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Emission Evaluation of Di Diesel Engine by using Bio-Diesel

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Abstract— Now a day's raise in average temperature of earth is unsustainable for the human beings and all creatures, due to what are the manmade technologies we are using for our comfortness like refrigeration& air conditioning, thermal power stations, automobiles etc. among the above automobiles have significant contribution towards pollution and global warming. By means of emitting CO_2, CO, HC, NO_X. In view of this present experiment was carried out on a single cylinder diesel engine by using palm oil blends to evaluate the Emissions are such as carbon dioxide, carbon monoxide and unburned hydrocarbon are measured.

Key words: Emissions, CO_2, CO, HC, NO_X

I. INTRODUCTION

Compression ignition engines are employed particularly in the field of heavy transportation and agriculture on account of their higher thermal efficiency and durability. However, diesel engines are the major contributors of oxides of nitrogen and particulate emissions. Hence most stringent norms are imposed on the exhaust emissions. Subsequent the global energy crisis in the 1970s and the increasingly stringent emission norms, the search for alternative renewable fuels has intensified.

II. LITERATURE SURVEY

The gradual depletion of world petroleum reserves, increases in prices of petroleum based fuels and environmental pollution due to exhaust emissions have encouraged studies to search for alternative fuels. In view of these, vegetable oil has been considered as alternative fuels for compression ignition engines. Vegetable oils are renewable, nontoxic, biodegradable, and have low emission profiles. However, there are some drawbacks related to the use of straight vegetable oils in diesel engines primarily due to their high viscosity, lower volatility and lower heat content [1-8].

The important compositional difference between biodiesel and the diesel fuel is concerned with oxygen content. Biodiesel contains 10–12% oxygen in weight basis and this lowers the energy content. The lower energy content causes reductions in engine torque and power. Biodiesel containing oxygen reduces exhaust emissions such as HC, smoke and CO mainly due to the effect of complete combustion. Since biodiesel contains little sulphur compared to the diesel fuel, a significant reduction in CO & HC emission was obtained. There is four possible reasons for reduction in particulate emissions. First is the presence of oxygen in fuel rich regions of the combustion fuel spray Second is the modification of radical pool, which inhibits key soot formation reactions and provides OH radicals for oxidation of soot precursors. Third is the removing carbon from soot formation process via C–O bonding within molecule due to oxygen, thereby sequestering carbon from the soot formation process. Fourth is the low level of sulphur content of biodiesel. NOx emissions mainly depend on the engine fuelling system, engine type and engine loading. Two different observations can be seen in the literature. First, higher NOx emissions may be due to higher temperatures of combustion chamber using biodiesel .This is also evident from higher exhaust gas temperatures from biodiesel fuelled engines. However, some studies showed lower NOx emissions. This is because higher cetane numbers of biodiesel shortens the ignition delay. The amount of premixed fuel and peak burning temperature are reduced, leading to the reduction in NOx emissions. The price of edible vegetable oils is higher than that of the diesel fuel. Therefore, instead of using such oils, use of waste vegetable oils and non-edible crude vegetable oils have been considered as potential alternative fuels. A single cylinder stationary Scottiler engine is used to compare the Performance and Emission and Combustion characteristics between pure diesel and biodiesel oil blends. The Biodiesel oil blends are in percentage of 20%, 30%, 50% of Biodiesel oil to 80%, 70%, 50% of diesel. Results show that Biodiesel blend can be used in existing diesel engines without compromising the engine performance.

In the present work, the Biodiesel oil, that is non-edible oil, it was considered as a potential alternative of fuel for the compression ignition engines. Provision of the Biodiesel oil investigated and compared these specifications with the other vegetable oils and this was the basic stimulus behind the explore in this paper. The engine tests were carried out on a direct injection diesel engine fuelled with diesel fuel and 20%, 30% and 50% Biodiesel oil-diesel blends by volume. The results were summarized.

Properties	Diesel	PALM oil (Biodiesel)
Kinematic viscosity at 40 ^{0}C (cSt)	3.52	4.88
Density at 15 ^{0}C (kg/m^3)	850	880
Flash point (^{0}C)	49	148
Calorific value (kJ/kg)	42000	38000
Sp. Gravity	0.85	0.88

Table 1: Properties of Palm oil (Biodiesel)

III. PREPARATION OF BIODIESEL

To convert the Palm Oil into biodiesel the transestrification process has been conducted with the palm oil. The above procedure is involved in this method is as follows: 1000 ml of Palm oil is taken in a three way type flask. 5.6 grams of Potassium hydroxide (KOH) and 200 ml of methanol (CH3OH) are taken in a beaker. The potassium hydroxide (KOH) and the alcohol are thoroughly mixed until it is properly dissolved. The solution obtained is mixed with Palm oil in three way flask and it is stirred properly. The methoxide solution with Palm oil is heated to 60 ^{0}C and it is continuously stirred at constant rate for 1 hour by stirrer. The solution is poured down to the separating beaker and is allowed to settle for 4 hours. The glycerin settles at the bottom and the methyl ester floats at the top (coarse biodiesel). Methyl ester is separated from the glycerin. This coarse biodiesel is heated above 100°C and maintained for 10-15 minutes to remove the untreated methanol

IV. SPECIFICATION OF THE PROBLEM

In the present work the performance of characteristics and emissions are evaluated on single cylinder 4 stroke diesel engine is fuelling with 20%, 30%, 50%, for biodiesel. Due to the high viscosity of e biodiesel 60% and additional percentages have been not taken into Palm oil-diesel blend. Experiments was carried out of a diesel engine by using palm oil as substitute fuel which is single cylinder, four-stroke, water cooled at stable speed engine accomplished of the developing a power output of 7.5kW at 1500 rpm. Performance parameters such as the brake power, specific fuel consumption and the indicated thermal efficiency are calculated based on experimental analysis of the engine. Emissions are such as carbon dioxide, carbon monoxide and unburned hydrocarbon are measured.

A. Experimental Set Up

The experimental set up consists of engine, an alternator, top load system, fuel tank, exhaust gas measuring digital device and manometer.

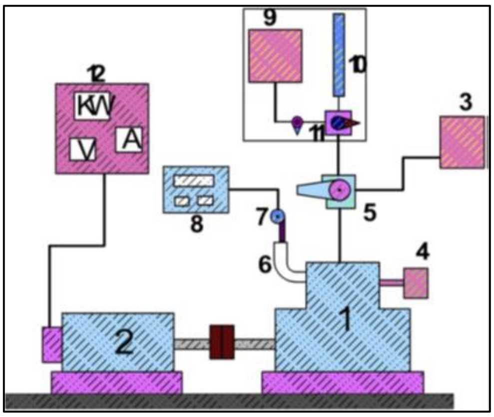

Fig. 4.1: Experimental Setup of the Test Engine

1) Various Parts of Experimental Setup

- SCOTTILER ENGINE
- ALTERNATOR
- DIESEL TANK
- AIR FILTER
- THREE WAY VALVE
- EXHAUST PIPE
- PROBE
- EXHAUST GAS ANALYSER
- ALTERNATIVE FUEL TANK
- BURETTE
- THREE WAY VALVE
- CONTROL PANEL

B. Experimental Procedure

As first said, diesel alone is allowed to run the engine for about 30 min, so that it gets warmed up and steady running conditions are attained. Before starting the engine, the lubricating oil level in the engine is checked and itis also ensured that all moving and rotating parts are lubricated.

The various steps involved in the setting of the experiments are explained below

1) The Experiments were carried out after installation of the engine
2) Precautions were taken, before starting the experiment.
3) Always the engine was started with no load condition

4) The engine was started at no load condition and allowed to work for at least 10 minutes to stabilize.
5) The readings such as Speed, manometer reading, emission etc., were taken as per the observation table.
6) The load on the engine was increased by 1000W of FULL Load using the engine controls and the readings were taken as shown in the tables.
7) Step 3 was repeated for different loads from no load to full load.
8) After completion of test, the load on the engine was completely relieved and then the engine was stopped.
9) The results were calculated as follows.

V. RESULTS AND DISCUSSION

Experiments were conducted when the engine was fuelled with the Biodiesel blends with diesel in proportions of 20:80, 30:70 and 50:50 (by volume) which are generally called as BD20, BD30, BD50 respectively. The experimentation covered a range of loads. The performance of the engine was evaluated in terms of emission characteristics of the engine were studied in terms concentration of HC, CO, CO_2 and O_2. The results obtained for Biodiesel blends with diesel were compared with the results of diesel.

S. N0	Load W	Speed Rpm	Time Sec	B.P kW	CO %vol	HC ppm	CO_2 %vol	O_2 %vol
1	0	760	50	0	0.016	10	0.33	20.73
2	1000	760.1	39	1.061	0.005	10	0.08	20.46
3	2000	755	30.8	2.12	0.06	10	0.4	18.91
4	3000	742	24.2	3.07	0.08	69	12.81	17.44
5	4000	742	19.2	4.12	0.106	79	0.13	19.28
6	5000	723	16.8	5.02	0.112	95	17.60	15.78

Table 1: Emission test Results at Pure Diesel:

S. N0	Load W	Speed Rpm	Time Sec	B.P kW	CO %vol	HC ppm	CO_2 %vol	O_2 %vol
1	0	774.7	50.12	0	0.06	10	0.4	20.31
2	1000	764	40.32	1.04	0.06	10	0.4	19.10
3	2000	756	31.60	2.1	0.06	10	1.4	18.37
4	3000	747.3	25.24	3.07	0.511	48	12.97	17.84
5	4000	735.6	20.95	4.05	0.641	40	17.19	17.34
6	5000	725.7	18.1	4.88	0.644	45	16.98	16.45

Table 2: Emission test Results at BD 20

S. N0	Load W	Speed Rpm	Time Sec	B.P kW	CO %vol	HC ppm	CO_2 %vol	O_2 %vol
1	0	762.8	46.07	0	0.06	10	0.4	20.25
2	1000	758.3	40.78	1.034	0.054	10	0.4	20.1
3	2000	732.8	32.36	2.086	0.06	10	0.4	18.74
4	3000	743.5	26.21	3.06	0.322	55	12.51	17.99
5	4000	738.1	20.88	3.99	0.561	56	14.18	17.12
6	5000	730.2	17.88	4.88	1.45	84	18.85	15.23

Table 3: Performance and emission test Results at BD 30:

S. N0	Load W	Speed Rpm	Time Sec	B.P kW	CO %vol	HC ppm	CO_2 %vol	O_2 %vol
1	0	769	54.2	0	0.06	10	0.40	21.12
2	1000	755.9	37.01	1.034	0.06	10	0.4	20.31
3	2000	747.6	32.04	2.086	0.06	10	0.4	18.87

Table 4: Performance and emission test Results at BD 50:

S. N0	Load W	Speed Rpm	Time Sec	B.P kW	CO %vol	HC ppm	CO_2 %vol	O_2 %vol
1	0	774.7	50.12	0	0.06	10	0.4	20.31
2	1000	764	40.32	1.04	0.06	10	0.4	19.10
3	2000	756	31.60	2.1	0.06	10	1.4	18.37
4	3000	747.3	25.24	3.07	0.511	48	12.97	17.84
5	4000	735.6	20.95	4.05	0.641	40	17.19	17.34
6	5000	725.7	18.1	4.88	0.644	45	16.98	16.45

Table 5: Emission test Results at BD 20:

S. N0	Load W	Speed Rpm	Time Sec	B.P kW	CO %vol	HC ppm	CO_2 %vol	O_2 %vol
1	0	762.8	46.07	0	0.06	10	0.4	20.25

2	1000	758.3	40.78	1.034	0.054	10	0.4	20.1
3	2000	732.8	32.36	2.086	0.06	10	0.4	18.74
4	3000	743.5	26.21	3.06	0.322	55	12.51	17.99
5	4000	738.1	20.88	3.99	0.561	56	14.18	17.12
6	5000	730.2	17.88	4.88	1.45	84	18.85	15.23

Table 6: Performance and emission test Results at BD 30:

S. N0	Load W	Speed Rpm	Time Sec	B.P kW	CO %vol	HC ppm	CO_2 %vol	O_2 %vol
1	0	769	54.2	0	0.06	10	0.40	21.12
2	1000	755.9	37.01	1.034	0.06	10	0.4	20.31
3	2000	747.6	32.04	2.086	0.06	10	0.4	18.87
4	3000	739.5	24.8	3.07	0.465	43	12.47	17.98
5	4000	727.6	21.37	4.01	0.793	43	14.88	17.75
6	5000	721.1	18.11	4.92	1.182	43	16.04	17.72

Table 7: Performance and emission test Results at BD 50:

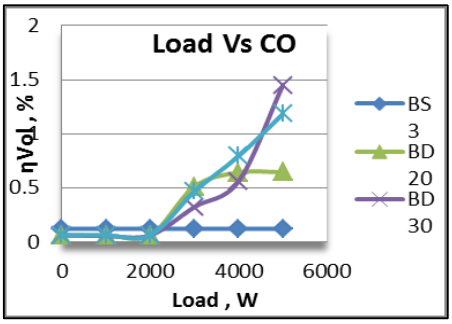

Fig. 4.8: Load vs. CO

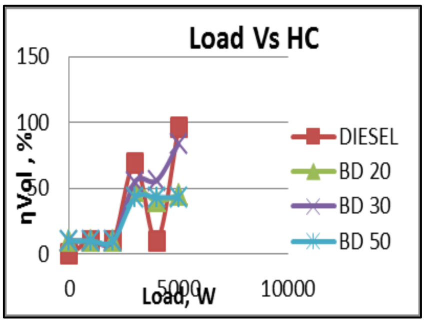

Fig. 4.9: Load vs. HC

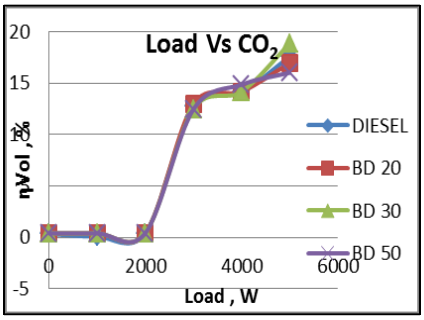

Fig 4.10: Load vs. CO_2

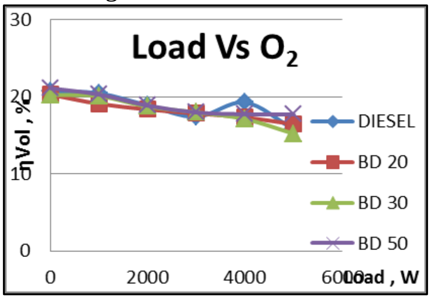

Fig. 4.11: Load vs. O_2

VI. CONCLUSIONS

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

- CO emission increases with increase in percentage of Biodiesel in the fuel up to 2000W.By comparing to Bharath Stage IV norm, it is suggested that all the blends can be used upto 2000W load.
- CO_2 emission increases as load increase in the load for all the blends including the diesel
- HC emissions of Biodiesel blends are lower than that of diesel.

  By observing all the above conclusions the palm oil is suggested to use up to 2000watts for less emissions.
  The emission results are optimum upto 2000watts

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