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Investigation and performance evaluation of hippie seed oil blended with diesel using the twin cylinder diesel engine.

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Abstract

In view of increasing pressure on crude oil reserves and environmental degradation as an outcome, fuels like Biofuel may present a sustainable solution as it can be produced from a wide range of carbon based feedstock. The present investigation evaluates Biofuel as a C I engine fuel. This report describes the setups and the procedures for the experiment which is to analyze the emission characteristics and fuel consumption of diesel engine due to usage of the both fuels. Detail studies about the experimental setup and components have been done before the experiment started. Data that are required for the analysis is observed from the experiments. Calculations and analysis have been done after all the required data needed for the thesis is obtained. The experiment used C I engine with no load which means no load exerted on it.

A four stroke Twin cylinder C I engine was adopted to study the brake thermal efficiency, brake specific energy consumption, and emissions at zero load & full load with the fuel of Biofuel. In this study, the diesel engine was tested using Biofuel. By the end of the report, the successful of the project have been started which is Twin cylinder C I engine is able to run with Bio fuel but the engine needs to run by using diesel fuel first, then followed by Bio fuel and finished with diesel fuel as the last fuel usage before the engine turned off. The performance of the engine using Biofuel compared to the performance of engine with diesel fuel. Experimental results of Bio fuel and Diesel fuel are also compared.

Keywords: Diesel, Performance, Emissions, Biofuel, Hippie Seed oil.

1. Introduction

Rising petroleum prices, increasing threat to the environment from vehicle exhaust emissions and fastly depleting stock of fossil fuels have generated an intense international interest in developing alternative renewable fuels for IC engines. Bio fuel is an oxygenated fuel which increases the combustion and makes reduce exhaust emission. It can be produced from crops with high sugar or starch content. Some of these crops include sugarcane, sorghum, corn, barley, cassava, linseed plants, sugar beets etc. Besides being a biomass based renewable fuel, Biofuel has cleaner burning and higher octane rating than the various vegetable oils. Jason and Marc (2002) presented the exergetic environmental assessment of lifecycle emissions from M-85, E-85 (used for the gasoline engine) and other alternative fuels. Diesel exhaust is a major contributor to various types of air pollution,

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including particulate matter (PM), oxides of nitrogen (NOx), and carbon monoxide (CO). It has been demonstrated that the formation of these air pollutants can be significantly reduced by incorporating or blending oxygenates into the fossil fuels matrix. Diesel engines are an important part of the public and private transportation sector and their use will continue and grow into the future. But their smoke has become biggest threat to health and environment. Keeping in mind the higher octane number of the ethanol, variable compression ratio engine is a good option in this direction using the ethanol diesel blend as fuel; Shaik *et al.,* (2007) demonstrated VCR engine has great potential for improving part-load thermal efficiency and reducing greenhouse gas emissions.

There were many attempts made to use Biofuel in compression ignition (CI) engine. Huang *et al.*, (2008) carried out tests to study the performance and emissions of the engine fuelled with the ethanol diesel blends. They found it feasible and applicable for the blends with n-butanol to replace pure diesel as the fuel for diesel engine. Bhattacharya and Mishra (2002) evaluated the feasibility of preparing diesel-ethanol blends using 200° (anhydrous ethanol) and ethanol lower proof *et al.,*. They found that ethanol blends indicated power producing capability of the engine similar to that of diesel. Hansen *et al.,* (2001) found that the properties of ethanol-diesel blends have a significant effect on safety, engine performance, durability and emissions. Wang *et al.,* (2003) analyzed that the most noteworthy benefits of E-diesel use lie with petroleum fuel reductions and reductions in urban PM_{10} and CO emissions by heavy vehicle operations. Ajav and Akingbehin (2002) experimentally determined some fuel properties of local ethanol blended with diesel to establish their suitability for use in compression ignition engines. Eckland *et al.,* (1984) presented, State-of-the-Art Report on the Use of Alcohols in Diesel Engines .

Techniques that have been evaluated for concurrent use of diesel and alcohols in a compression-ignition engine include (1) alcohol fumigation, (2) dual injection (3) alcohol/diesel fuel emulsions, and (4) alcohol/diesel fuel solutions. Heisey and Lestz (1981) reported significant reductions in particulate generation; however, NOx generation increases. Likos *et al.*, (1982) reported increased NOx and hydrocarbon emissions for diesel-ethanol emulsions. Khan and Gollahalli (1981) reported decreased NOx and hydrocarbon emissions with increased particulate emissions for diesel-ethanol emulsions. Lawson *et al.,* (1981) reported increased NOx and decreased particulate emissions with diesel methanol emulsions. This type of inconsistent performance is what has hindered the use of ethanol in diesel. Baker (1981) reported diesel-ethanol emulsions produce similar NOx, hydrocarbon, and particulate emulsions as compared to baseline runs with straight diesel. Ahmed (2001) found Diesel engines are major contributors of various types of air polluting exhaust gasses such as particulate matter (PM), carbon monoxide (CO), oxides of nitrogen (NOx), sulfur, and other harmful compounds. Ethanol blended diesel (e-diesel) is a cleaner burning alternative to regular diesel for both heavy-duty (HD) and light-duty (LD) compression ignition (CI) engines used in buses, trucks, off-road equipment, and passenger cars. Karabektas and Murat Hosoz (2009) reported the increase of fuel consumption with increase in percentage of ethanol in the blends. Rao *et al.,* (2008) carried out experiment in order to found out optimum compression ratio, experiments were carried out on a single cylinder four stroke variable compression ratio diesel engine.

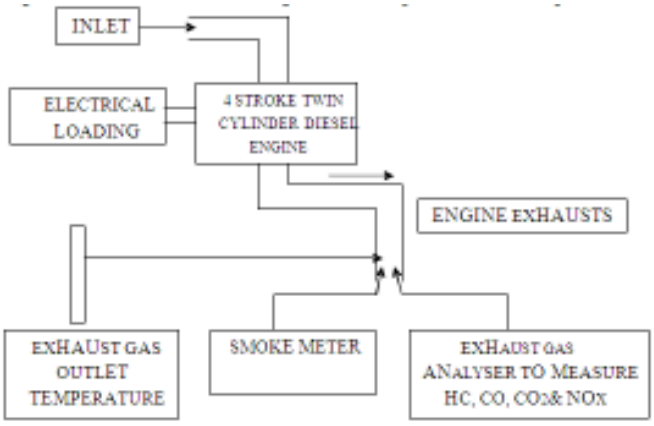

Fig 1: Schematic arrangement of Experimental Set-up

2. Objectives of the project

- It is proposed to use Bio Fuel in the diesel engine (CI engine).
- The emissions like HC, CO in the exhaust gases are proposed to reduce during the combustion itself.
- To study the performance evaluation of the using Bio fuel as fuel in the diesel engine.
- Analyze the exhaust emissions and measurement, reduction in the exhaust gas.

a) Properties of diesel and Bio Fuel.

Table 1 :

Property	Diesel	Hippie Oil
Density (kg/m^3)	832	965
Sp gravity	0.86	0.890
K V (c St), 40^{0}C	2.78	4.25
Flash point ^{0}C	50	116
Calorific value (kJ/kg)	43,200	35,800

3. Experimental Setup (Test RIG)

Kirloskar make four stroke twin cylinder diesel engines of AV series

Fig 2: Test engine

Table 2 :

Test Engine specification

Engine type	Four stroke Twin cylinder diesel engine
No. of cylinders	02
Stroke	100 mm
Bore Diameter	87 mm
Engine power	15 KV
Compression ratio	17.5:1
RPM	1500
Type of starting	Crank starting
Load type	Water loading

Table 3 :

Load bank specification

Max. Output	15 KV
Generator type	1 Phase
Amps	63
RPM	1500
PF	0.8
Volts	240

f) Precaution Observed Starting the Engine

At the time of starting the engine for each of the tests it was measured that the engine level was in the safe zone and its condition is also good in case the condition was bad, then fresh SAE 40 was introduced into the pump after draining the old . The foundation and mounting bolts were checked periodically as they may go loose due to high speed operations and vibrations.

In the course of experiments the following precautions were observed:

- The ambient temperature variations during the experiment should not be more than 6°C and this was observed as far as possible.
- After each load is applied the engine in allowed to settle before further loads are applied.

Before stopping the engine, it was allowed to run on pure diesel for some time. This is done so that the engine can be restarted easily

g) Experimental procedure

Experiments were initially carried out on the engine using diesel as fuel in order to provide base line data. The Bio fuel were prepared and made to run on the engine.

1st Case:-The engine was started using neat diesel and allowed to run for at least 30 minutes before taking observations. After engine conditions stabilized and reached to steady state, the base line data were taken.

Load was varied using the alternator load bank and the same was recorded. Gaseous emissions, fuel consumption were also recorded from the respective sensor.

2nd Case:- The engine was started on diesel and when engine became sufficiently heated; the supply of diesel was slowly substituted by Bio fuel for which a two way valve was used. After engine conditions stabilized and reached to steady state, the base line data were taken. Load was varied using the alternator load bank and the same was recorded. Gaseous emissions, fuel consumption were also recorded from the respective sensor.

4. Results and Discussion

h) Performance parameter

Tabular Column IV

Diesel readings								
Sl. No	Brake Load N	m_f kg/min	TFC kg/hr	B.P. KW	BSFC kg/kw-hr	Emissions		
						CO %	HC ppm	Smoke
1.	0	0.0122	0.73	0	0	.11	90	47
2.	29.43	0.0130	0.78	0.98	0.794	.10	70	68
3.	49.05	0.0141	0.85	1.64	0.516	.09	80	77
4.	78.48	0.015	0.90	2.62	0.343	.08	70	80

Hippie oil blended with diesel (B-20)								
Sl. No	Brake Load N	m_f kg/min	TFC kg/hr	B.P. KW	BSFC kg/kw-hr	Emissions		
						CO %	HC ppm	Smoke
1.	0	0.0116	0.69	0	0	.05	20	20.3
2.	29.43	0.0126	0.76	0.98	0.769	.06	30	24.7
3.	49.05	0.0134	0.81	1.64	0.491	.05	30	51.8
4.	78.48	0.0137	0.83	2.62	0.315	.05	30	63

i) Comparison of Specific Energy Consumption with Power Output

a) Specific fuel consumption:

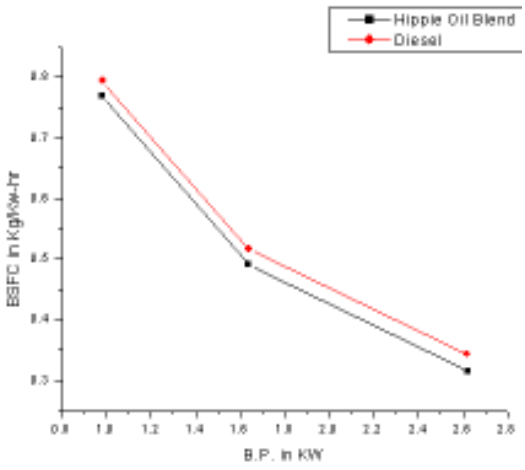

Fig 3: Comparison of Specific fuel consumption with Power Output

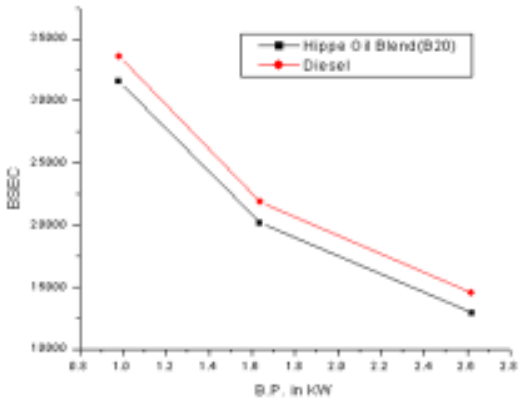

Fig 4 : Comparison of Specific energy consumption with Power Output

b) Brake thermal efficiency :

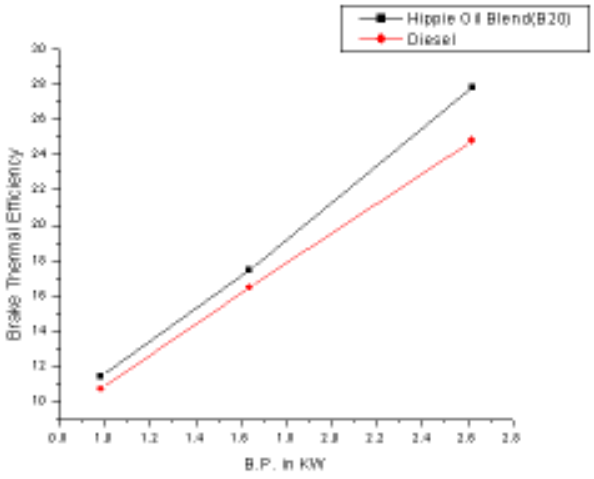

Fig 5 : Comparison of Brake Thermal Efficiency with Power Output

J) Emission parameters:

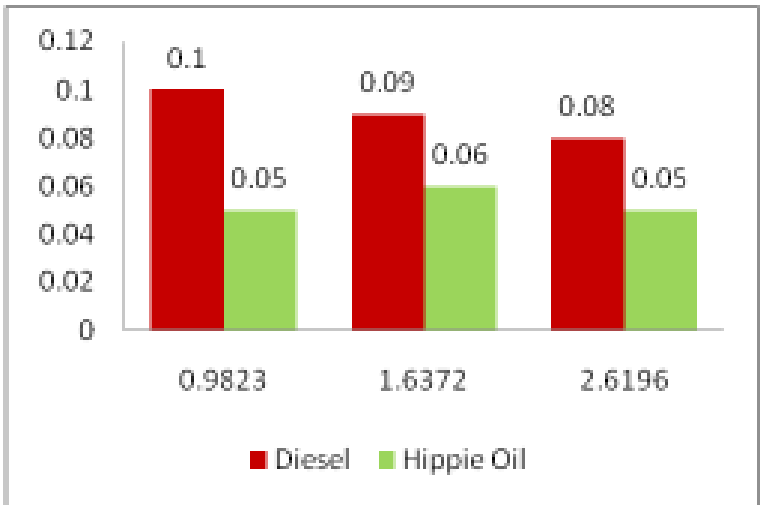

Fig 6 : Comparison of CO % with Power Output

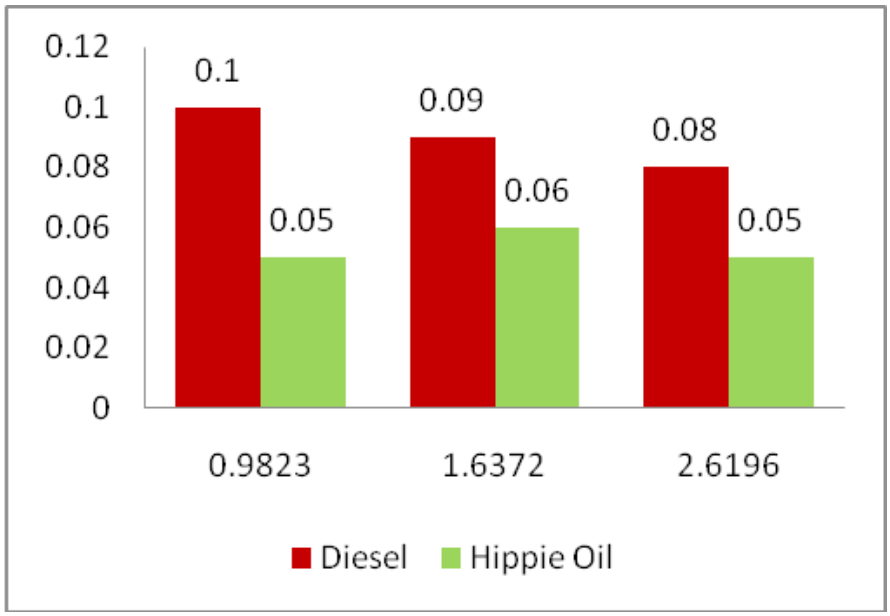

Fig 7 : Comparison of Unburnt Hydro Carbon with Power Output

h) Smoke :

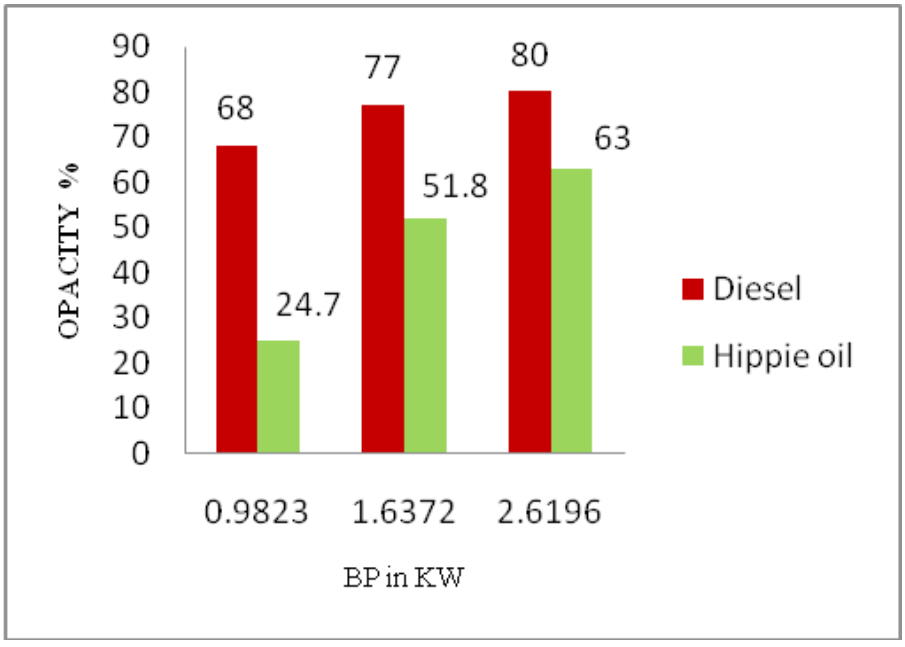

Fig 8 : Comparison of Smoke with Power Output

5. Conclusion and future scope

Based on the performance and emissions of Bio fuel, it is concluded that the bio fuel oil represents a good alternative fuel with closer performance and better emission characteristics to that of a diesel. From the above analysis the bio fuel shows better performance compared to the Diesel in the sense of better performance characteristics like Brake thermal efficiency, Specific fuel consumption and decrease in the emission parameters like, Smoke, HC, CO is lower than the diesel. Hence the bio fuel can be used as a substitute for diesel.

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