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Performance and Emission Characteristics of CI Engine using Hippie Oil and Cotton Seed Oil Blended with Methanol

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***Abstract* – Creating a suitable energy and environmental, alternative energy is needed to develop instead of using fossil fuels. The demand of resources and fuels for the technologies development is increasing day by day. In order to keep the development high we need to think about some alternative fuel with better efficiency which would help the demand keeping in mind the resources for the future generation An alternative fuel needs to be developed and researched upon which could help us get greener and better tomorrow. In this paper I would like to highlight upon the usage of Methanol (25%) blended with Hippie oil (75%), Methanol (25%) blended with Cotton Seed Oil for a compression ignition engine and the performance characteristics of this blended fuel.**

***Keywords*-- CI Twin Cylinder Engine, Cotton Seed Oil, Engine Performance, Emissions, Hippie oil, Methanol.**

I. Introduction

A lot of researches have been done on the prospect of methanol as an alternative fuel. Methanol, CH_3OH, is the simplest of alcohol and originally produced by the destructive distillation of wood. Today it is produced in very large quantities from natural gas by the reformation of the gas into carbon monoxide and hydrogen followed by passing these gases over a suitable catalyst under appropriate conditions of pressure and temperature [1]. Historically, alcohols have been added to the engine intake air (fumigation) since they do not mix well with diesel [2, 3]. Few tests have been conducted using fumigation method. The results are very impressive. The thermal efficiency for fumigated diesel has improved 30% in a direct injection engine at certain combination of alcohol and diesel fuel ratios and overall equivalent ratio [4]. It has been observed that engines running on methanol alone were prone to pre-ignition, in spite of high octane rating of the fuel. Due to the cost factor and other technical problems, the use of methanol as fuel was confined mainly to the racing arena. For internal combustion engines, alcohols, methanol and ethanol, are tested and demonstrated in the world [5].

E10 (10% ethanol in volume and 90% gasoline in volume) fuel and M15 (15% methanol in volume and 85% gasoline in volume) is used [6]. Table 1 compares a parts of the fuel properties, from which the advantages can be summarized as following [7, 8 and 9]: (1) Emissions from methanol cars are low in reactive hydrocarbons (which form smog) and in toxic compounds. Methanol-fuelled trucks and buses emit almost no particulate matter (which cause smoke, and can also be carcinogenic), and much less nitrogen oxides than their diesel-fuelled counterparts. (2) Methanol can be manufactured from a variety of carbon-based feedstock such as natural gas, coal, and biomass (e.g. wood). Use of methanol would diversify the country's fuel supply and reduce its dependence on imported petroleum. (3) Methanol is much less flammable than gasoline and results in less severe fires when it does ignite. (4) Methanol has a higher laminar flame propagation speed, which may make combustion process finish earlier and thus improve engine thermal efficiency [9]. (5) Methanol is a high-octane fuel that offers excellent acceleration and vehicle power. Though the latent heat of methanol is higher, measures are not necessary for the mixture preparing due to lower fraction, while it may increase engine volumetric efficiency and thus increase engine power [6]. With economies of scale, methanol could be produced, distributed, and sold to consumers at prices competitive with gasoline. This paper will carry out further study on the effects of methanol, and its fraction on CI engine.

Methanol is another kind of oxygenates, with high Oxygen content, high heat of evaporation, and low Viscosity, making it a potential additive for biodiesel fuel [10]. Cheung et al. [11–13] and Yu et al. studied the influence of methanol addition on the performance and emissions of engine fueled with biodiesel in a pump-line-injector diesel engine and a common-rail (CR) diesel engine respectively.

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II. OBJECTIVES OF THE PRESENT STUDY

- It is proposed to use Methanol Fuel in the diesel engine (CI engine).
- The emissions like CO, HC, and Smoke in the exhaust gases are also proposed to reduce during the combustion itself.
- To study the performance evaluation of the using Methanol blended with Hippi oil and Cotton Seed Oil as fuel in the diesel engine to Analyze the exhaust emissions and measurements, reduction in the exhaust gas

III. SOURCES OF BIO-FUEL

Methanol is a renewable energy source because the energy is generated by using a resource, sunlight, which cannot be depleted. Creation of Methanol starts with photosynthesis causing a feed stock, such as sugar cane or a grain such as maize (corn), to grow. These feed stocks are processed into methanol.

Following are the methods to produce the

a) Following are methods to producing Bio Fuel:-

- Fermentation
- Distillation
- Dehydration
- Blending (Mixing of methanol and Hippi Oil, Methanol and Cotton Seed Oil)

b) Methods of Extraction of Hippie oil

Two methods of extraction are available.

- Water Steam distillation
- Soxhlet extraction

c) *Properties of Bio Fuels.*

Table 1.Properties of bio fuels

Sl. No	**Properties**	**Methanol**	**Hippi oil**	**Cotton Seed Oil**
1	Density(kg/m^3)	796.6	965	874
2	Calorific value (kJ/kg)	23,800	35800	39500
3	Kinematic viscosity @ 40C (cst)	1.04	4.25	50.7
4	Cetane number	4	59.8	51.2-55
5	Flash point ºC	12	116	205
6	Fire point ºC	97.6	176	228
7	Specific gravity	0.79	0.952-.975	0.948

IV. EXPERIMENTAL SETUP

The experimental test set up Figure-1 consisted of twin cylinder diesel engine, four stroke, Forced cooling system, crank start. The setup is provided with a resistance load bank, Multi gas analyzer made by testo and Stack monitoring kit for particulate matter & formaldehyde as HCHO.,etc for performance and emissions analysis.

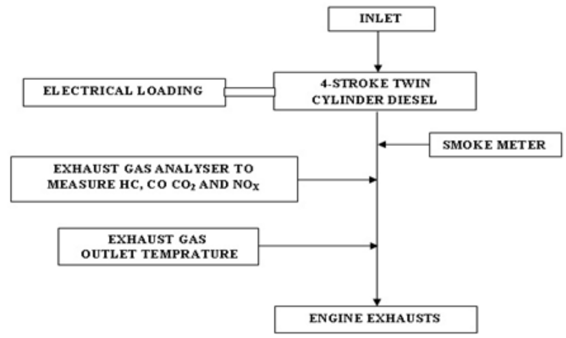

Fig1: Schematic arrangement of Experimental Set-up

The engine is cooled using the water jackets on the engine block and cylinder head using a Forced Feed System. While the recommended injection timing given by the manufacturer is 27º BTDC (static), the opening pressure of the nozzle was set at 1800 bar and the engine speed at 1500rpm.There are a number of transducers used in the engine such as piezoelectric pressure transducer flush with the cylinder head surface to measure cylinder pressure. Specifications of engine are shown in Table 2.

d) Engine Specification

Table 2-Engine specification

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

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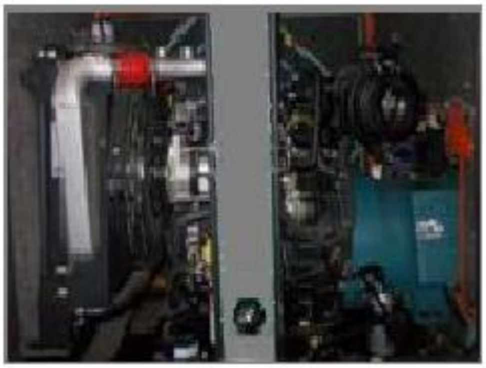

Fig 2: Test engine

e) Load Bank Specification

Table 3- Load Bank Specification	
Max. Output	15 KVA / 12.06 KW
Generator type	1 Phase
Amps	63
RPM	1500
PF	0.8
Volts	240

V. Precaution Observed Before Starting Of 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°Cand 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

VI. Experimental Procedure

Experiments were initially carried out on the engine using diesel as fuel in order to provide base line data. The methanol 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 (Zero load & full load condition) 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 100 % Methanol 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 (Zero load & full load condition) using the alternator load bank and the same was recorded. Gaseous emissions, fuel consumption were also recorded from the respective sensor.

VII. Results And Discussion

The performance and exhaust emission parameters of the engine with methanol blend with hippi oil and methanol blend with Cotton Seed oil from zero to full load condition are presented and discussed below.

Table-4 Methanol Blended with Hippie Oil readings

Load in KW		Load In %	Torque In N-M	Speed In Rpm (N)	SFC mg/stroke	BP in KW
V	I					
230	0	0	12.308	1500	8.5	1.933
	5.22	10	16.319	1500	11.00	2.563
	13.04	25	28.352	1500	15.00	4.453
	26.09	50	48.407	1500	21.50	7.603
	39.13	75	76.484	1500	32.50	12.014
	52.17	100	100.55	1500	44	15.794

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Table-5 Methanol Blend with Cotton Seed Oil readings						
Load in KW		Load In %	Torque In N-M	Speed In Rpm (N)	SFC mg/stroke	BP in KW
V	I					
230	0	0	8.297	1500	7.5	1.303
	5.22	10	20.33	1500	12	3.193
	13.04	25	32.363	1500	16	5.083
	26.09	50	52.418	1500	22.5	8.233
	39.13	75	80.495	1500	35.5	12.644
	52	100	100.55	1500	43.5	15.794

a) Specific fuel consumption

From the figure-3 it is clear that at different loads the SFC of Methanol blended with hippie and Cotton Seed oil as shown, at Zero load and full load the fuel consumption is highest value for blended Hippie oil as compared to blended Cotton seed Oil with methanol.

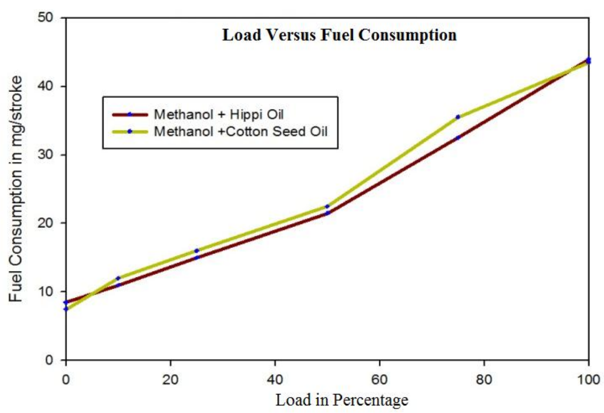

Fig 3: SFC versus Load applied in percentage

b) CO Concentration

Figures 4, shows the variation CO level with respect to different loads

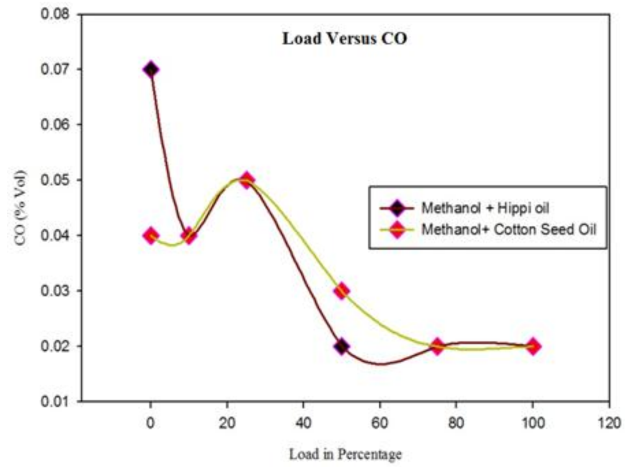

Fig 4: Load applied in Percentage versus CO

From the graph it is clear that the CO level increases when Methanol blended with Hippie oil has a fuel. This is due to the fact that engine is not optimized to run with Methanol with Hippie oil, so there is a large possibility of rich fuel-air mixture in the cylinder and the higher specific fuel consumption resulting in a higher CO level. Carbon monoxide occurs in engine exhaust. It is a product of incomplete combustion due to insufficient amount of air in the air fuel mixture or insufficient time in the cycle for the completion of combustion. CO level is comparatively More when compared to Methanol mix with Cotton Seed Oil & can be reduce by increasing the compression ratio.

C) HC concentration

Fig 5 Shows the HC concentration with respect to different loading, with different bio fuels. By the observation the Methanol blended with Cotton oil has more HC (ppm) as compared to Methanol is blended with hippie oil.

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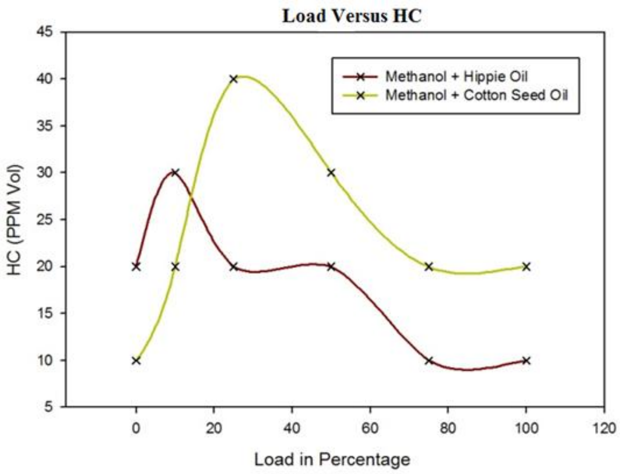

Fig5: Load applied in percentage versus HC

d) Smoke:

Fig 6, the Smoke level for different loading Condition with different bio-fuels Concentration level is more for the methanol is blended with Hippie Oil

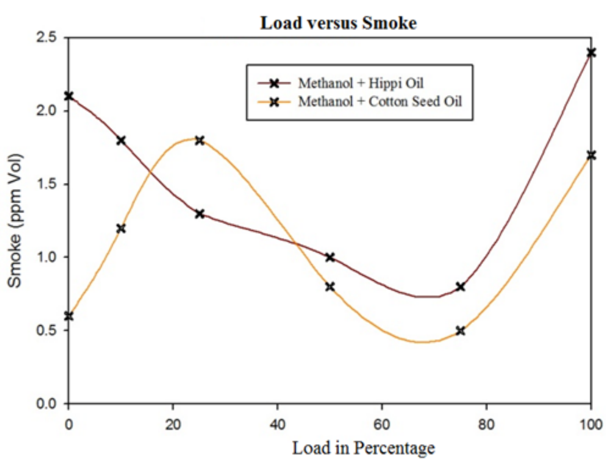

Fig 6: Load applied in Percentage versus Smoke

e) Power Output:

Fig 7, the power output is higher for methanol is blended with Cotton Seed oil, but at zero loading condition the power output is lower as compared to methanol is blended with Hippie Oil.

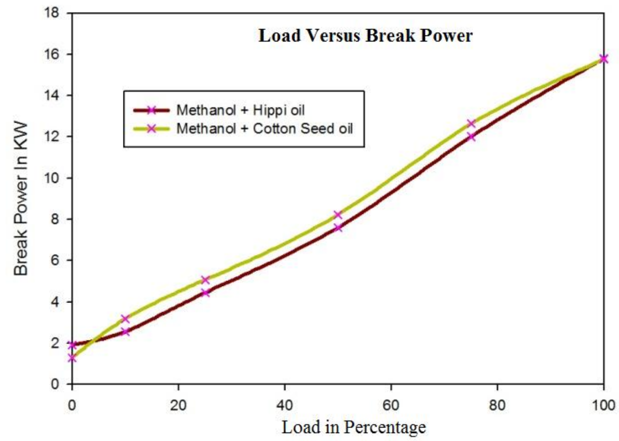

Fig7: Load applied in Percentage versus Brake Power

VIII. CONCLUSION

The emission and performance characteristics have been observed, at the measure of fuel consumption, CO concentration and HC level is higher for methanol is blended with Hippie oil as compared to blended with Cotton seed oil.

The Smoke level and brake Power is more for the methanol blended with Cotton Seed Oil as compeered to methanol blended with Hippie Oil.

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