to find the brake power and mechanical efficiency of the engine with using different types of test specimens.

Fig.2. Blending diesel with mahua biodiesel.

c) *Step 3:* The temperature rise in the engine will noted with help of thermo couples placed inside the engine and the time consumption of 10 ml of fuel will be calculated with help of stop watch.

The readings for the gauge and temperature indicators are tabulated, with help of these readings the work done by the engine is
2. Brake power.

C. Calculated and the Fuels Efficiency is Calculated with Help of Calculating the Following

*1)*Volumetric efficiency
*2)*Specific fuel consumption
*3)*Brake thermal efficiency
*4)*Indicated thermal efficiency
*5)*Mechanical efficient
*6)*Different graphs are plotted to find the effectiveness of specimen fuel and there consistency on the engine working.

III. RESULTS AND DISCUSSIONS

A. Experiments Conducted on

1) Performance Analysis
2) Heat Balance Sheet

And calculated results were noted down in Table 1, 2, 3 and 4 respectively.

TABLE 1. B0 (PURE DIESEL)

Volts	192	195	215	226	228
Ammeter reading	0	0.9	2.6	4.2	5.8
Speed(rpm)	1530	1525	1512	1500	1477
Manometer h1	25	25	24	24	21
h2	10	9	8	8	7
Time taken for 10ml of fuel consumption(sec)	76	62	48	37	33
Time taken for water(sec)	7	7	7	6	8
Brake power(KW)	0	0.1755	0.559	0.9492	1.3224
TFC(kg/hr)	0.3884	0.4761	0.615	0.797	0.894
SFC(kg/hr)	0	2.712	1.1001	0.839	0.676
Volumetric efficiency (%)	36.59	40.74	43.92	42.93	46.18
Brake thermal efficiency (%)	0	3.041	7.5	9.817	12.199

TABLE 2. B10

Volts	175	204	221	228	229
Ammeter reading	0	0.9	2.7	4.4	5.9
Speed(rpm)	1530	1523	1512	1505	1483
Manometer h1	27	27	27	26	26
h2	8	8	7	7	7
Time taken for 10ml of fuel consumption(sec)	104	79	56	45	37
Time taken for water(sec)	5	5	5	5	5
Brake power(KW)	0	0.1836	0.5967	1.0032	1.3511
TFC(kg/hr)	0.3235	0.4259	0.6008	0.7477	0.9094
SFC(kg/hr)	0	2.3197	1.0068	0.7453	0.673
Volumetric efficiency (%)	32.97	43.96	46.08	46.41	47.061
Brake thermal efficiency (%)	0	4.163	9.592	12.958	14.35

TABLE 3. B20

Volts	192	211	221	227	228
Ammeter reading	0	1.2	2.8	4.5	6
Speed(rpm)	1515	1506	1490	1475	1450
Manometer h1	27	27	27	26	26
h2	7	7	7	7	6
Time taken for 10ml of fuel consumption(sec)	108	77	59	46	38
Time taken for water(sec)	5	5	5	5	5
Brake power(KW)	0	0.2532	0.6188	1.0215	1.368
TFC(kg/hr)	0.3115	0.4369	0.5703	0.7314	0.8855
SFC(kg/hr)	0	1.7255	0.92162	0.716	0.6472
Volumetric efficiency (%)	47.52	47.81	47.58	48.32	48.177
Brake thermal efficiency (%)	0	5.597	10.48	13.48	14.92

Table 4.B30

Volts	190	210	222	227	229
Ammeter reading	0	1.1	2.7	4.2	5.7
Speed(rpm)	1535	1525	1493	1475	1450
Manometer h1	28	28	28	28	28
h2	6	6	5	5	5
Time taken for 10ml of fuel consumption(sec)	101	76	58	45	37
Time taken for water(sec)	6	6	6	6	6
Brake power(KW)	0	0.231	0.5994	0.9534	1.3053
TFC(kg/hr)	0.3331	0.0442	0.58014	0.7477	0.9094
SFC(kg/hr)	0	0.1913	0.9678	0.7842	0.6966
Volumetric efficiency (%)	49.168	49.49	51.71	51.191	52.34
Brake thermal efficiency (%)	0	50.39	9.97	12.31	13.86

B. Comparision of Mahua Biodiesel Blends with Pure Diesel

Findings were plotted in the Figures 3, 4, 5, 6, 7 and 8 respectively.

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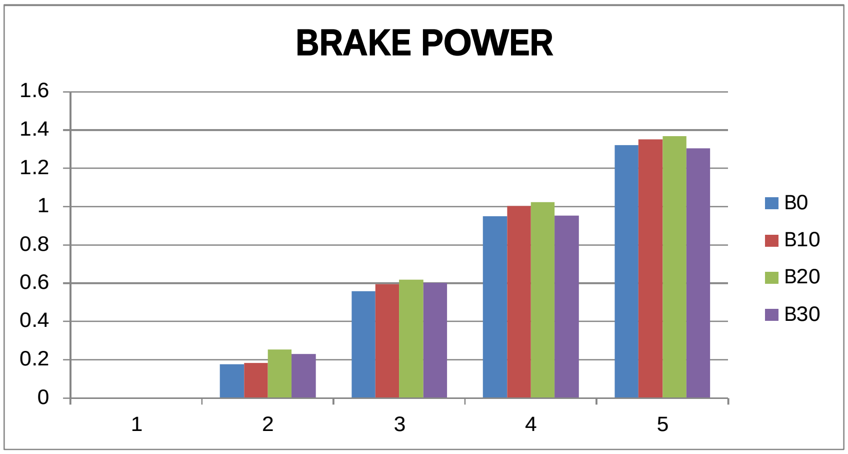

Fig. 3. Brake power

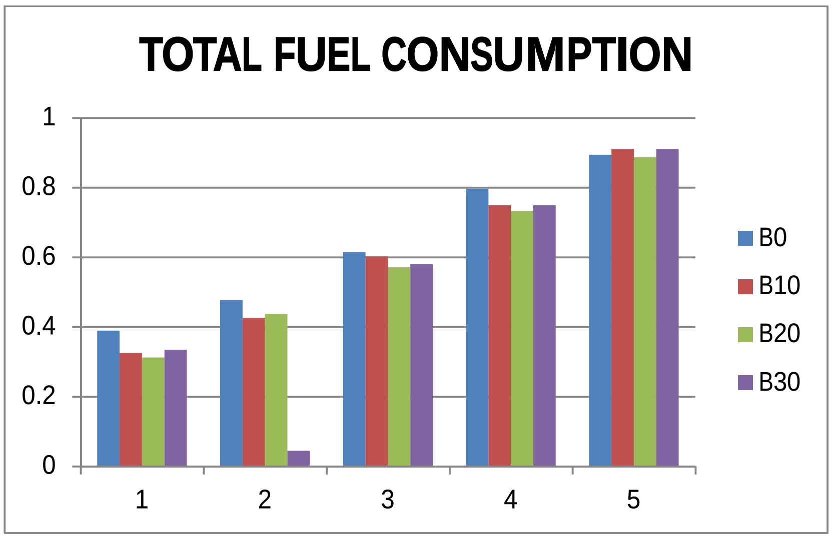

Fig. 4. Total fuel consumption

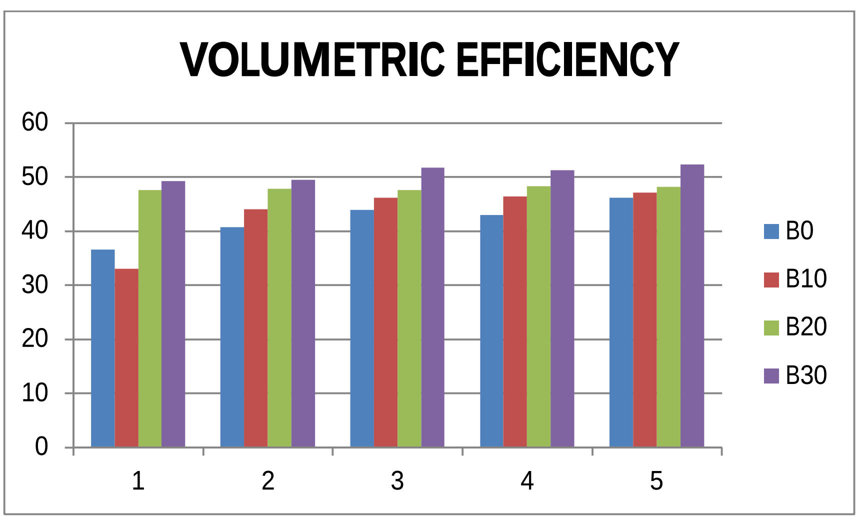

Fig. 5. Volumetric efficiency

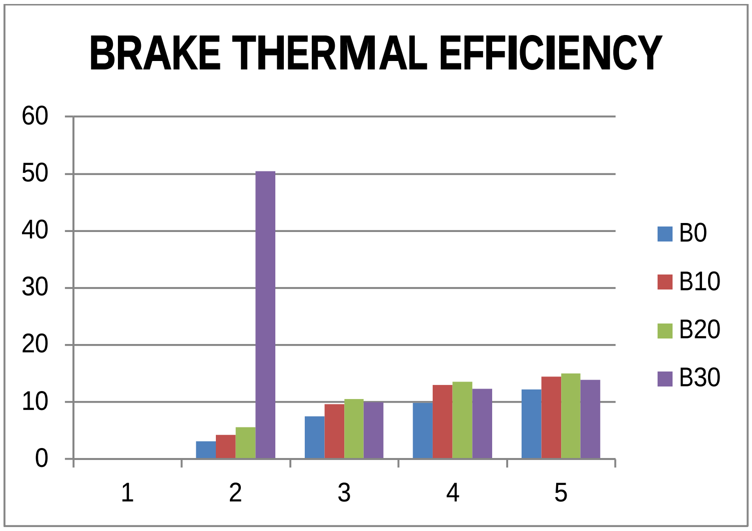

Fig. 6. Brake thermal efficiency

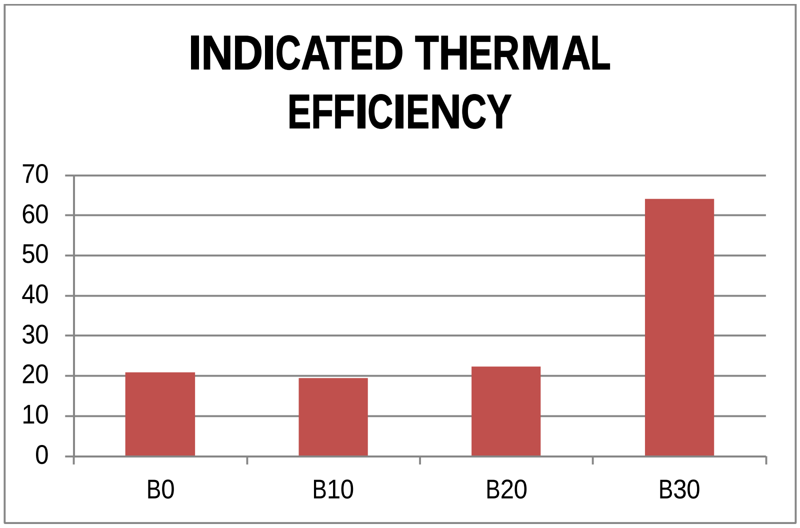

Fig. 7. Indicated thermal efficiency

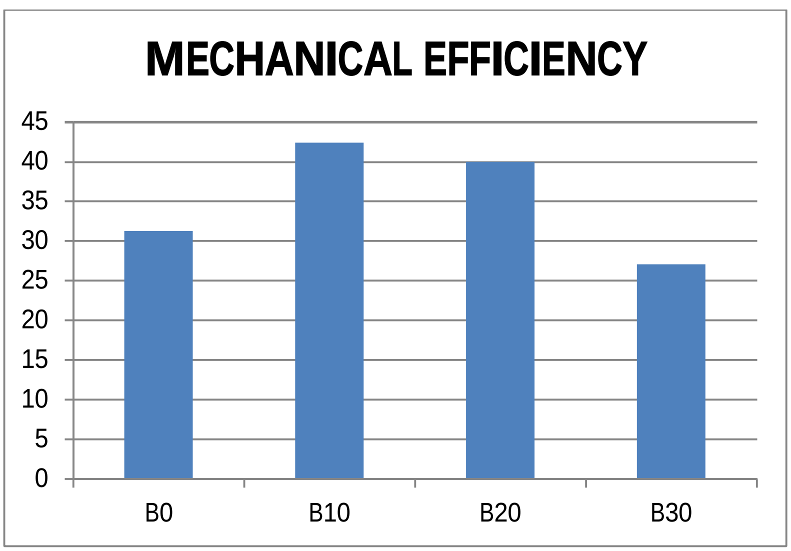

Fig. 8. Mechanical efficiency

IV. CONCLUSIONS AND FUTURE SCOPE

The experiments are conducted on the Single-cylinder 4 Stroke diesel engine with electrical loading test with pure diesel and blends of pure diesel and the following conclusions were made

A. Brake power is high for B30
B. TFC is also high for B30
C. Volumetric efficiency of all blends are nearer to diesel
D. Brake thermal efficiency is high for pure diesel
E. Indicated thermal efficiency is high for B30
F. Mechanical efficiency is high for B10 and B20

1) The future of biodiesel fuel

The future of biodiesel is growing. More companies are offering this solution to the consumers. At this stage, only diesel powered automobiles can use the new fuel. This is expected to change in the upcoming years. The mounting concern of off-shore oil as well as the environmental issues has groups in an uproar. Already there are several types of companies using biodiesel as their main source for transportation. The Yellowstone Nation Park bus system uses a mixture of biodiesel and petroleum to run the whole fleet. Tests by the government have proven that this type of fuel is overall more functional and safe than petroleum based products. As fossil beds run dry, everyday scientists come closer to new alterative. Soon biodiesel will become the new source of power. Through research and constant testing, biodiesel is more productive that the petroleum based fuel. It has been discovered that this type of product will become the new source of power. Not only for diesel automobiles but for other power sources individuals desperately require living and surviving. Before long, this type of supply will be not only in vehicles but also in homes and factories.

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