

EXPERIMENTAL INVESTIGATION ON PERFORMANCE AND EMISSION CHARACTERISTICS OF DIESEL ENGINE USING CORNOIL AS AN ALTERNATE FUEL

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Abstract: Fuel crisis occurs due to increase in usage of fossil resources because of significant growth of population and change in life style. In order to keep the pace of development there is a need to think about an alternative fuel. Bio fuels appear to be a solution to substitute fossil fuels and more environment friendly. With the help of renewable sources like Vegetable oil, Essential oil, Animal fat and used cooking oil, the biodiesel can be produced. In this paper will be examined the use of diesel-corn oil mixtures in diesel four stroke engine. For those mixtures the indicated thermal efficiency, brake specific fuel consumption and combustion characteristics. The gas emissions of carbon dioxide (CO₂), hydrocarbons (HC) are being measured.

Keywords- Bio fuel, emissions, vegetable oil, combustion

I. INTRODUCTION

As fossil fuels are limited sources of energy, this increasing demand for energy has led to a search for alternative sources of energy that would be economically efficient, socially equitable and environmentally sound. Biofuels are considered as alternative sources of energy. Speaking in terms of advantages, much heard is they, as an alternative fuel, could solve served is used as the increasing energy prices worldwide. By using renewable resources like Vegetable oils [1], Animal fats tallow's etc., biodiesel can be produced. Low content of sulfur, aromatic content and having high cetane number and lubrication properties are seen in biodiesel by many investigations [2]. With the help of biodiesel blends with diesel fuel many investigations are carried out and results showed that there is less in emissions like CO, HC, SO₂ [3].

In this paper, would like to highlight upon the usage of different blends (10%, 20%, 30% and 40%) of corn oil for a compression ignition engine and studied the performance and Emission characteristics of this fuel at different loads. A single cylinder CI engine (Kirloskar, 4 stroke water cooled with 5HP, 1500rpm) coupled with eddy current dynamo meter loading is used for

experimental investigation and following results have been recorded.

II. LITERATURE SURVEY

O.M.I.Nwaforetal [4], expresses the view that rapeseed methyl ester (RME) and Diesel fuel in blends of 25%-75%, 50%-50%, 75%-25% Diesel/RME by volume. While carbon monoxide emissions were similar to those of diesel, the carbon dioxide were slightly higher for RME fuel operation at high engine brake power conditions. The HC emissions were very low for the same.

k.pranamic [5], has done a study in detail to reduce the viscosity of pongamia curcas oil close to that of conventional fuel to make it suitable for use in as a fuel in a CI engine fuel and to evaluate the performance of the engine with the modified oils. Among the various blends, blends containing upto 30% pongamia oil have a viscosity value close to that of diesel fuel. Acceptable brake thermal efficiencies were achieved with blends containing 50% pongamia oil.

K.sureshkumar et al [6], presents the results of performance and emission analysis carried out in an unmodified diesel engine fueled with pongamia pinnata methyl ester (PPME) and its blends with diesel. The results reveal that blends of PPME with diesel up to 20% by volume (B20) provide better engine performance and improved emission characteristics.

Ma zhihao et al [7], has done experiment on a diesel seed named pistacia chinensis bunge with diesel blends. The findings showed that CO, HC and exhaust emissions decrease when the proportions of biodiesel increases in the blends B10, B20 emitted lesser NO_x while slightly increased for B30.

III. CORN OIL

Corn is an important raw material for bioethanol production. The oil is contained in the germ of the grain. Up to 70% of corn is used as an animal feed, 20% for food, and 5% in industry. Industrial use of corn is expanding by-

product of bioethanol production -DDGS (Distillers dried grains with solubles) is used for the production of animal feed. Corn oil can be produced from germ separated in preparation of maize grains for fermentation or for production of starch. Corn oil processing starts with corn germ, the first step in corn oil processing is mechanical: corn kernels are dehulled and then crushed with a grooved roller to break down the cell walls. The resultant cake is then “wet milled”, steeped in water acidified with sulfur dioxide to separate the components of the seed.

Oil is expelled from the germ using a heated screw press, which can yield as much as 50 percent of the germ oil and remaining oil is stripped from the “press cake” with the solvent hexane, a volatile by-product of gasoline production. (Hexane is introduced to the cake bed with an exposure time as brief as possible so that hexane residual in the oil is limited). The corn oil in the hexane solution is heated to vaporize the volatile solvent, which is captured as a condensate and used again. Then the heated expelled and hexane extracted oils are recombined as crude oil. The remaining cake is processed for livestock feed.

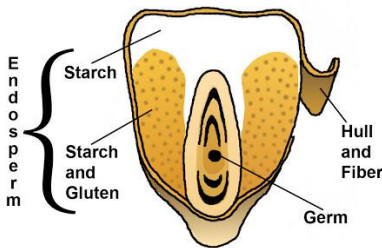


Fig.1: corn kernel

IV. BIODIESEL PRODUCTION PROCESS

Transesterification: The process of converting bio-oils less viscous and it is a chemical process by which bio-oils are turned into biodiesel by separating glycerin.

Transesterification process: Corn oil is added into a three neck fitted with condenser, thermometer and methanol dozer. The oil is heated upto 60°C. Meanwhile prepare sodium hydroxide in appropriate amount of methanol and add this solution to preheated oil and stir it for 1-1.5 hours. Then in a separating funnel the mixture is poured to settle down. Glycerin which is settled at the bottom as thick, cloudy liquid is drained out. The biodiesel remains on top as a translucent liquid.

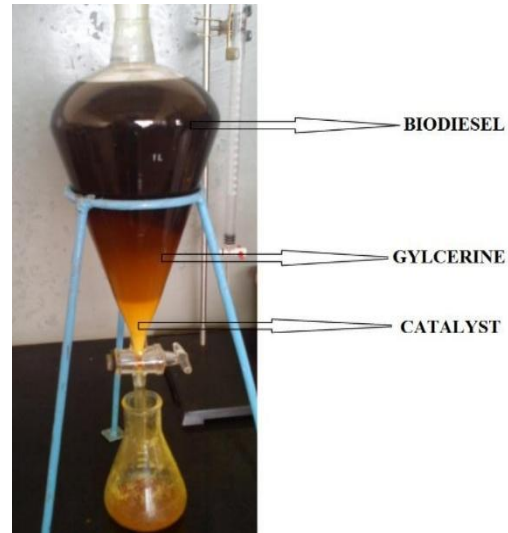


Fig.2: separating funnel

TABLE I

PROPERTIES OF CORN OIL COMPARISON WITH DIESEL

PROPERTIES	CORNOIL	DIESEL
Density at 15°c (gm./cc)	0.893	0.827
Calorific value(KJ/kg)	36,210	42,682
Kinematic viscosity at 40°c	5.512	5
Flash point(°c)	182	72
Fire point(°c)	196	85

By seeing the properties of corn oil the following conclusions are made:

1. Corn oil has high flash point, it means it is safer to transport than diesel.
2. Corn oil is nontoxic than diesel.
3. Corn oil can be used as an alternative fuel because of calorific value which is nearer to diesel.

V. EXPERIMENTAL INVESTIGATION



1. Engine Specification:

Engine make: Kirloskar

Type: single cylinder, 4 stroke water cooled

Capacity: 5HP @ 1500 rpm

Bore diameter: 80 mm

Stroke length: 110 mm

- 2. Test rig description:** Brand new kirloskar make AV1 model diesel engine of 5HP[3.7kW] capacity and water cooled was used. To measure the engine power, eddy current dynamometer was connected [8]. Thermocouples are provided at appropriate positions and are read by digital temperature indicator[9]. Engine speed and load applied at various conditions are determined by digital rpm indicator and energy meter reading. The emission like NO_x, HC, CO, O₂ and CO₂ are measured by employing an exhaust gas analyzer.
- 3.** Always engine was started at no load condition by hand cranking using de-compressor lever and allowed to work for at least few minutes to stabilize at rated value. Load the engine by switching on the loading switches. Experiments were carried out with pure diesel and various blends of biodiesel [B10, B20, B30 and B40]. At a rated speed, with no load and varying load conditions all blends were tested. The ammeter, voltmeter, time taken for 10cc of fuel consumption parameters which are related to performance of engine were recorded. The emissions from exhaust gas analyzer were recorded. Brake thermal efficiency, brake specific fuel consumption for pure diesel and its blends were calculated [10].

1. Brake Specific Fuel Consumption:

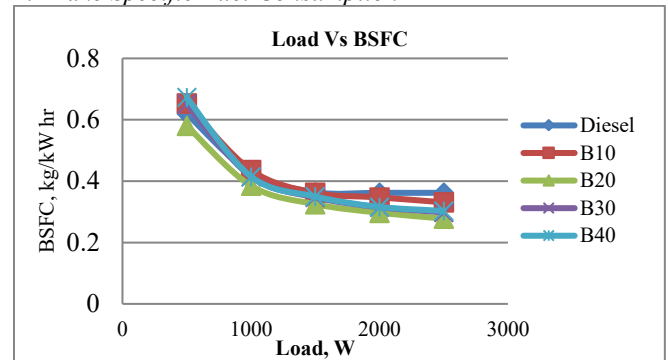


Fig.3: Load Vs Brake specific fuel consumption

The variation of brake specific fuel consumption with various loads for diesel and various blends of biodiesel is shown in fig.3. It is observed that the brake specific fuel consumption is found to decrease with increase in load. B20 showed lowest brake specific fuel consumption (0.278 kg/kW-hr). This is due to lower calorific value of the blended fuel as compared with diesel.

4. Brake Thermal Efficiency:

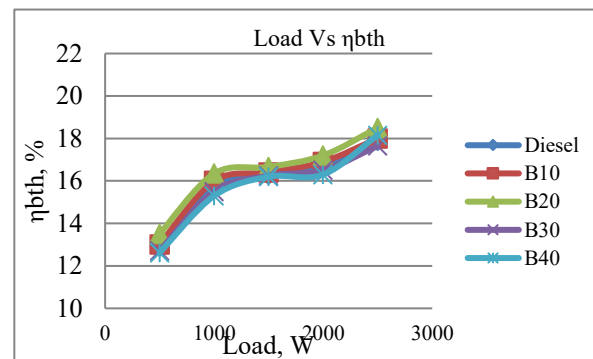


Fig.4: Load Vs Brake Thermal Efficiency

The variation of brake thermal efficiency with respect to various loads of the engine is shown in fig.4. It is observed that the maximum thermal efficiency for B20 (18.5%) was higher than that of diesel (17.89%). This may be due to variation of total power produced by the engine with respect to heat supplied in the form of fuel.

3. Exhaust Gas Emissions of Carbon dioxide:

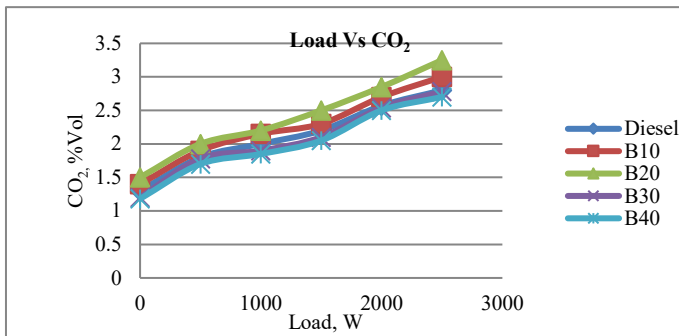


Fig5:Load Vs Carbon dioxide

The variation of carbon dioxide emission with respect to various loads of the engine is shown in fig.5. From the results, it is observed that amount of carbon dioxide emission produced while using corn oil blends (B10 and B20) are higher than diesel at full load condition, this indicates the complete combustion of fuel.

4. Unburnt Hydrocarbons:

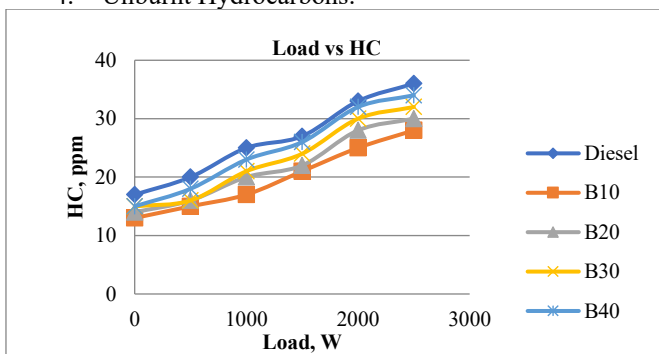


Fig.6: Load Vs Hydro carbons

The hydrocarbons variation with brake power for the blends and diesel are shown in fig.6. The hydrocarbons are lower for all blends for all the blends compared to diesel. This is depends on oxygen quantity and fuel viscosity, in turn atomization.

5. Exhaust Gas Emissions of Carbon monoxide:

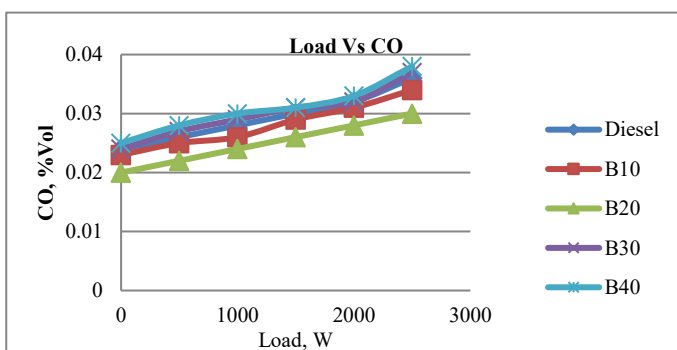


Fig7: Load Vs Carbon monoxide

The variation of carbon monoxide emission with respect to various loads of the engine is shown in fig.7. Variation of CO emission against various loads are recorded. These lower CO emissions of biodiesel blends (B10 and B20) may be due to their more complete oxidation as compared to diesel.

VII.CONCLUSIONS

Following are the conclusions based on the experimental results obtained while operating single cylinder water cooled diesel engine fuelled with corn Oil and its diesel blends.

1. It is observed that the maximum thermal efficiency for B20 (18.5%) was higher than that of diesel (17.89%).
2. B20 showed lowest brake specific fuel consumption (0.278kg/kW-hr).
3. It is observed that amount of carbon dioxide emission produced while using corn oil blends are higher than diesel at full load condition.
4. CO emission is reduced for corn oil blended fuels compared to diesel
5. HC emission is reduced for corn oil blended fuels compared to diesel.
6. A slight increase in NOx is observed for blends of corn oil compared to diesel.

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