Experimental Analysis and Performance Test of a Direct Injection Diesel Engine Fuelled with Madhuca Indica Biodiesel

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***Abstract* - The performance studies on the diesel engine with blends of mahuva biodiesel. This examination researches the utilization of ethyl liquor (ethanol) as an oxygenated added substance with 20% Mahuva methyl ester diesel mix (B20). Investigation were led to examine the impact of Mahuva methyl ester on execution, discharge and burning attributes of an immediate infusion diesel motor worked at a steady speed of 1500 rpm. The outcomes showed that brake warm effectiveness somewhat expanded and exhaust outflows are essentially diminished with ethanol at full burden conditions. The result revealed that the blend of diesel, biodiesel and Madhuca indica oil can be effectively used as an effective alternative fuel for diesel engines.**

***Index Terms* - Biodiesel, esterification, transesterification, Mahuva methyl ester, performance, emissions.**

I.INTRODUCTION

The increment on energy interest, natural worry of the an Earth-wide temperature boost and expanding in the oil cost in the worldwide has significantly expanded the interest of utilizing elective powers in inside burning motors. For as far back as couple of many years, a great deal of exertion has been made to diminish the reliance on oil powers for power age and transportation from one side of the planet to the next. Among the proposed elective powers, biodiesel and alcohols have gotten a lot of consideration as of late for diesel motors and could be one cure in numerous nations to diminish their oil imports [S.A.Sahir 2014]. Biodiesel and liquor enjoy numerous upper hands over diesel as inexhaustible and locally created energy assets. In addition, they are perceived as harmless to the ecosystem elective energizes [Istvan Barbas 2010]. The creation of biodiesel from the microalgae as the third era biodiesel feed stock, the efficient portrayal of green growth biomass, green growth oil and green growth biodiesel to build up the capability of microalgae for biodiesel creation [[M.G.Dastidar, et al 2001]. Among the alcohols ethanol is utilized as a successful elective fuel, a fuel extender, an oxygenate for diesel motors. Ethanol is sees as a sustainable fuel since it tends to be produced using numerous sorts of crude materials like corn, sugar stick, sugar beets, molasses, cassava, squander biomass materials, sorghum, grain, maize, and so on By and large, madhuca indica can be mixed with diesel and can be utilized as an elective fuel for diesel motor with no motor adjustments [Alan C.Hansen 2005]. Madhuca indica is somewhat immiscible with diesel which prompts stage partition and unsteadiness of the mix. The stage division can be forestalled twoly: by adding an emulsifier that demonstrations to suspend little drops of ethanol inside the diesel fuel, or by adding a co-dissolvable that goes about as a spanning specialist through sub-atomic similarity and attaching to deliver a homogeneous mix [M. Lapuerta, et al 2007].

II. PREPARATION OF BIO-DIESEL

The Mahua seeds were gathered from Chincholi taluka of Gulbarga region, Karnataka state and kept up with under 6% of dampness. Expeller measure was utilized to extricate Mahua oil at the amount of 350 ml for each kg of Mahua seed, figure 1 shows the vital substance response. It was tracked down that the free unsaturated fat substance was about 18% by titration strategy. The properties of unrefined Mahua oil and Mahua biodiesel were resolved and can be found in Table 1 and the pictorial perspective on crude Mahua oil separated and Mahua biodiesel can be found in Fig (2). A two phase esterification measure was utilized with Acid esterification followed by base catalyzed esterification. The pretreatment and Transesterification tests were directed in research center conditions which comprised of 1000 cc upset neck cup with impermeable conditions. The response climate was kept up with between room temperature and 65°C with 5% Concentrated Sulphuric corrosive and 0.36 v/v methanol to oil proportion. The reactant blend was constantly mixed at 450 rpm for around an hour and a half with a time frame minutes. The corrosive worth was constantly checked at these stretches by titration technique till the ideal worth was accomplished. The pretreatment cycle was trailed by base catalyzed response in which a molar proportion of 1:6 (oil to methanol molar proportion) was employed.0.8% (w/w of Sodium hydroxide to oil) was utilized as an impetus to treat and kill the unsaturated fats.

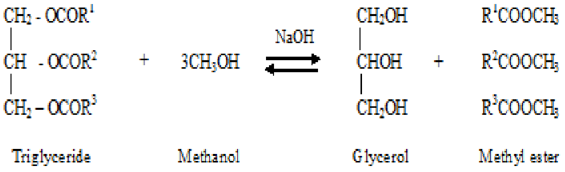

Fig 1 Transesterification reaction of Mahuva oil Biodiesel

III. EXPERIMENTAL SET UP OF ENGINE

(i) The engine
(ii) Dynamometer
(iii) Pressure sensor
(iv) Temperature sensor
(v) Computerized setup

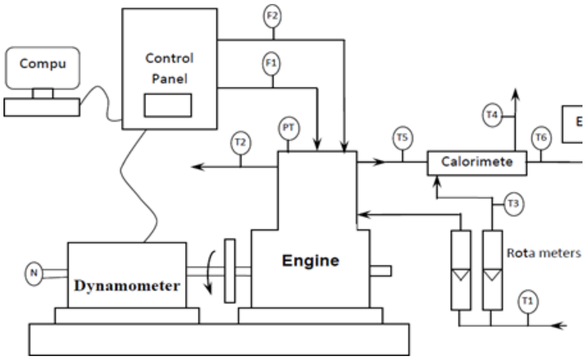

Fig. 2: Schematic diagram of experimental setup

The performance and exhaust emission test were carried out in a constant speed, direct injection diesel engine. The specification of the test engine was listed in table 2. The motor was combined with vortex current dynamometer. The performance, combustion was analyzed with ENGINE-SOFT, software connected to the engine. The three fuels used are pure diesel (D), pure biodiesel (B) and blend of diesel (70%vol), biodiesel (20%vol) and ethanol (10%) the blend is named as B20.

Specifications	Details
Number of strokes	4
Power output	5.2 kW/ 7BHP
Bore x Stroke	87.5 mm x 110 mm
Number of cylinders	One
Constant speed	1500 RPM
Orifice diameter	20 mm
Injection pressure	180-220
Swept volume	0.662 liter
Nozzle hole diameter	0.223 mm

Table 1. Engine specifications

IV. METHODOLOGY

The experiment is conducted under varying load with injection pressure of 200 bar. Firstly the normal diesel engine is run with diesel fuel under variable load conditions. The readings are always recorded after the engine attains stability of operation after 4-5 minutes of running. Then the Madhuca indica biodiesel is used in place of diesel at different loads. The performance parameter such as Brake Thermal Efficiency, Indicated Thermal Efficiency, Brake specific fuel consumption (BSFC), Brake specific Energy consumptions (BSEC), Exhaust Gas Temperature (EGT) and Mechanical Efficiency are evaluated. These performance and combustion parameter of oils are compared to those of pure diesel.

V. RESULTS AND DISCUSSION

A. Performance characteristics

The variety of brake warm effectiveness with brake power is displayed in figure 3; it shows that the brake warm productivity of B20 is more prominent than unadulterated Mahuva methyl ester and unadulterated diesel fuel at full burden. The most extreme brake warm proficiency of unadulterated diesel, biodiesel and B20 are 27.5%, 26% and 28.5% separately at full burden. The expansion in brake warm proficiency might be because of the presence of oxygen in the ethanol with assists with lessening the surface strain helped in better atomization of the fuel, which prompts total burning of the fuel and subsequently further develops the brake warm productivity Figure 4; shows the variety of brake explicit fuel utilization with brake power, the brake explicit fuel utilization diminishes with load. The BSFC of B20 is practically same as that of unadulterated diesel fuel yet not exactly that of unadulterated biodiesel at full loads. The BSFC of unadulterated diesel, unadulterated biodiesel and B20 are 0.3, 0.4 and 0.32 kg/kW-h separately at 80% of burden. This might be because of lower calorific worth and cetane number of the unadulterated biodiesel and B20 as contrasted and the unadulterated diesel fuel. Figure 5; shows that the variety of fumes gas temperatures, the fumes gas temperatures increments with expansion in the heap. The fumes gas temperatures of unadulterated diesel fuel, biodiesel and B20 are 425, 430 and 450 oC individually at full burden. Somewhat increment of fumes gas temperature for biodiesel and B20. The expansion in fumes gas temperature might be because of lower warming worth of the biodiesel and B20

Brake thermal efficiency

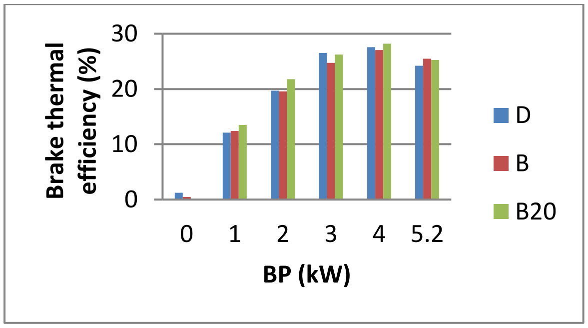

Fig: 3. Variation of Brake Thermal Efficiency with BP

Brake specific fuel consumption

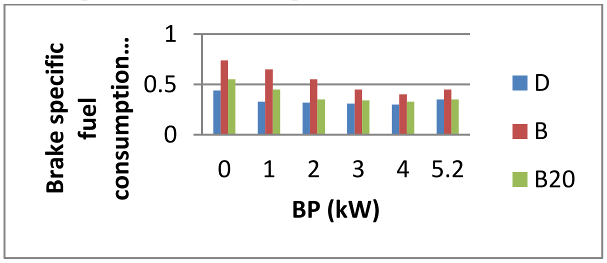

Fig: 4. Variation of Brake Specific Fuel Consumption with BP

Exhaust gas temperature

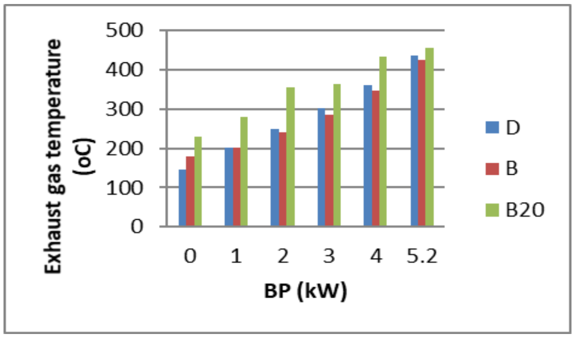

Fig: 5. Variation of Exhaust Gas Temperature with BP

B. Emission characteristics

Figure 6; shows the variety of carbon monoxide with brake power. The fossil fuel byproduct increments with expansion in load. At lower stacks the CO outflow is practically same for unadulterated diesel; biodiesel and B20.The carbon monoxide discharge of unadulterated diesel, biodiesel and B20 are 0.38, 0.05, and 0.15% by volume. The carbon monoxide discharge is less for unadulterated biodiesel than unadulterated diesel and B20 it very well might be because of quality of more oxygen in biodiesel, which makes the ignition complete, bringing about lower carbon monoxide outflow.

Figure 7; shows the variety of carbon dioxide emanation with brake power. The CO2 increments with expansion in load. The unadulterated diesel has higher CO2 emanations than unadulterated biodiesel and B20 mix; it could be because of the presence of higher C-H proportion and the sky is the limit from there oxygen in the biodiesel and its mix. The CO2 outflows at full burden for unadulterated diesel, biodiesel and B20 are 1.38%, 0.7 and 1.2% by volume individually.

Figure 8; shows the variety of hydrocarbon outflows with BP. The hydrocarbon outflows increment with increment of burden. The hydrocarbon outflow of B20 is more than that of unadulterated diesel and biodiesel it very well might be because of lower calorific worth and cetane number of biodiesel and ethanol. The hydrocarbon outflow with unadulterated diesel fuel, biodiesel and B20 are 2, 3 and 14 PPM at full burden separately.

Figure 9; shows the variety of nitrogen dioxide with BP, nitrogen oxide emanation increments with expansion in load because of higher chamber temperature. The NO discharge if there should be an occurrence of unadulterated biodiesel is higher than that of unadulterated diesel fuel and B20 mix. It is a result of higher burning temperature of biodiesel. At the point when ethanol is added to the diesel-biodiesel mix the NO discharges diminish it is a result of higher inert warmth of ethanol, because of which lower ignition temperature decreases. The NO of unadulterated diesel, biodiesel and B20 are 485, 523 and 455 PPM separately.

Figure 10; shows the variety smoke with BP, smoke increments with expansion in load. It is seen that smoke discharge is diminished with mixing of biodiesel and ethanol with diesel fuel. The smoke discharges for unadulterated diesel, biodiesel and B20 are 100, 82, and 95 % by volume separately at full burden.

Carbon monoxide

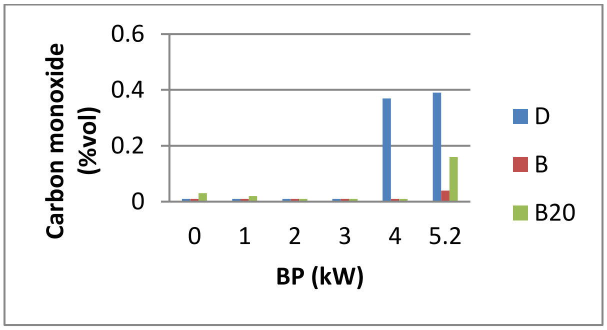

Fig: 6. Variation of Carbon monoxide emission with BP

Carbon dioxide

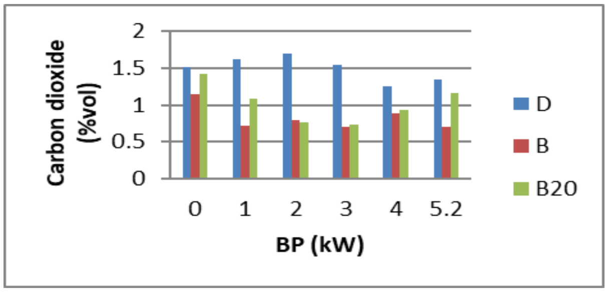

Fig: 7. Variation of Carbon dioxide emission with BP

Hydrocarbon

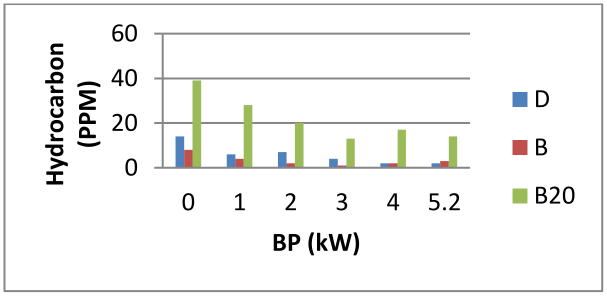

Fig: 8. Variation of Hydrocarbon emission with BP

Nitrogen oxide

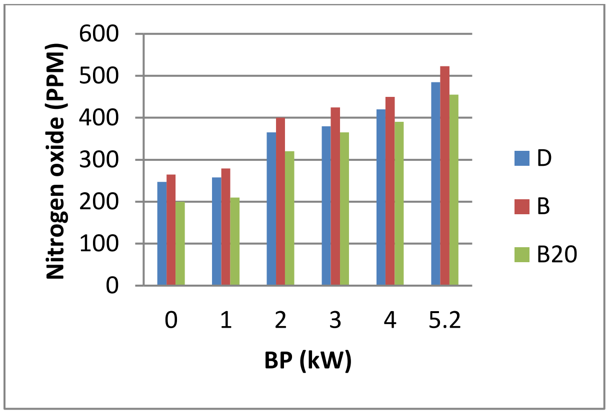

Fig: 9. Variation of Nitrogen oxide emission with BP

Smoke

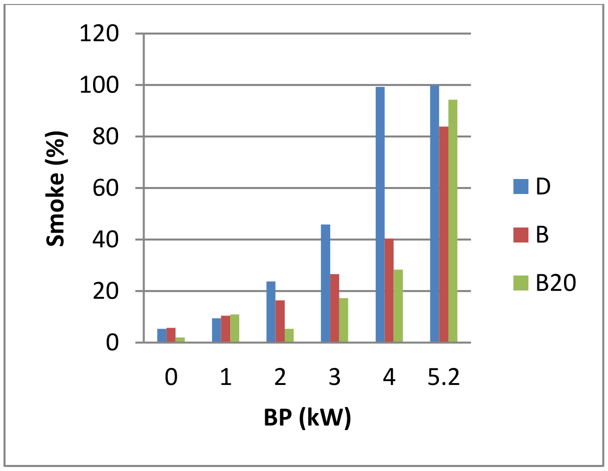

Fig: 10. Variation of Smoke emission with BP

C. Combustion parameters

Cylinder pressure

Figure 11, figure 12 and figure 13 shows the variety of chamber pressure with wrench point of unadulterated diesel, biodiesel and B20 separately. The pinnacle pressure for diesel fuel is 68 bar, where concerning the biodiesel and B20 mix, it is 69 and 68 bar separately. The pinnacle chamber pressure is basically reliance upon the burning rate. The mix B20 has lower top chamber pressure ac contrasted with unadulterated diesel and unadulterated biodiesel it is because of low cetane number of ethanol. Figure 14 shows the variety of pace of pressing factor ascend with wrench point. Every one of the energizes have same pattern of pressing factor rise, thus unadulterated biodiesel and its mix with ethanol can be utilized as an elective fuel viably.

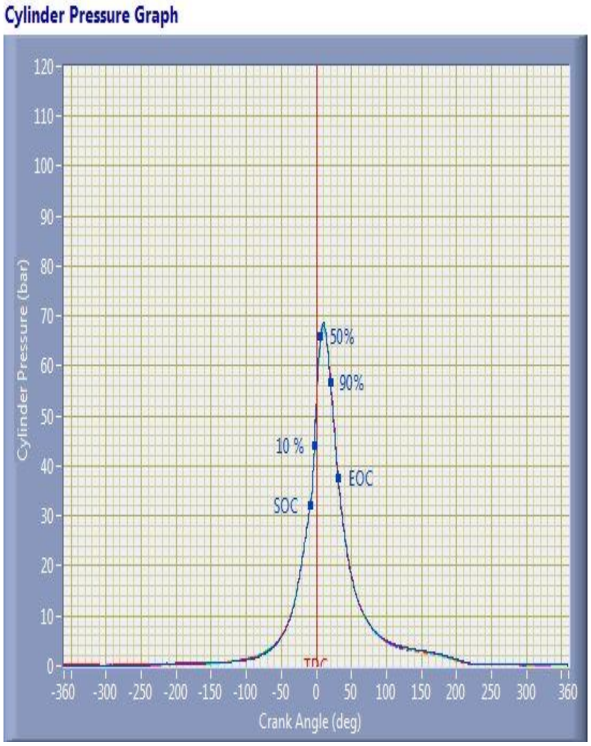

Fig: 11. Variation of Cylinder pressure with Crank angle of diesel fuel

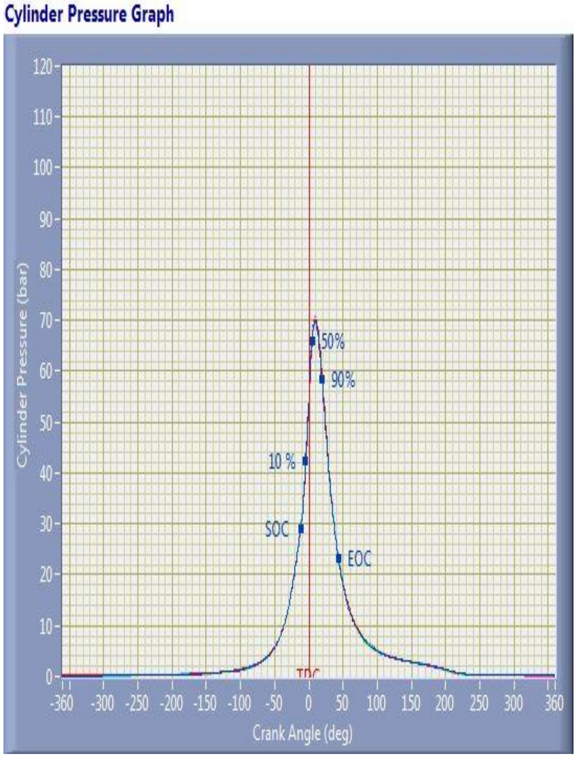

Fig: 12. Variation of Cylinder pressure with Crank angle of Mahuva methyl ester (Biodiesel)

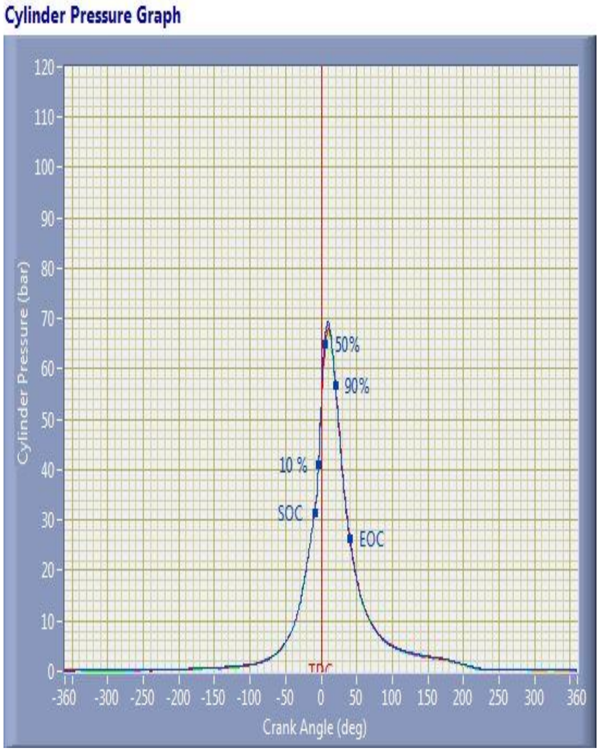

Fig: 13. Variation of Cylinder pressure with Crank angle of B20 blend

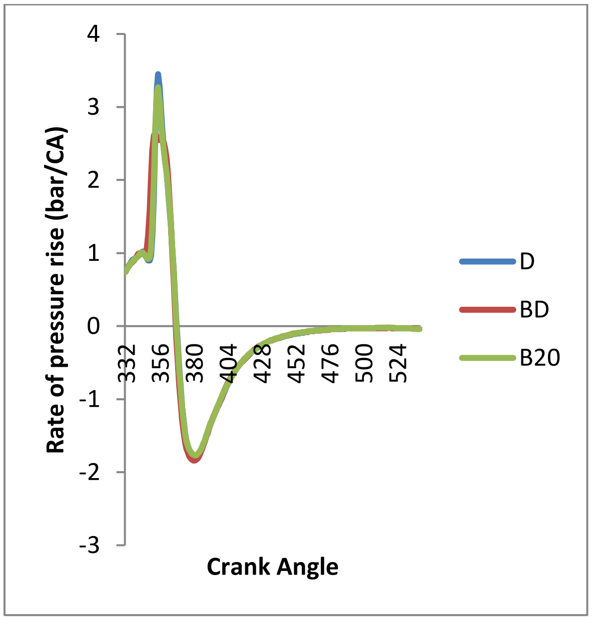

Fig: 14. Variation of Rate of pressure rise with Crank angle

VI. CONCLUSIONS

The tests were directed with 20% Mahuva methyl ester (MME:B20) utilizing ethanol has been concentrates widely through execution, outflows boundaries.

Coming up next are the significant ends drawn from the current examinations with the impact of ethanol with biodiesel on an immediate infusion diesel motor

- Brake thermal efficiency of B20 is higher than unadulterated biodiesel and Mahuva methyl ester (biodiesel) by 1% and 2.5% separately.
- Brake specific fuel consumption of B20 and
- Exhaust gas temperatures of pure diesel fuel is lower by 25ºC than that of B20 and 10ºC of pure biodiesel.
- Carbon monoxide emission of B20 is 35% less than that of pure diesel, and slightly higher than that of pure biodiesel.
- Carbon dioxide emission is lower by 1.5% than pure biodiesel at higher loads.
- Hydrocarbon emissions of B20 are lower by 13 PPM and 10 PPM of diesel fuel and biodiesel fuel respectively.
- Nitrogen oxide emission of B20 blend is less by 70PPM and 30PPM than that of pure diesel fuel and biodiesel.
- Smoke emission is 0.2% less with B20 blend than pure biodiesel at full load.
- The peak cylinder pressure of B20 is less than pure diesel and biodiesel fuel. The trend of Rate of pressure rise of all the three fuels is similar; hence B20 blend can be used as an alternative fuel.
- From the above points it can be concluded that B20 blend fuels can be effectively used as an alternative fuels for diesel engines.

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