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EXPERIMENTAL INVESTIGATIONS OF PERFORMANCE CHARACTERISTICS ON FOUR STROKE SINGLE CYLINDER WATER COOLED DIESEL ENGINE BY USING LINSEED OIL AS BIOFUEL

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Abstract:

There is a great demand of energy in the present world. Increased energy demand and the concern about the environmental friendly technology, renewable biofuels are a better alternative source to petroleum products. In the present study linseed oil B30(30% Linseed oil and 70% Diesel) was used as an alternative fuel for diesel engine fuel to investigate the performance characteristics of Diesel Engine with linseed oil blended diesel fuel and the results were compared with the baseline data of pure diesel. The tests were performed at compression ratio of 18CR at pressures 240bar, 220bar and Crank angle at 23° Bottom Dead Center. The results showed that the Brake power was more for B30 blend compared to diesel, it also showed that the brake thermal efficiency was found higher for diesel when compared to B30 blend at lower load conditions but brake thermal efficiency for blended fuels is higher as load increases and the Brake Specific fuel consumption was higher for the B30 blend. Linseed oil is non edible and self-lubricating oil, so it can be used as an alternative for diesel engines and for small and medium energy needs.

KeyWords: Linseed Oil, Emission, Compression Ratio, Crank Angle & Self-Lubricating

1. Introduction:

Energy obtained from the fossil fuels is greater than any other resources. The demand of energy of the world is increasing day by day. Majority of energy supplied to the world are through coal, oil, natural gas, and petroleum ores. The consumption of fossil fuels is increasing day to day which leads to depletion of the resources. The environmental pollution caused by the burning of these fossil fuels hasled to search of alternative fuels. Biodiesel is the very suitable for transportation vehicles. Vegetable oils are used for production of biodiesel. Vegetable oil are very suitable alternative fuel because of their chemical and properties are very close to that of diesel compared to other alternative fuels. They are easily available, non-toxic, biodegradable, and ecofriendly.

Hanbey Hazar et al. observed that linseed oil + diesel fuel mixtures and a slight increase in the NOx emission values occurred. It was determined that coating the combustion chamber element of a diesel engine with Cr3Cr2 improved the performance and harmful emissions of the engine. In addition, it was concluded that pre-heated linseed oil in standard and coated diesel engines resulted in improved combustion efficiency of fuel [1]. N. Supanchaiyamat et al. observed the resulting composite demonstrated good thermal stability up to 300°C, good low temperature modulus, flexibility and uniformity. The bio-based composites suggested that these materials can potentially be utilized as membranes [2]. Danilo Leitea et al. studied that Biodiesel density increased linearly as a function of the increase in vegetal oil in the biodiesel blends from 0.84 to 0.90 g cm-3 for linseed biodiesel. For a nominal resistive load of 750 W, the use of linseed biodiesel provided an increase in power as a function of the increase in linseed oil in the mixture. At medium load (1500 W), the vegetal-oil-based fuels presented behavior similar to that recorded at 750 W. Linseed biodiesel resulted in a linear increase of power, going from 1861 kW (B10) to 1873 KW (B70). At medium loads (1500W and 2250 W), most of the vegetable-oil based fuels are presented higher efficiency against diesel. Despite this, an increase in specific consumption was observed for linseed (0.37 to 0.47 g kW−1 h−1) as a function of the biodiesel mixtures in diesel of 10–70% at a load of 1500 W. In fuels produced from linseed oil blends and diesel, 30% and 50% concentrations of linseed oil produced more emissions. The mean value of linseed B50 was 1590 mgm−3 of CO, which was around 68% higher than that of conventional diesel. For a 70% concentration of linseed oil (B70), the CO value was only 13% higher than diesel [3]. H. K. Rashedul et al. observed that The BSFC increases with increasing load for all blends of biodiesel. The B30 blend of linseed biodiesel shows the highest fuel consumption and thus BSFC. The BTE of the engine decreases with increasing blend ratio or percentage,

and B10 is the optimum blend. The BTE of the B20 blend is lower than that of diesel and other blends. The mechanical efficiencies of the linseed biodiesel blends are higher than that of diesel, and the highest efficiency is observed in the B30 blend. The mechanical efficiency increases with increasing load for all biodiesel blends. The CO emission of the biodiesel fuel is lower than that of diesel fuel because of the complete combustion of the biodiesel fuel. The CO emission decreases as the load increases for all blends, and B20 shows the optimum blend [4]. A. M. Ashraful et al. concluded that Biodiesel fuels have excellent kinematic viscosity, except jojoba, neem, and linseed biodiesel. Except for jojoba, neem, and linseed oil biodiesels, other biodiesels meet the specified flash point limit [5]. Mohd. Yunus Khan, and S. Abid Hasan stated that the chemical and physical properties of linseed oil are more or less comparable with those of diesel, except kinematic viscosity, the kinematic viscosity of linseed oil is found to be several times higher than that of diesel, which is a major disadvantage. Blending with diesel and heating achieved a significant reduction in the kinematic viscosity of linseed oil, the friction power was noted to increase with decrease in the viscosity of the fuel blend while mechanical efficiency curves showed reversed trends [6].Rishi Malhotra et al. tested B10 linseed oil (linseed oil 10% and diesel 90%), B10 0.5% camphor and B10 1% camphor and the result showed that brake thermal efficiency was found higher for diesel when compared to blended fuel at lower load conditions but brake thermal efficiency for blended fuels becomes higher as the load increases. Addition of camphor was found with providing good significance in brake thermal efficiency. Blended fuel was found with higher brake specific fuel consumption when compared to diesel because of lower calorific value. Exhaust gas temperature for blended fuel was found higher than diesel because of higher viscosity. Emission parameters such as CO, CO2, HC was found higher for blended fuel than diesel [7]. S. Nandha Kumar et al. found that Compared to diesel fuel, a little amount of power loss occurs in biodiesel blends due to higher viscosity and density. It also observed that there is the significant reduction in CO2, unburnt HC, NOx emissions for biodiesel blends compare with diesel fuel. However, CO and Smoke emission of biodiesel blends is marginally higher than the diesel fuel [8].

2. Methods and Methodology:

Diesel, B30 linseed blend (30%linseed oil and 70% Diesel) were tested. Experiment was conducted on the diesel engine coupled with eddy current dynamometer by varying loads 6kg, 12kg at constant speed 1500 RPM. Time taken for 20CC was noted to determine the fuel consumption. Emission characteristics CO, CO_2, HC and NO_x are measured by Mars gas analyzer.The methodology adopted in the experimental work is given below. Check the fuel Linseed blend (Linseed oil + Diesel) level in the fuel tank

- Allow fuel, start the engine by hand cranking.
- The engine is set to the speed of say 1500-1600 RPM.
- Apply the load by switching the mains from the dynamometer loading unit at range 6 – 12 KG.
- Allow some time so that the speed stabilizes.
- Note down the manometer readings.
- Now take the time taken for 20cc consumption of fuel and note down the time.
- Repeat the procedure for (3) to (6) for different loads and different Injection opening pressures.
- Tabulate the readings as shown in the enclosed list.
- After the experiment is finished the load is gradually reduced at kept at zero position.
- The fuel supply is controlled after the experiment is over.
- Check the emissions with the help of gas analyzer and tabulate the values

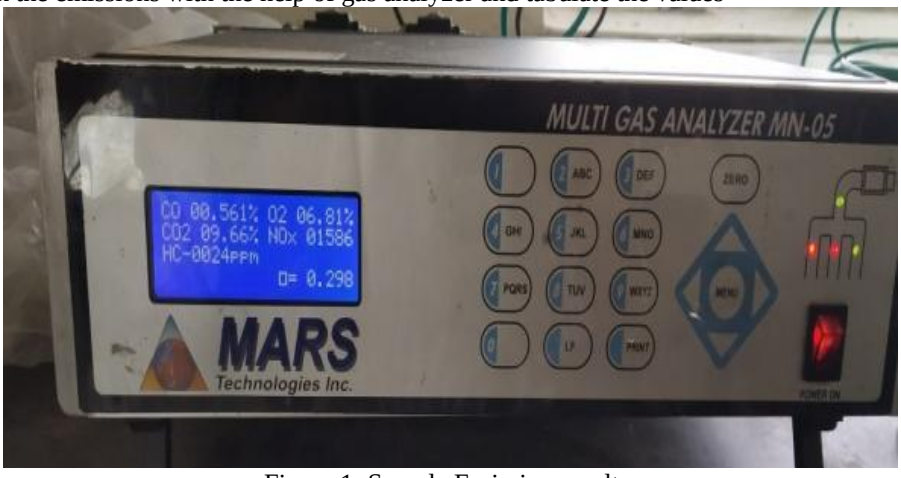

Figure 1: Sample Emission results

2. Experimental Setup:

The test rig used in this investigation is a four-stroke, single-cylinder, water-cooled diesel engine. The performance characteristics of the engine at different loads and settings were evaluated was evaluated in terms of Brake Power, Brake thermal efficiency, Specific fuel consumption.

Figure 2: Experimental Setup

Table 1: Specifications of Experimental Engine

Description	Specification
Make	Apex Innovations
No of Cylinder	Single Cylinder
No of Stroke	Four stroke
Rated Power	3.5 kW at 1800 RPM
Compression Ratio	12:1-18:1
Stroke	110mm
Bore	87.5mm
Capacity	661CC
Type of Cooling	Water Cooling

3. Results and Discussion:

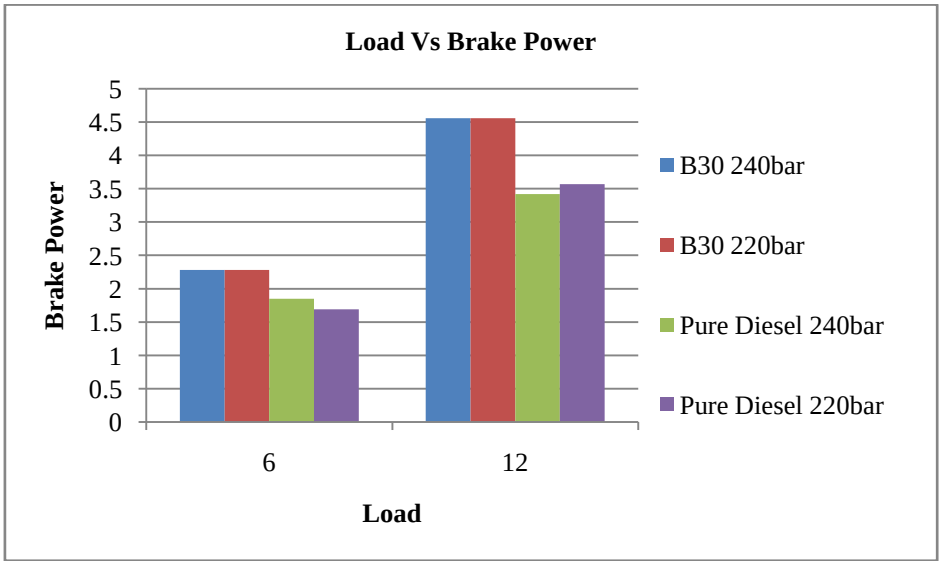

Figure 3: Load Vs Brake Power

On the analysis of the brake power of engine in figure 3, it is found that the diesel fuel shows minimum brake power as compare to biodiesel blended fuels. It is also seen that as the load was increasing the brake power is also increasing for all the fuels. As the concentration of the blends increases, in the biodiesel the brake power increases. It is so because at high concentration of the biodiesel fuel, high combustion of fuel takes place and high brake power produced in the engine.

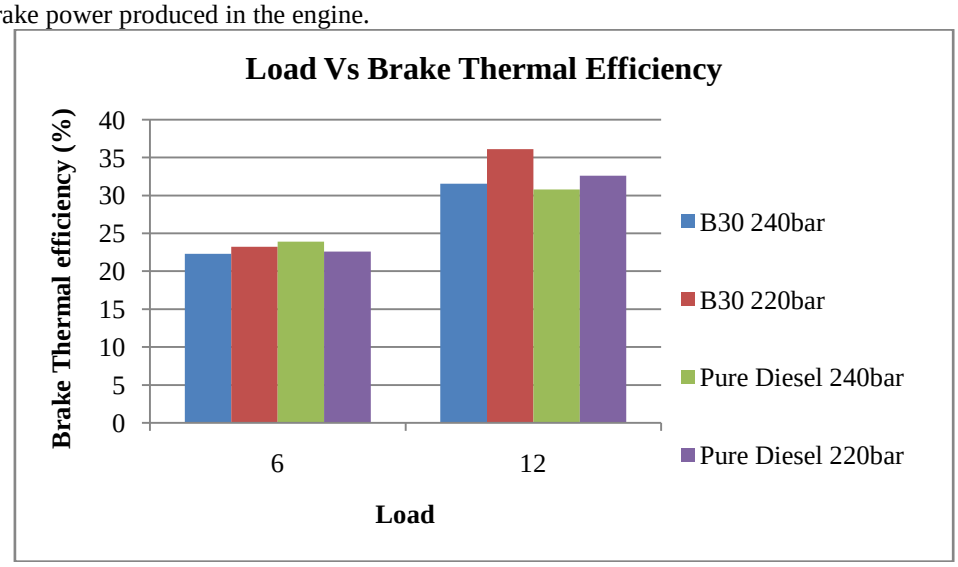

Figure 4: Load Vs Brake Thermal Efficiency

Brake thermal efficiency is a main important parameter, while calculating the performance characteristics of the engine. In the analysis of the brake thermal efficiency in figure 4, it is observed that the diesel fuel has high efficiency as compare to the biodiesel blended fuels. The efficiency of the diesel fuel is increasing, as the load was increasing. It is also seen that the Pure Diesel fuel shows high efficiency up to 24% at 6kgs (240bar) as compared to the all other fuels. However, at high load conditions, B30 (220bar) blended fuel shows little bit higher increase in the efficiency value as compared to the B30 (240bar) fuel. It is also observed that at full load condition, all the fuel i.e. diesel and B30 (240bar) were having approximately similar values of efficiencies. At high load conditions, better combustion of fuel takes place and efficiency is increasing.

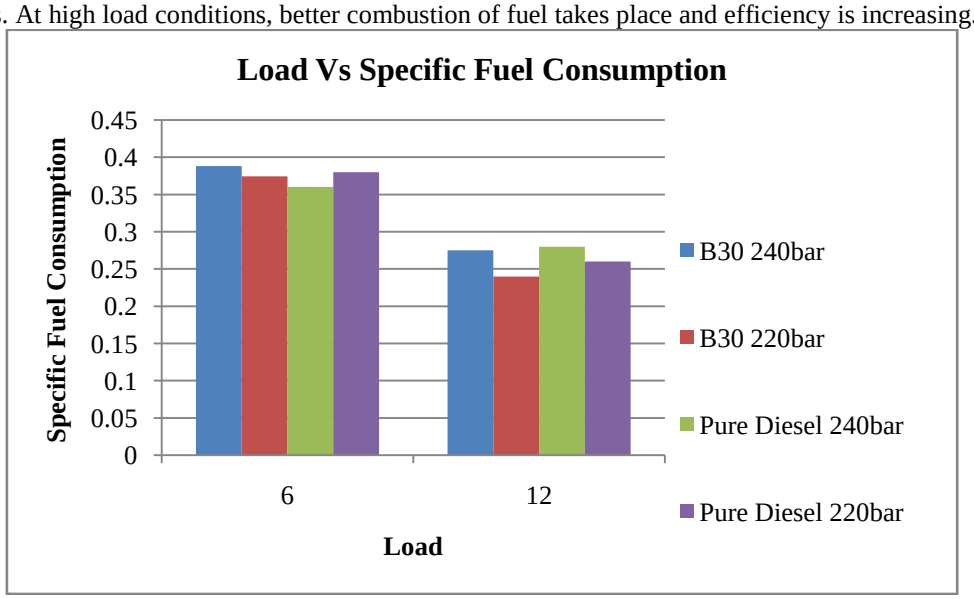

Figure 5: Load Vs Specific Fuel Consumption

The amount of fuel used in the experiment to run the engine is simply known as the specific fuel consumption. In the analysis of the brake specific fuel consumption of the engine, same blend i.e., B30 with different pressure and pure diesel fuels were used in the engine. The analysis of brake specific fuel consumption shown that B30 at 240bar fuel shows higher value of specific fuel consumption as compared to B30 at 220bar and diesel fuel at low load condition. As the load increases, the specific fuel consumption decreases. This is because, as the loads on engine increases, fuel consumption also increases, which make the engine to run at the high limit and increases the proper mixing of the air-fuel ratio.

4. Conclusions:

In the present work, the performance characteristics of a single cylinder diesel engine was analyzed with one blend at two different pressures and compared with the pure diesel. Preparation of the biodiesel was made by using Linseed oil. The performance characteristic of the diesel engine was analyzed at different load and pressure conditions. The blend B30 biodiesel results were compared with the pure diesel. The following are conclusions are drawn on comparison:

- Brake Power was increasing with the increasing of load for all the fuels.
- As the concentration of the Biodiesel fuel in blends increases, the brake power increases.
- B30 fuel at different pressures shows approximately similar values of brake power as compared to the diesel fuel.
- It is observed that the diesel fuel has high Brake thermal efficiency as compare to the biodiesel fuels. As the load was increasing the efficiency of diesel is also increased.
- It is observed that at 6kgs load condition, all the fuel i.e. diesel and B30 were having approximately similar values of efficiencies. Some amount of deviation occurs due to the variation in the density of the blended biodiesel fuel at different pressures.
- The analysis of specific fuel consumption shows that B30 at 240bar fuel shows higher value of specific fuel consumption as compared to B30 at 220bar and diesel fuel.
- The specific fuel consumption decreases with increasing in the load.

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