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EVALUATION OF PERFORMANCE AND EMISSION CHARACTERISTICS OF POPPY SEED OIL BLENDS ON SINGLE CYLINDER FOUR STROKE DIESEL ENGINE

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Abstract:**In the proposed project, Fuel properties like, viscosity, calorific value, density, specific gravity, flash and fire points of diesel fuel and various proportions of Poppy Seed oil-diesel blends are to be found out by conducting experiments in the laboratory. In this project, it is planned to carry out an experimental investigation on 4- stroke Single Cylinder Diesel Engine with rope dynamometer run with different proportions of Poppy Seed oil blended with Diesel. Experiments are carried out on a diesel engine usingdiesel and blends of Safflower oil biodiesel as alternative fuel, which is a single cylinder, four-stroke, water cooled, and constant speed engine capable of developing a power output of 3.7 kW at 1500 rpm. Performance parameters such as brake power, specific fuel consumption, brake thermal efficiency and indicated thermal efficiency are calculated based on experimental analysis of the engine. At all the load conditions, performance of the engine is obtained better for blend B25. At all the load conditions, Brake thermal Efficiency is more for the all blends compared to that of diesel and is highest for blend B25. At all the load conditions, Indicated Thermal Efficiency is less for the blend B25. All the properties of blends obtained better than that of diesel fuel. The emissions COX, NOX and HC are decreased than diesel.**

Keywords: Alternative fuel, trans-esterification, Diesel Engine, Poppy Seed oil, Engine Performance, Emissions.

I. INTRODUCTION

In the recent years increase of population andVehicles lead to increase of fuel usage. Fuel sources are two types' renewable and non-renewable sources. Energy sources like hydro, fossil fuels, wind, and

Biomass wastes arerenewable they will extinct soon. As diesel is a fossil fuel it extinct soon, so there is a need to find an alternative fuel source for future generations. Usage of diesel lead to environmental pollution due to release of COX, NOX, SOX and smoke by use of fossil fuels. These emissions will cause greenhouse effects and acid rains. These negative effects of diesel fuel and decreasing of fuel sources increases the studies on new fuel types that can be used in automobiles vehicles. One of the alternative fuels is vegetable oils. Vegetable oils were first used as fuel in diesel engine by Rudolf Diesel in 1990. Vegetable oils have several advantages such as high flash point, better lubricating properties, high cetane number, and low sulphur content. But there are disadvantages also; they have low volatilities and high viscosity. Due to low volatility, its cause's poor fuel atomization and incomplete combustion. Due to high viscosity it leads to gummy nature and ring sticking in diesel engine.To decrease viscosity the methods such as trans-esterification, preheating and blending. In my study I had trans-esterified the poppy seed oil and also blended with diesel in different proportions and the performance and emissions characteristics were evaluated.

II.LITERATURE REVIEW

There is a wide variety of Alternative Fuels available as renewable fuels to replace diesel fuel.

F. Aksoy*etal [1]*, has concluded by conducting has concluded by conducting performance test on pure diesel and 50% diesel and 50% diesel fuel mixture on single cylinder, 4-stroke, air cooled and pre-combustion chamber diesel engine at different speeds and its effects on engine performance and emissions are studied. When compared to diesel fuel on an average engine torque and power decreases at 4% and 5.73. CO and NOX have decreased to 15.5% and 5.9% respectively.

M. P. SudeshKumar*etal [2]*, has concluded in his paper that the utilization of various vegetable derived biodiesel blends in a diesel engine as alternative fuels is a major improving step to increase diesel engine performance and lowering the emissions.

III. MEASUREMENT OF FUEL PROPERTIES

*A. Density Measurement:*Empty beaker of capacity 50ml is taken and weighed that empty beaker using a Digital Weighing Machine. Reading is noted down. Now Fuel sample of 50ml is measured in a beaker and weighed by using that Digital weighing machine. Beaker with fuel weight also noted. By subtracting the weight empty Beaker from the weight of Beaker with fuel, mass of fuel can be obtained. Now, by dividing mass of fuel with volume of fuel taken in that beaker, Density of that fuel is calculated. The same procedure is repeated for diesel and all other blends.

TABLE 1
DENSITY OF THE FUELS

S.No	Fuel/Blend	Density(Kg/m^3)
1	Diesel	827
2	B10	831
3	B15	846
4	B20	859
5	B25	871
6	B30	879
7	B35	886
8	B40	894

*B. Specific Gravity Measurement:*Fuel of 50ml is taken in a beaker and measured its density by using the above procedure. By dividing density of fuel with density of reference fluid i.e., water, Specific gravity of that fuel is calculated.

TABLE 2

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C. Viscosity Measurement:Viscosity is a measure of a fluid's resistance to flow. It describes the internal friction of a moving fluid. A fluid with large viscosity resists motion because its molecular makeup gives it a lot of internal friction. A fluid with low viscosity flows easily because its molecular makeup results in very little friction when it is in motion. The apparatus used is *say bolt viscometer.*

TABLE 3

VISCOSITY OF THE FUELS

S.No	Fuel/Blend	Viscosity (cst)
1	Diesel	2.9
2	B10	3.09
3	B15	3.2
4	B20	3.28
5	B25	3.36
6	B30	3.63
7	B35	3.92
8	B40	4.01

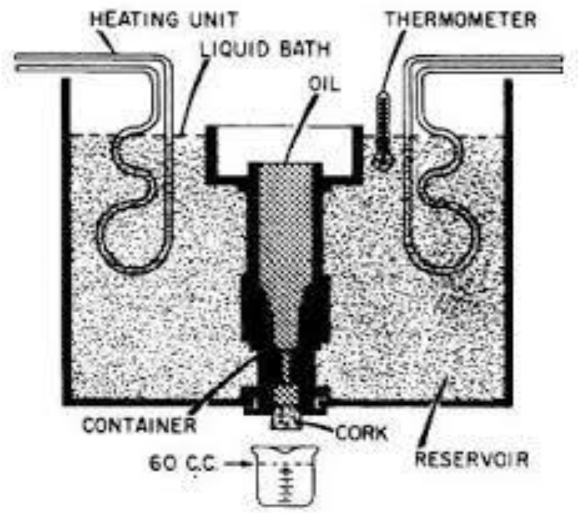

Fig.1 Say bolt Viscometer

*D. Calorific Value Measurement:*Amount of heat produced by the complete combustion of a unit weight of fuel. Usually expressed as calories per gram or Kilo joule per kg. In general the calorific value (C.V) of fuel is measured by using Bomb Calorimeter. A known mass of solid / liquid fuel is burnt and the liberated heat is made by known mass of water. From the rise in temperature, the C.V is calculated. Bomb calorimeter consists of a strong cylindrical stainless steel bomb capable of withstanding high pressures and corrosion resistant. The bomb is provided with a tight lid. The lid is provided with a stainless electrodes and an oxygen inlet valve. A ring is attached to one of the electrodes to support nickel crucible. The bomb is placed in a copper calorimeter. The copper calorimeter I surrounded by air jacket and water jacket to prevent the loss of heat by radiation. The copper calorimeter is provided with a stirrer and Beckman's thermometer (which can measure a temperature difference up to 0.01 degree).A definite amount of fuel is taken in a crucible and is supported over the ring. The electrodes are inserted into the crucible. The lid is tightened and is filled with oxygen at 30 kg/cm^2. The bomb is placed in the copper calorimeter after taking known mass of water into it.The initial temperature of water is noted. The fuel is ignited by connecting the electrodes to a 6V battery. The fuel is burnt completely and the liberated heat is transferred to the water. Water is stirred with the help of stirrer and the maximum temperature attained is recorded.

TABLE 4

CALORIFIC VALUE OF THE FUELS

S.No	Fuel/Blend	Calorific Value (KJ/Kg)
1	Diesel	43350
2	B10	43296
3	B15	43208
4	B20	43157
5	B25	43104
6	B30	43972
7	B35	42553
8	B40	42336

Fig. 2 Bomb Calorimeter

E. Flash and Fire Point Measurement

Flash point is the lowest temperature at which the oil will flash, when a small flame is passed across its surface. Flash point is important considering the safety of the fuel; this temperature

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should be as high as practical. Bio-Diesel and its blends are safer in storage than conventional Diesel. Typical values of commercial vegetable fuels range between 50 and 110°C. Addition of vegetable oil with Diesel to form a blend should not decrease the flash point temparature.

TABLE 5
FLASH ANDFIRE POINTS OF THE FUEL

Fuel/Blend	Fire Point	Flash Point
Diesel	56	49
B10	64	51
B15	69	54.5
B20	76	56
B25	82	58
B30	89	61
B35	97	64
B40	106	68


Fig. 3
Penky-Martin Apparatus

IV.EXPERIMENTAL WORK

Before starting the engine, the fuel injector is separated from the fuel system. It is clamped on the fuel injection pressure tested and operates the tester pump. Observe the pressure reading from the dial. At which the injector starts spraying. In order to achieve the required pressure by adjusting the screw provided at the top of the injector. This procedure is repeated for obtaining the various required pressures.As first said, Diesel alone is allowed to run the engine for about 30 min, so that it gets warmed up and steady running conditions are attained. Before starting the engine, the lubricating oil level in the engine is checked and it is also ensured that all moving and rotating parts are lubricated.The various steps involved in the setting of the experiments are explained below. The Experiments were carried out after installation of the engine. The injection pressure is set at 200 bars for the entire test.Precautions were taken, before starting the experiment.Always the engine was started with no Brake Power condition. The engine was started at no Brake Power condition and allowed to work for at least 10 minutes to stabilize. The readings such as fuel consumption, spring balance reading, cooling water flow rate, manometer reading etc., were taken as per the observation table. The Brake Power on the engine was increased by 20% of FULL Brake Power using the engine controls and the readings were taken as shown in the tables. Step 3 was repeated for different Brake Powers from no Brake Power to full Brake Power.After completion of test, the Brake Power on the engine was completely relieved and then the engine was stopped.The results were calculated as follows. The above experiment is repeated for various Brake Powers on the engine. The experimental procedure is similar as foresaid. While starting the engine, the fuel tank is filled in required fuel proportions up to its capacity. The engine is allowed to run for 20 min, for steady state conditions, before Brake Power is performed. Finally, the engine is run by blend (200atm) at various Brake Powers and the corresponding observations are noted.

The test is carried on the Kirloskar Engine for the following fuel blends:

1. 100% Diesel (B0).
2. 10% Poppy Seed Oil + 90% Diesel (B10)
3. 15% Poppy Seed Oil + 85%Diesel (B15)
4. 20% Poppy Seed Oil + 80% Diesel (B20)
5. 25% Poppy Seed Oil + 75% Diesel (B25)
6. 30%Poppy Seed Oil + 70% Diesel (B30)
7. 35% Poppy Seed Oil + 65% Diesel (B35)
8. 40% Poppy Seed Oil + 60% Diesel (B40)

TABLE 6
ENGINE SPECIFICATIONS

Engine type	4 - Stroke Engine
B.H.P	5HP
Rated Speed	1500RPM
Bore Size	85mm
Stroke Length	110mm
No.of Cylinders	Single Cylinder
Cooling	Water cooling

V. RESULTS AND DISCUSSIONS

*A. Brake Thermal Efficiency:*The brake thermal efficiency is plotted out considering with load on X-axis. The efficiency is an increasing curve from the origin. The brake thermal efficiency mainly depends on the heat input. The fig 4shows the variations in the efficiency with load variations. The poppy oil showed an increasing factor in the efficiency.Among the poppy oil and diesel blends B25 had higher efficiency when compared to other blend properties. The B40blend efficiency curve was the last position. The values of the efficiency for the proportions at maximum load were shown as 18.176%, 20.18%, 21.18%, 21.226%, 21.56%, 19.4%, 18.98% and 18.146% for B0, B10, B15, B20, B25, B30, B35 and B40blends respectively.

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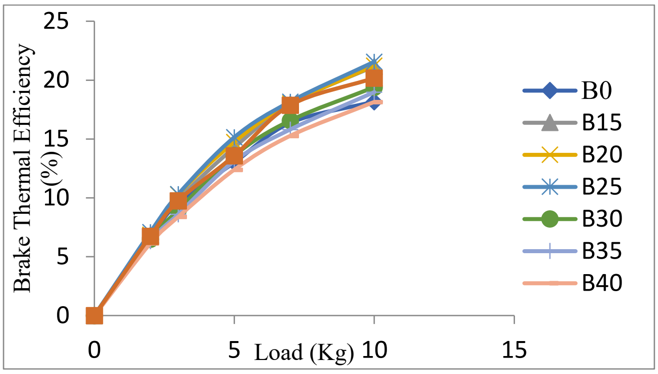

Fig. 4 Load vs. Brake Thermal Efficiency

*B. Indicated Thermal Efficiency:*The figure 5 shows the variations of ITE values of diesel and poppy seed oil blends. The ITE is highest for B25 blends and it is lowest for B40 blend when compared to other blends. The values of the ITEat the maximum load for the diesel and poppy seed oil blends are 26.68%, 28.96%, 31.25%, 33.85%, 36.05%,

32.6% and 29.69% at B0, B10, B15, B20, B25, B30, B35 and B40respectively.

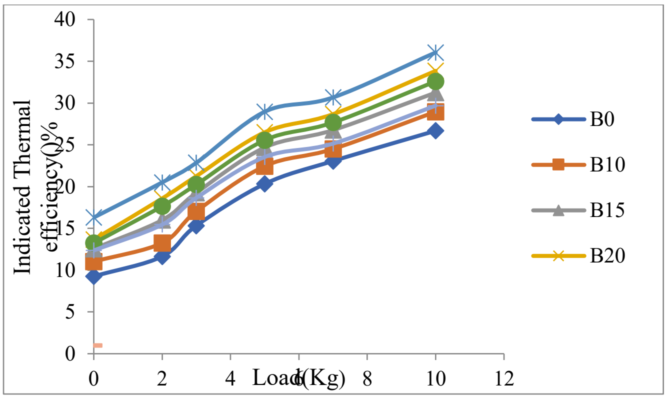

Fig. 5 Load Vs Indicated Thermal Efficiency

C. Mechanical Efficiency: The mechanical efficiency is another important factor which is decided by BP and IP. The mechanical efficiency for the considered engine with different blends is shown in figure6 it is clearly observed that the curves pass through the origin [3]. It is in the shape of half parabola. The mechanical efficiency is high for B25proportion at any load considered. All the remaining proportions have very close values [4]. The efficiency values at different proportions are as follows at maximum load are 70.65%, 79.38%, 84.25%, 86.52%, 88.92%, 82.1%, 75.06% and 71.175% at B0, B10, B15, B20, B25, B30 and B40 respectively [5].

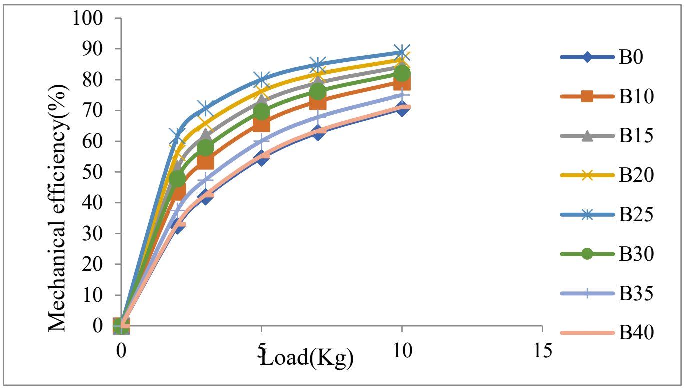

Fig. 6 Load Vs Mechanical Efficiency

*D. Brake Specific Fuel Consumption:*The figure 7 shows the variations of BSFCvalues of diesel and diesel –poppy seed oil blends. The BSFC was decreased as the brake power increased. The B40 blend has highest consumption of fuel. The B25 blend has lowest BSFC when compared to other blends. The values of the BSFCat the maximum load for the diesel and poppy seed oil blends are 0.326, 0.3925, 0.4054, 0.3878, 0.3934, 0.4318, 0.4416 and 0.4685 at B0, B10, B15, B20, B25, B30, B35, and B40 respectively.

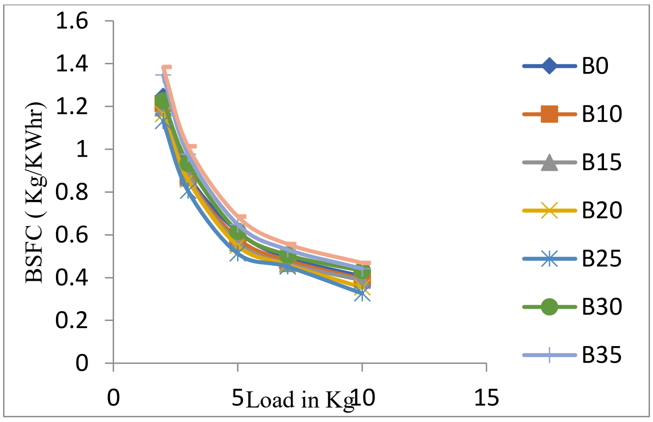

Fig. 7 Load Vs Brake Specific Fuel Consumption

VI. CONCLUSIONS

After conducting the experiments at different proportions with poppy oil fuelled 4-stroke single cylinder diesel engine the following conclusions are done. Brake Specific Fuel Consumption for diesel engine fuelled with Poppy seed oil is 0.3934Kg/KW-sec and is lower than pure diesel at B25. The maximum Brake Thermal Efficiency is 21.56% at B25. It is more for all blends than pure diesel.The maximum Indicated Thermal Efficiency for the diesel is 26.68% and for the poppy oil is 33.85% for B25 than pure diesel. It is least for B40.Even the mechanical efficiency is increasedfrom 70.65% to 88.92%for diesel and poppy seed oil. The CO2 Emissions which are harmful were reduced from 2.8%vol to 2.1%volfor diesel and poppy seed oil.The NOx emissions are diminished by the addition of poppy seed oil from 401ppm to 308ppm when compared to pure diesel [6].Even the HC are lowered when diesel is mingled up with poppy seed oil. The changes in the emissions are as follows from21ppm to 15ppm for diesel and poppy seed oil [7].

VII. SCOPE OF FUTURE WORK

This work can be extended by using various types of alternative fuels performance and emission characteristics of engine can be find out [8] [9].

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