PERFORMANCE ANALYSIS OF DIESEL ENGINE WITH WASTE COOKING OIL AND SC5D ADDITIVE

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ABSTRACT

Due to rapid diminution of petroleum fuel, researchers are looking throughout the world for alternate fuels to run the engines. Present days Biodiesel is a best solution to substitute for diesel fuel. Biodiesel is a completely natural, renewable fuel made from biological sources like vegetable oils and animal fatty oils. In most situations, where conventional petroleum such as liquefied petroleum gas, petrol, diesel, kerosene are used. In this paper, Esterified waste cooking oil is blended with diesel in different proportions (B10, B20, B30 & B40). Among these proportions SC5D fuel additive is added to B20 which increases performance parameters like brake thermal efficiency, indicated thermal efficiency, mechanical efficiency, brake mean effective pressure, indicated mean effective pressure and decreases the brake specific fuel consumption.

KEYWORDS: Diesel, Esterified Waste Cooking Oil & SC5D Fuel Additive

Original Article

Received: May 25, 2020; **Accepted:** Jun 15, 2020; **Published:** Jun 29, 2020; **Paper Id.:** IJMPERDJUN2020124

1. INTRODUCTION

1.1. Vegetable Oil

The use of vegetable oil in diesel engine is not a new concept. In fact early engines were demonstrated with vegetable oils and it has few properties namely Cetane number (CN) and Calorific Value (CV) similar to diesel and heat contents about 80-90% of diesel fuel. It's one of the best promising alternate to diesel, since they are renewable and easily existing in rural areas.

1.2 SC-5D Additive

SC-5D is one type of additive, applicable to diesel engines only with 1:2000 proportions. This additive helps to inject high quality of fuel it occurs due to fine atomization later enters into the combustion chamber that developed good combustion so, it produces best mechanical work and also protects from corrosion.

2. PROPERTIES

Table 1: Properties

S.No	Property	Additive
1	Density (g/ml)	0.795 at 29°C
2	Vapour pressure	0.796 millibar
3	Lower Explosion Limit	0.9%
4	Upper Explosion Limit	7%
5	Auto Ignition Temperature	210°C
6	Flash point	>21 °C and <55 °C

3. ENGINE SPECIFICATIONS

- Set up Single Cylinder Four Stroke (1C 4S) Diesel Engine
- Mode HMT04
- Make Comet oil Engine Ltd.
- Ignition system Compression Ignition
- Arrangement of Cylinder Vertical
- Cooling Water cooled
- Bore 0.080m
- Stroke 0.11m
- Compression ratio 17.5
- Speed 1500 RPM
- Rated Power 5 HP at 2000 RPM.

4. STANDARD PROCEDURE

- Maintain the injection pressure at 200bar.
- Follow the Precautions, before starting the experiment.
- To avoid damage to pressure sensor, temperature should not exceed 121°C.
- The engine was started with null load and wait for steady state at least 10 minutes to stabilize.

5. EXPERIMENTAL PROCEDURE

- Switch ON the ignition to do the experiment after installation set up was done on the engine.
- Mention the readings such as Load in kg, time in seconds for calculate the fuel consumption at 20cc& speed in rpm.
- Repetitive the procedure as mention as above up to full load.
- With the help of engine controls, load was increased up to full load.
- After done this procedure, the entire loads were released later switch OFF the ignition.
- Getting outcome with standard formulas.

6. METHODOLOGY

The test is carried by the following manner:

Initially, experiment was performed by using pure diesel and further four types of blends B10, B20, B30 & B40 in sequence. During B10 procedure, the proportion of diesel will be 90% and 10% of esterified waste cooking oil. Both are

mixed well with the help of stirrer as per proportion for respective blends. Similarly the percentage of proportion carried out for other blends are listed below.

- B20: 20 Percent of esterified waste cooking oil and 80 percent of Diesel
- B30: 30 percent of esterified waste cooking oil and 70 percent of Diesel
- B40: 40 percent of esterified waste cooking oil and 60 percent of Diesel

After completing the experiment as mentioned above, calculate the performance were we get better outcome for that particular blend we add SC5D additive.

20% waste cooking oil+ 80% Diesel+0.5ml additive

7. RESULTS

The Brake Specific Fuel Consumption (BSFC) is depends on the parameters i.e. Total Fuel Consumption and Brake Power. The BSFC is occurred at lower value; as a result good combustion takes place in the combustion chamber. The Load versus Brake Specific Fuel Consumption for various blends and B20 blend with additive when compared to diesel are shown in following figure 1 and figure 2.

Figure 1: Load Vs Brake Specific Fuel Consumption.

Figure 2: Load Vs Brake Specific Fuel Consumption.

The Brake Thermal Efficiency (η_{bth}) depends on the parameters i.e. Brake Power and Heat Input. The η_{bth} is occurred at higher value, and it depends on the fuel consumption. The fuel consumption is less the η_{bth} is increased. The Load versus Brake Thermal Efficiency for various blends and B20 blend with additive when compared to diesel are shown in following figure 3 and figure 4.

Figure 3: Load Vs Brake Thermal Efficiency.

Figure 4: Load Vs Brake Thermal Efficiency.

The Indicated Thermal Efficiency (η_{ith}) is depends on the parameters i.e. Indicated Power and Heat Input. The η_{ith} is occurred at higher value, and it depends on the fuel consumption. The fuel consumption is less the η_{ith} is increased. The Load versus Indicated Thermal Efficiency for various blends and B20 blend with additive when compared to diesel are shown in following figure 5 and figure 6.

Figure 5: Load Vs Indicated Thermal Efficiency.

Figure 6: Load Vs Indicated Thermal Efficiency.

The Mechanical Efficiency (η_{mech}) is depends on the parameters i.e. Brake Power and Indicated Power. The Load versus Mechanical Efficiency for various blends and B20 blend with additive when compared to diesel are shown in following figure 7 and figure 8.

Figure 7: Load Vs Mechanical Efficiency.

Figure 8: Load Vs Mechanical Efficiency.

The Brake Mean Effective Pressure (BMEP) is depends on the parameters i.e. Brake Power and engine specifications (Stroke, Area of the Bore, Speed and Number of cylinders). The BMEP is occurred at higher value, and the BMEP is the average effective pressure throughout the whole power stroke. In fact the cylinder pressure varies considerably during the power stroke. The Load versus Brake Mean Effective Pressure for various blends and B20 blend with additive when compared to diesel are shown in following figure 9 and figure 10.

Figure 9: Load Vs Brake Mean Effective Pressure.

Figure 10: Load Vs Brake Mean Effective Pressure.

The Indicated Mean Effective Pressure (IMEP) depends on the parameters i.e. Indicated Power and engine specifications (Stroke, Area of the Bore, Speed and Number of cylinders). The IMEP is occurred at higher value, and the IMEP is the average effective pressure throughout the whole power stroke. In fact the cylinder pressure varies considerably during the power stroke. The Load versus Indicated Mean Effective Pressure for various blends and B20 blend with additive when compared to diesel are shown in following figure 11 and figure 12.

Figure 11: Load Vs Indicated Mean Effective Pressure.

Figure 12: Load Vs Indicated Mean Effective Pressure.

8. CONCLUSIONS

- By adding 0.5 ml of SC-5D additive to B20, it minimizes the Specific Fuel Consumption(SFC) around 0.5% compared to pure diesel.
- By adding 0.5 ml of SC-5D additive to B20, it maximizes the Brake Thermal Efficiency (η_{bth}) nearly 1.2% compared to pure diesel.
- By adding 0.5 ml of SC-5D additive to B20, it minimizes the Indicated Thermal Efficiency (η_{ith}) more than 10% compared to pure diesel. But we observed fluctuations in it.
- By adding 0.5 ml of SC-5D additive to B20, it maximizes the Mechanical Efficiency (η_{mech}) almost 2% compared to pure diesel.
- By adding 0.5 ml of SC-5D additive to B20, it maximizes the Brake Mean Effective Pressure(BMEP) in the region of 1% compared to pure diesel.
- By adding 0.5 ml of SC-5D additive to B20, it maximizes the Indicated Mean Effective Pressure(IMEP) about 10% compared to pure diesel.
- As a result, by means of 20 percent of waste cooking oil + 80 percent of Diesel + 0.5 ml additive fuelled engine was increased the performance parameters those are listed above when compared to diesel fuelled engine.
- Concluded was the B20 with 0.5 ml SC-5D additive could be suggested as an alternate fuel to diesel for getting the better performance.

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