Characterization and Analysis of Zero Effluent using Thumba as Biodiesel on Diesel Engine

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Abstract- *In recent years there are requirements for development of automotive fuel technologies that may contribute to reducing environmental load, such as diversification of primary energy resources and reduction in CO2 emission as well as reduction in motor vehicle emissions. As one of the measures to reduce environmental load is the use of bio-fuels. Diesel engines dominate the field of commercial transportation and agricultural machinery on account of its superior fuel efficiency. Due to shortage of petroleum diesel fuel and its increasing cost, an alternate source of fuel for diesel is very much needed. It has been found that vegetable oils hold special promise in this regard, since they can be produced from the plants grown in rural areas. Vegetable oils from crops such as soybean, peanut, sunflower, rape, coconut, neem, cotton, musterd, Jatropha, linseed & castor have been evaluated in many part of the world, which lack petroleum reserves as fuels for CI Engines. It is clean burning, renewable, non-toxic, bio-degradable and environmentally friendly transportation fuel that can be used in neat form or in blends with petroleum derived diesel in diesel engine.*

Keywords- Biodiesel, Thumba, Zero effluent discharge

I. INTRODUCTION

In recent years there are requirements for development of automotive fuel technologies that may contribute to reducing environmental load, such as diversification of primary energy resources and reduction in CO_2 emission as well as reduction in motor vehicle emissions. As one of the measures to reduce environmental load is the use of bio-fuels. Diesel engines dominate the field of commercial transportation and agricultural machinery on account of its superior fuel efficiency. Due to shortage of petroleum diesel fuel and its increasing cost, an alternate source of fuel for diesel is very much needed. It has been found that vegetable oils hold special promise in this regard, since they can be produced from the plants grown in rural areas. Vegetable oils from crops such as soybean, peanut, sunflower, rape, coconut, neem, cotton, musterd, Jatropha, linseed & castor have been evaluated in many part of the world, which lack petroleum reserves as fuels for CI Engines.

II. LITERATURE SURVEY

In the recent years, serious efforts have been made by several researchers to use different sources of energy as fuel in existing diesel engines. The use of straight vegetable oils is restricted by some unfavorable physical properties, particularly their viscosity.

Due to higher viscosity, the straight vegetable oil causes poor fuel atomization, incomplete combustion and carbon deposition on the injector and valve seats resulting in serious engine fouling. It has been reported that when direct injection engines are run with neat vegetable oil as fuel, injectors get choked up after few hours and lead to poor fuel atomization, less efficient combustion and dilution of lubricating oil by partially burnt vegetable oil [1]. One possible method to overcome the problem of higher viscosity is blending of vegetable oil with diesel in proper proportion, and the other method is transesterification of oils to produce biodiesel. It was [2] reported that the transesterification process has been proven worldwide as an effective means of biodiesel production and viscosity reduction of vegetable oil. Temperatures, catalyst type, concentration ratio of alcohol to fuel and stirring speed rate have been observed to influence the transesterification process to a greater extent. A brief study was conducted [3]on the use of biodiesel from coconut oil (50/50 blend), ‘‘B50” in motor coaches. This study revealed that it is a viable and a practical alternative fuel for older in-service engines. Particulate matter was almost negligible with the use of this fuel. Operators reported that the test vehicles had no noticeable drivability downsides. On the other hand, it was observed that the vehicles had some improved power performance while operating under city traffic conditions. It was [4] also found that no significant engine problems were reported in tests with urban bus fleets running on B20. A study by Ryan and Bagboy found that the vegetable oils (peanut, sunflower, cottonseed and soybean oils) exhibit characteristics opposite to those expected in most other fossil fuels [5]. They observed a lower penetration and a larger spray angle despite their higher viscosities. By using sampling collection method, they concluded that chemical reaction plays a significant role in increasing the atomization process of vegetable oil during the injection process, leading to shorter ignition delay. Apart from the problem of diesel scarcity and higher fuel costs, there is the growing menace of vehicular pollution. To compensate for the shortages of diesel fuel, the adaptation of a selected alternative fuel to suit the diesel engine is considered more economically attractive in the short-term than engine modification to suit the fuel. For this purpose, an alternative liquid fuel that wills blend readily with diesel fuel is required Many researchers have studied performance and emission characteristics of undi oil blended with diesel. C. Srinidhi et al. [6] performed an experiment analysis of performance parameter (such as brake power, break specific fuel consumption,brake thermal efficiency and Exhaust Gas temperature) and emission characteristics (NOx, HC, CO. etc.) Is obtained for various bio diesel and diesel blends and compared with ordinary diesel at various loads on a modified variable compression ratio CI engine. The results of the investigation shows that the performance and emission characteristics of the engine fuelled with Honne oil methyl ester – diesel blends is comparable to the ordinary diesel.

III. EXPERIMENTATION

In four-stroke cycle engines there are four strokes completing two revolutions of the crankshaft. These are respectively, the suction, compression, power and exhaust strokes. Only pure air is drawn into the cylinder during this stroke through the inlet valve, whereas, the exhaust valve is closed. These valves can be operated by the cam, push rod and rocker arm. The next stroke is the compression stroke in which the piston moves up with both the valves remaining closed. Their, which has been drawn into the cylinder during the suction stroke, is progressively compressed as the piston ascends. The compression ratio usually varies from 14:1 to 22:1. The pressure at the end of the compression stroke ranges from 30 to 45 kg/cm2. As the air is progressively compressed in the cylinder, its temperature increases, until when near the end of the compression stroke, it becomes sufficiently high (650-800 ^{oC}) to instantly ignite any fuel that is injected into the cylinder. When the piston is near the top of its compression stroke, a liquid hydrocarbon fuel, such as diesel oil, is sprayed into the combustion chamber under high pressure (140-160 kg/cm2), higher than that existing in the cylinder itself. This fuel then ignites, being burnt with the oxygen of the highly compressed air. The cooling water temperature is maintained constant (65 to 70℃) throughout the research work by controlling the flow rate of water.The entire engine experiments were conducted at a rated speed of 1000 rpm with an injection timing of 27º before Top Dead Center (TDC). The engine was allowed to run till the steady state is reached. Then the engine was loaded in terms of 25%, 50%, 75% and 100% load at various compression ratio viz. 17.5:1, 16.5:1, 15.5:1 and 14.5:1.Experiment is carried out initially using neat diesel fuel to generate the base line data. After recording the base line data, tests are carried out using 25, 50, and 75% biodiesel blends. The engine tests are conducted at various loads and the parameters related to performance and emission characteristics are recorded.

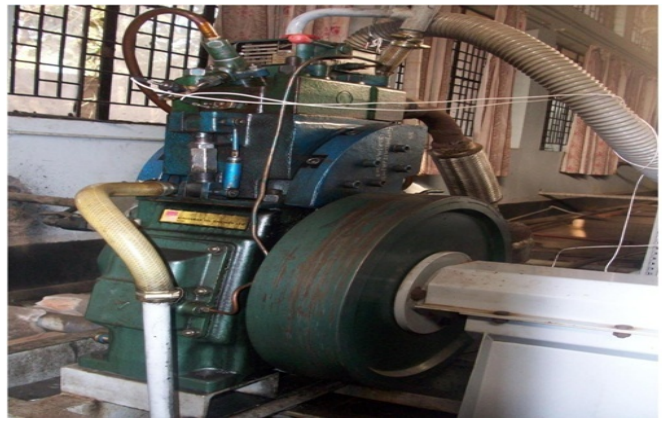


Figure . Four Stroke Diesel Engine

Thumba (Citrulluscolocyntis) As ZED Biodiesel:

Citrulluscolocyntis is known as the colocynth, Citrulluscolocyntis is like watermelon, member of the Cucurbitaceous family. Its family consists of nearly 100 genera and 750 species. Cucurbitaceous family with great genetic diversity and widespread adaptation. It includes tropical and subtropical regions, arid deserts and temperate locations. Cucrbits are specially known for their high protein and oil content. Cucurbits seeds are the sources of oils and protein with about 50% oil and up to 35% protein. Characteristic of plant is drought-tolerant species with a deep root system.

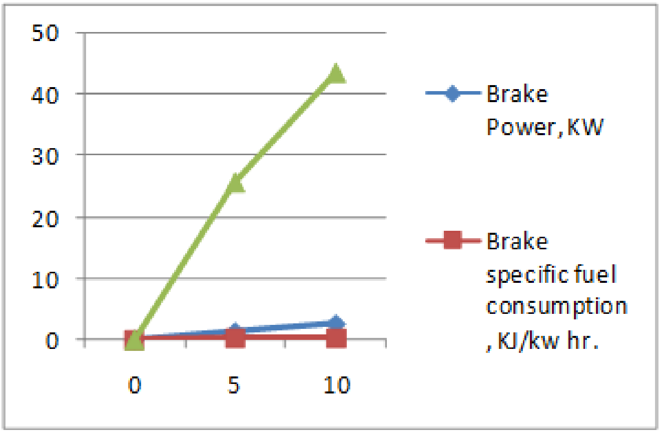
IV. RESULT AND DISCUSSION

Observation Tables and Calculations:

1. PURE DIESEL

Table .Observation of Pure diesel

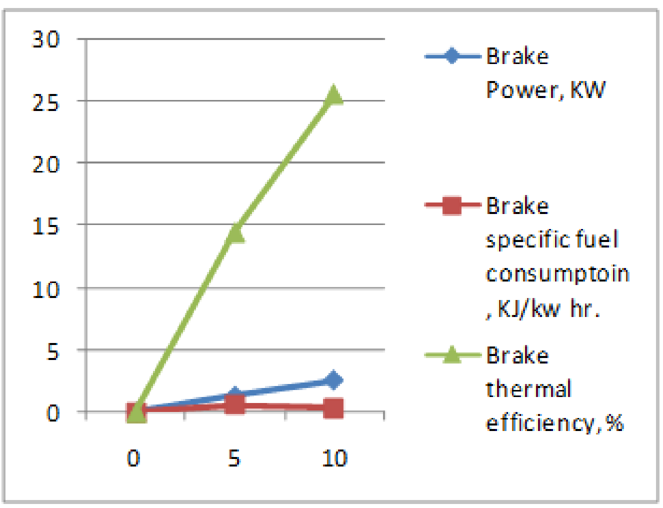
Sr.no.	Load (Kg)	Speed	Time (sec)
1.	O	1585	480
2.	5	1568	337
3.	10	1552	289



H25

Table. Observation of H25 blend

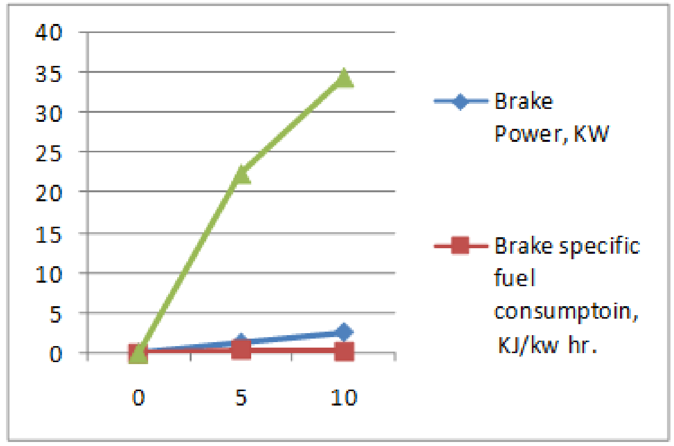
Sr.no.	Load (Kg)	Speed	Time(sec)
1.	O	1576	417
2.	5	1552	195
3.	10	1528	175



H50

Table No. Observation of H50 blend

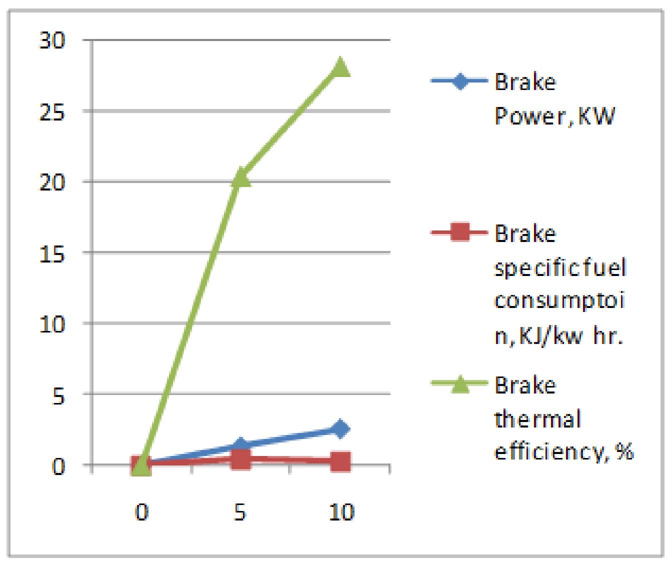
Sr.no.	Load (Kg)	Speed	Time (sec)
1.	O	1575	479
2.	5	1563	298
3.	10	1552	232



H75

Table No. Observation of H75 blend

Sr.no.	Load(Kg)	Speed	Time (sec)
1.	O	1562	404
2.	5	1552	270
3.	10	1520	190



RESULT TABLES:

5 KG Load

Blends	Brake Power (Kw)	Brake Torque (Nm)	BSFC (Kj/Kw Hr)	B Th Efficieny (%)
Purediesel	1.329	8.087	0.3295	25.70
H25	1.314	8.089	0.5897	14.50
H50	1.3246	8.093	0.3838	22.36
H75	1.3146	8.0927	0.4348	20.44

10 KG Load

Blends	Brake Power (Kw)	Brake Torque (Nm)	BSFC (Kj/Kw Hr)	BTh Efficiency (%)
Pure Diesel	2.6307	16.1865	0.194	43.63
H25	2.5887	16.1865	0.34	25.64
H50	2.630	16.1821	0.2489	34.42
H75	2.5761	16.18	0.3153	28.19

V. CONCLUSION

Diesel engine performed smoothly and satisfactorily on a wide range of specified blends of thumba oil in diesel and no undesirable combustion phenomenon was observed during the investigation. The results of experimental study show that the thumba biodiesel and its blends with diesel can be used successfully in diesel engines without any hardware modifications and without posing any problems related to combustion and engine knock. The engine performed quite well when fuelled with thumba biodiesel and its various blends, in addition to this the characteristics of thumba biodiesel are also very close to mineral diesel, therefore, thumba biodiesel becomes a strong candidate to replace or substitute the mineral diesel in compression ignition engines.

Transesterification reactions are emerged as the most acceptable reaction pathways to produce biodiesel. Any type of feedstock that contains free fatty acids or triglycerides such as vegetable oils, waste oils, animal fats, and waste greases can be converted into biodiesel by transesterification process. Esterification process has been found more effective, efficient and economical process to convert thumba vegetable oils into biodiesel.

The main objective of the present investigation was to evaluate the suitability of Thumba biodiesel blend in terms of engine performance and emissions. The performance tests were conducted with diesel, and blends of Thumba at constant compression ratio. From the experimental results obtained, Thumba oil blends are found to be a promising alternative fuel for compression ignition engines. At constant CR BTE and BSFC of Thumba H50, H75 and BP of Thumba H50 showed better performance. The emissions such as CO, HC, CO2 of H75 of Thumba biodiesel showed less emission percentage/ppm , and for NOx emissions of H25 and H50 of Thumba biodiesel showed less emission ppm but it is more than pure diesel. Compression ratios and load increases the performance of all blends of Thumba biodiesel showed better performance .At constant CR BTE, BSFC and BP of all blends of Thumba biodiesel showed better performance. From engine test results, it has been established that Thumba biodiesel can be substituted for existing diesel in CI engine without any major modifications

1. BTE: - At constant CR BTE of Thumba H50 (22.36%) showed better performance than all other blends of Thumba biodiesel for 5kg load and for 10kg load H50 (34.42%) showed better performance than all other thumba biodiesel.
2. BSFC:-At constant CR BSFC of Thumba H75, H100 (0.31 kg/kwhr) showed better performance than all other blends of Thumba biodiesel and pure diesel fuel (0.194 kg/kwhr) for 10kg load.
3. BP:-At constant CR BP of Thumba H50 (2.63 kW) showed better performance than all other blends of Thumba biodiesel and nearly equal to the pure diesel (2.63 kW) for 10kg load.

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