Behavior Change of Diesel Engine under Starting Low Temperature and idling Condition with Calophyllum oil Biodiesel.

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Abstract- ***Increasing petroleum prices, depletion of fossil fuels and pollution are leading to find out alternative sources for petroleum fuels. Among the biodiesel, natural gas, electric batteries and hydrogen gas, biodiesel getting worldwide attention due to renewable and environmentally friendly nature and also it does not required modifications in diesel engine. The present work confers the study of impact on diesel engine performance characteristics when engine is fuelled with biodiesel produced from Calophyllum oil and the engine is at low temperature and at idling condition. In the present work engine is run on neat diesel, emulsified diesel and emulsified biodiesel B10, under the engine load conditions of 0 kg load, 5kg load, 10 kg load, and 15 kg load.***

IndexTerms: Performance, Calophyllum Inophyllum, Brake Thermal Efficiency (BTE).

I. INTRODUCTION

In 2040, the demand for global energy will be about 30% higher than that of in 2010. Global crude oil demand is expected to reach 101.6 million barrels per day in 2020. Fossil fuels provide for approximately 86 percent of primary energy demand, which is steadily increasing. The majority of industries rely on diesel as a source of energy. Mankind relies heavily on fuels for every aspect of their everyday life, good transport and electricity in particular. Since the last few decades, there is a drastic increase in demand of fuel, price and no. of a road vehicle, climate changes due to air pollutions and now it has become a serious topic for the researchers to guarantee the availability of energy alternatives and reduction in environmental pollution due to vehicular emissions [1]. The fuels which have potential to replace the fossil fuels are natural gas like CNG, LPG, hydrogen gas, electric energy, but all these required modifications in the existing engine or fuel system, but energy sources like primary alcohols or blend of primary alcohols with gasoline, ethers, and biodiesel and its blends [2].

Biodiesels are biodegradable, renewable and more environment friendly than petroleum-based fuels [3]. Ever increasing petroleum products prices and uncertainties concerning their availability have Increased the importance of vegetable oil-based biofuel tremendously. The biodiesel has some rewards as compared to petroleum diesel [4-5].

In the present experimental study, performance and emission characteristics of the single-cylinder diesel engine are investigated under the variation of compression ratio, engine load and biodiesel blend proportion. This study focused on finding variation in Brake Specific Energy Consumption (BSEC), Brake Thermal Efficiency (BTE), Exhaust Gas Temperature (EGT).

II. MATERIALS AND METHODS

a) Materials-

In the present study non edible oil namely Calophyllum inophyllum is chosen for experimentation on Single Cylinder Direct Injection Diesel Engine. Calophyllum oil is collected from local oil supplier and Methanol and KOH were purchased from Local chemical store in Pune.

b) Production and characterization of biodiesel-

Transesterification of Calophyllum oil was done using Methanol in presence of KOH as catalyst to chemically break the molecule of raw Calophyllum oil into methyl esters of Calophyllum oil with glycerol as by product. Emulsification of diesel and Calophyllum oil is done and their composition is shown in table 1.

Table No.1 Composition of Emulsified Diesel and Biodiesel

Emulsified Diesel	**Emulsified Calophyllum Oil**
Diesel – 270 ml	Calophyllum oil – 270 ml
Tween 80 - 9 ml	Tween 80 – 9 ml
Distilled water – 30 ml	Distilled water – 30 ml

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Then, type over sections of trans_jour.docx or cut and paste from another document and use markup styles. The pull-down style menu is at the left of the Formatting Toolbar at the top of your *Word* window (for example, the style at this point in the document is "Text"). Highlight a section that you want to designate with a certain style, and then select the appropriate name on the style menu. The style will adjust your fonts and line spacing. Do not change the font sizes or line spacing to squeeze more text into a limited number of

The properties of emulsified diesel and emulsified Calophyllum oil were obtain by testing them in laboratory named "Chem-tech laboratories Pune" compared. Those properties are as follows

Table No.2 Properties for Calophyllum oil

Fuel	Flash point (°c)	Kinematic Viscosity (mm^2/sec)	Calorific value (Cal/g)	Density (gm/cc)
Emulsified Diesel	55	1.9-1.4	1086 7.493	860
Emulsified Calophyllum oil	15	1.15-3	5335	868.7

III. EXPERIMENTAL SETUP –

The setup is basically which consists of single cylinder four stroke engine connected to Eddy current Dynamometer as Shown in Fig.1 and Fig.2

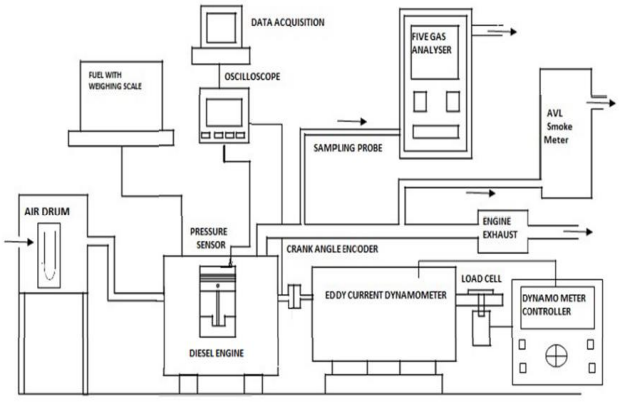


Fig.1 4-stroke single cylinder diesel engine setup (diagrammatic)

Fig.2 Actual setup

F

IV. EXPERIMENTAL PROCEDURE –

It is provided with necessary equipment's for Load, water flow, Fuel Measurements and to record the readings of the experiment. Rota meter are provided for cooling water and Calorimeter Water Flow measurement. Engine Performance is analysed by the "IC Engine Soft" Software. Which will be used for further conclusion.

Specifications for the Diesel Engine are given below in the tables:

Table No.3 Engine Specifications

No. of Cylinders	1
No. of Strokes	4
Fuel	High Speed Diesel
Rated Power	3.5 kW @1500 RPM
Cylinder Diameter	87.5 mm
Stroke Length	110 mm
Connecting Rod Length	234 33
Compression Ratio Vary	12 to 18:1
Orifice Diameter	20 mm
Dynamometer arm Length	185 mm
Cooling	Water Cooling
Loading	Electrical loading by varying voltage
Swept Volume	661.45 cc

Table No.4 Other Specifications

Fuel tank	Capacity 20 lit with glass fuel metering column
Temperature Sensor	Thermocouple
Software	ICEnginesoft

For experimental procedure, we performed the tests on 4-stroke, single cylinder, direct injection, water cooled, 3.5 KW output power with computerized diesel test

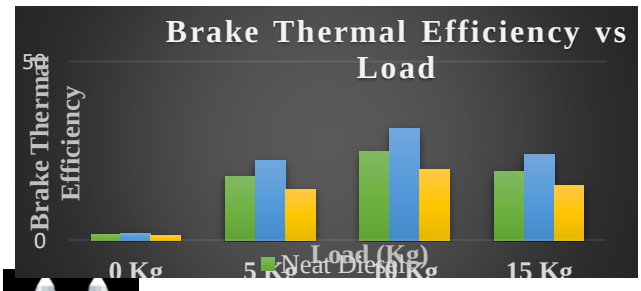
setup. The eddy current dynamometer is directly coupled to engine. The characteristics of engine are already cited in specifications and setup is shown in fig. For every fuel we used, the residual fuel cleanse out from fuel line. As we are testing behaviour change of diesel engine under starting low temperature and idling condition, so for new fuel and new load we should operate and take readings for first 30 min of engine start. The test setup ring has necessary attachments to check air-flow, fuel-flow, temperature, loads, etc. Fuel and lubrication oil indicators are there to check fuel level. There is three-way cock which allows fuel to flow in engine. Cooling water jacket is there to ensure adequate supply of cooling water as engine is water cooled. The setup is connected to software ICEnginesoft. Electric power is supplied to needed instruments. Loading and unloading of loads are done by varying voltage to dynamometer. The engine is started by electric switch mechanism. The readings noted are: load acting, speed in rpm, temperature, manometer values in cm, time, fuel consumptions, etc. The procedure is repeated for four different loads i.e., 0 kg, 5 kg, 10 kg, 15 kg and three different fuels i.e., neat diesel, Emulsified diesel and Emulsified Calophyllum oil biodiesel B10.

V. RESULTS AND DISCUSSIONS –

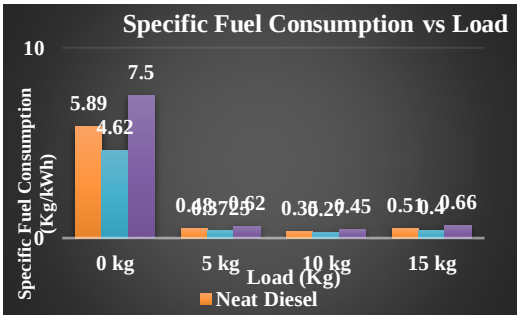
b) Specific Fuel Consumption-

The variation of the brake specific fuel consumption of diesel and blend of Calophyllum oil Biodiesel at different loads is shown in Fig 4. The specific fuel consumption is 5.89, 4.62 and 7.5 kg/kW-h for the Neat Diesel, Emulsified Diesel and Emulsified Biodiesel B10 respectively at 0 load. From the graph we can see that the specific fuel consumption Higher in every case of Emulsified Biodiesel B10 that Emulsified and Neat Diesel. This is because of the combined effects of lower heating value and higher fuel flow rate due to high density of blend. Higher proportions of Calophyllum oil in the blend increase the viscosity which in turn

The variation of the brake power of diesel and blend of Calophyllum oil Biodiesel at different loads is shown in Fig 5. Brake Power is almost Zero at 0 load condition. But when increase in load, Brake Power goes on



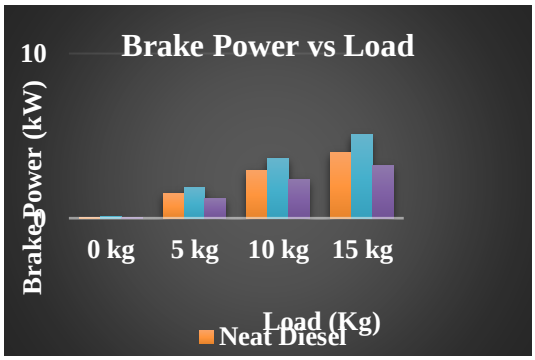
a) Brake Thermal Efficiency-



The variation of brake thermal efficiency of the engine with respect to emulsified Diesel and Emulsified Biodiesel blend B10 is shown in Fig 3 and compared with brake thermal efficiency obtained with neat diesel. Among these Emulsified Diesel gives higher brake thermal efficiency that the Emulsified Biodiesel B10 and neat Diesel at all the loads. The variation is significant particularly at higher loads. The decrease in brake thermal efficiency with increase in Calophyllum oil concentration is due to the poor mixing and evaporation of the blends due to their higher
viscosity.

increased the fuel consumption due to poor atomization of the fuel.

c) Brake Power-



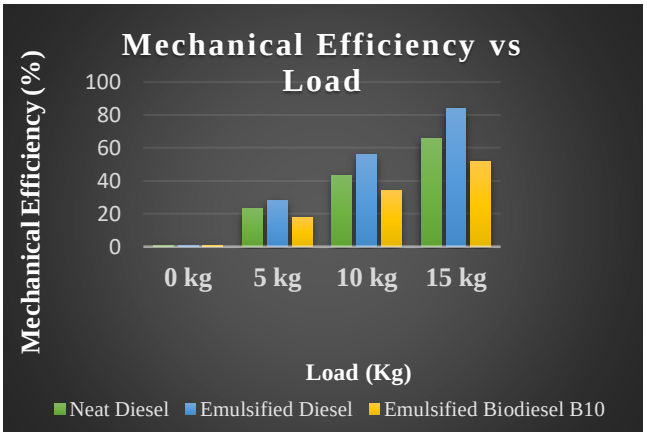
increasing. Emulsified Diesel gives higher value of brake power that Neat Diesel while Emulsified Calophyllum oil biodiesel blend B10 Gives the Lower value of brake power at any load condition that of neat and Emulsified Diesel.

d) Brake Mean Effective Pressure -

The variation of brake mean effective pressure against different loads of the engine for various compositions like emulsified diesel and emulsified biodiesel is compared with

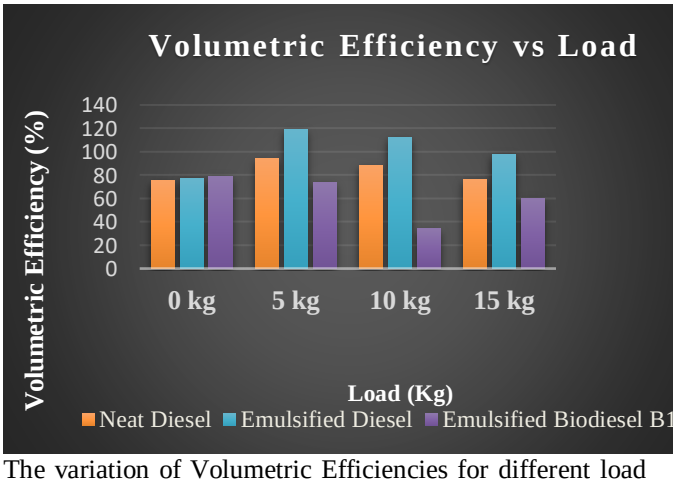
diesel and shown in Fig.6. The trend shows that brake mean effective pressure (BMEP) shows gradual increase after emulsification process. From graph we can see that, as load increases the Brake mean effective Pressure increases.

e) Mechanical Efficiency -



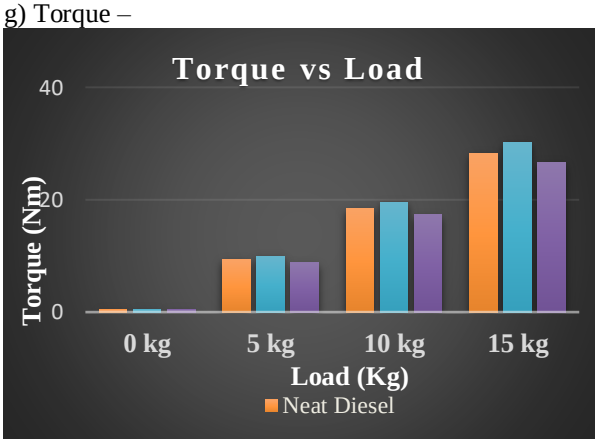
The variation of mechanical efficiency against different loads of the engine for various compositions like emulsified diesel and emulsified biodiesel is compared with neat diesel and shown in Fig 7. It is shown in fig that for 15 kg of load we get the highest efficiency up to 83% (emulsified diesel). From here we conclude that, at starting condition efficiency for all composition is much lower.

f) Volumetric Efficiency -



The variation of Volumetric Efficiencies for different load conditions are plotted above for Different compositions like Emulsified Biodiesel(B10) and Emulsified Diesel and compared with the volumetric efficiency of Neat Diesel. The trend shows that Efficiencies are comparatively same at starting conditions but varies as load increases from 5kg to 15kg. Emulsified Biodiesel (B10) shows sudden drop in Efficiency at 10kg due to incomplete Emulsification.

g) Torque –



The variation of torque against different loads of the engine for various compositions like emulsified diesel and emulsified biodiesel is compared with neat diesel and shown in Fig 9. It shows that the torque obtained for emulsified diesel is better compared to emulsified biodiesel and neat diesel for various load conditions. At zero load condition's torque is almost zero.

VI . CONCLUSION –

1) Overall, it was observed that, with increase in engine load even at starting time, engine performance improved.
2) Specific Fuel Consumption is higher at zero load and reduces as engine load increases.
3) Emulsification by 10 vol. % water shows no adverse effect on engine part.
4) Emulsification diesel shows better performance as compared to neat diesel and emulsified biodiesel.
5) Emulsified biodiesel also prove that it can be used as alternative fuel for diesel engine without any modification.

VII. REFERENCES –

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