Performance Investigation on VCR Engine by Using Blended Coconut Oil

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Abstract— Energy is a key factor for the development of any country. With the increased civilization and industrialization the need for energy is increasing day by day. Majority of the world’s energy demand is met through fossil fuels and natural gas. As a result fossil fuels are diminishing from year to year. Since fossil fuels are no renewable, fuel price is increasing with spiraling Demand and diminishing supply. To avoid dependency on foreign countries the use of renewable energy has become important. The coconut is considered as natural asset in India, Thailand and some other countries on the globe. So our Endeavour is to use coconut oil as alternative to conventional fossil fuels. Decrease in indicated thermal efficiency with similar values of brake thermal efficiency and volumetric efficiency is observed compared to diesel. In view of emission parameters a significant improvement is achieved. The use of coconut biodiesel as fuel for diesel engine will reduce dependency on fossil fuels and decrease environmental pollution.

Keywords— BIOFUEL, BIODIESEL, TRANSESTERIFICATION,

Nomenclature—

T- Temperature [K]
BP-Break power
FP-Frictional power
BMEP-Break mean effective pressure[]
IMEP-Indicated mean effective pressure []
SFC-Specific fuel consumption [w/m²]
VCR Engine-Variable compression ratio engine.

I. INTRODUCTION

Energy is key input for technological, industrial, social and economical development of a nation. Five generations (125 years) ago, wood supplied up to 90% of our energy needs. Due to the convenience and low prices of fossil fuels wood use has fallen globally. The present energy scenario now is heavily biased towards the conventional energy sources such as petroleum products, coal, atomic energy etc, which are finite in nature besides causing environmental pollution. Of the available energy, the present energy utilization pattern is heavily biased for meeting the high energy requirement in urban and metropolitan cities.

The extensive use of energy operated devices in domestic, industrial, transport and agricultural sectors in urban and rural areas have resulted in overall economical development of the society. The electricity available for farming operations and in rural and urban areas has been generated using the fossil and static energy resources such as petroleum oil, coal and atomic energy and to a limited extent by hydropower. These all sources have a great influence on our economy and environmental aspects. These have resulted in serious considerations for the use and availability of various energy resources.

In the following experiment coconut biodiesel blends B05, B10 and B20 are tested on VCR engine by varying 0.4 and 8 kg loads on the engine keeping the speed constant. First of all the experiment is done at 18 compression ratio and then with 16 compression ratio, the performance characteristics are compared among the tree blends for optimum blend, then performance characteristics of the optimum blend is
compared with performance characteristic of the pure diesel to find its acceptability.

II. LITERATURE REVIEW

The authors investigated the formulation, combustion and emissions of polypropylene (PP)–diesel fuel mixtures in a direct injection diesel engine. The exhaust temperatures have been practically identical for both fuels for all loads, with emissions of NOx, and CO reduced by 40% for the alternative fuel, while the CO2 exhibited almost the same values for both fuels. The smoke emissions decreased by 60–90% for the polypropylene blended fuel depending on the load. The engines’ overall efficiency was slightly lower for PP fuel at low loads compared with diesel combustion but at 100% load both reached 36%. The study showed that the new formulation process proposed by the authors is able to produce a new class of fuels from diesel blended with low density polypropylene, and resulted in hybrid fuels with very promising combustion prospects. The engine investigation proved that 25% PP fuels can be injected and burnt in a diesel engine at a residence time of about 5 ms from the start of injection, and the engine’s nominal power could be reached, with lower emissions than reference diesel fuel [1].

The present study investigated the effects of biodiesel blending under a wide range of intake oxygen concentration levels in a diesel engine. The experimental results indicated that the intake oxygen level had to be below 10 vol% to achieve the indicated specific NOx (ISNOx) below 0.2g/kWhr with the B000 fuel. However, a substantial soot increase was exhibited at such a low intake oxygen level. Biodiesel blending reduced NOx until the blending rate reached 60% with reduced in-cylinder temperature due to lower total energy release. As a result, 60% biodiesel blended diesel (B060) achieved NOx, soot, and COV of 0.2 g/kWhr, 0.37 filter smoke number (FSN), and 0.5, respectively, at an intake oxygen concentration of 14 vol% [2].

In the present study non edible Linseed oil was used as alternative source for diesel engine fuel. The study was done by using diesel & Diesel-linseed oil blends at various loads from no load to 100% loads with interval of 20%. The linseed fuel was blended into 5%, 10%, 15% and 20% v/v ratio with neat diesel and compared with baseline data of neat diesel operation. The thermal efficiency of the engine was lower and the brake specific energy consumption of the engine was higher when the engine was fueled with Linseed oil-Diesel blends compared to diesel fuel. Emission characteristics are better than diesel fuel. NOx formations, using various fuel blends during the whole range of experiment were lower than diesel fuel. The results from the experimental study suggest that the linseed oil could be a potential substitute for diesel engine in the near future as far as small and medium energy productions are concerned [3].

Based on the stability and fuel properties close to diesel the combination namely B70D20DEE10 (biodiesel 70%, diesel 20% and diethyl ether 10%) was further selected for experimental investigation. Experiments were performed on a single cylinder direct injection water cooled diesel engine under varying load, injection timing and injection pressure while keeping engine speed constant of 1500 rpm. The highest brake thermal efficiency was reported for B70D20DEE10 at an injection timing of 25.5 bTDC and injection pressure of 260 bar at full load condition which is 5.6% higher than diesel. The highest heat release rate (HRR) was observed at above operating condition is 29.4 MJ/°CA, which is 5.3% higher than diesel. Further a slight reduction in unburnt hydrocarbon (UBHC) by 12 ppm, nitric oxide by 116 ppm and smoke opacity by 18% was observed when compared to diesel [4].

The aim of the study is to apply LHR engine for improving the engine performance and reducing the emission when light vegetable oil (turpentine oil) is used as an alternate fuel. The work was carried out in two stages. In first Stage, The turpentine oil (20, 40, 60, 80 & 100, v/v) with diesel blends used in direct injection diesel engine and to identify best blend with respect to performance and emission. In second Stage, the work has been carried out by the converting direct injection diesel engine in to a LHR engine and the effects of different blends of turpentine oil (20, 40, 60, 80 & 100, v/v) with diesel fuel used in LHR engine and its performance, emission and combustion characteristics have been investigated experimentally. From the experimental investigation, the combination of LHR engine with blended fuels shows the better performance when compared to diesel engine. The smoke density decreases for the diesel engine (without LHR) whereas with [5].

Experimental study has been carried out to investigate performance parameters, emissions, cylinder pressure, exhaust and wall temperatures at different engine speeds and different percentage of EGR using sunflower and jojoba/diesel (B20) blend in comparison to diesel fuel. Sunflower oil and B20 were selected for the study because of its being widely used in Egypt and world. Results indicate that sunflower or B20 blend gives lower brake thermal efficiency, brake power, brake mean effective pressure, and higher BSFC due to lower heating value compared to diesel fuel. Sunflower or B20 blend gives lower NOx concentration due to lower gases temperature. Sunflower or B20 blend gives higher wall/exhaust temperatures due to incomplete combustion inside engine cylinder. Sunflower or B20
blend gives higher CO and CO2 concentrations due to higher carbon/hydrogen ratio [6].

This study aims to compare the engine performance and emission results of various blends of pure diesel and a multi-feedstock (MFS) biodiesel when used in a naturally aspirated air-cooled, single-cylinder direct injection diesel engine. The experimental results show that, relative to diesel, biodiesel had approximately 3–24% decrease in torque, 4–11% decrease in power, 11–32% increase in BSFC and 8–29% general reduction in engine efficiency. However, biodiesel reduced the emissions of CO (1.5–6%), CO2 (13–34%) and unburned HCs (3–25%), while NOx emissions were increased significantly (12–48%). These results indicate that smaller percentages of biodiesel (20% or less) could be blended with pure diesel and used in a diesel engine, without any engine modifications, as an alternative and environmentally friendly fuel and without significantly compromising engine performance [7].

The purpose of this study is to investigate the possibility of using ABE-Diesel blends with high ABE percentages as an alternative transportation fuel. The results show that the liquid penetration is reduced by the high percentage of ABE in the blends. At the same time, the soot formation is reduced significantly by increasing oxygen content in the ABE fuel. Even more interesting, a soot-free combustion was achieved by combining the low temperature combustion with the higher percentage ABE case. In terms of soot emission, high ABE ratio blends are a very promising alternative fuel to be directly used in diesel engines especially under low-temperature combustion conditions [8].

### III. MATERIALS AND METHODS

#### Preparation of coconut biodiesel:

Biodiesel is prepared by transesterification process. For 200ml of methyl alcohol 5gm of KOH is added and stirred in a Beaker.1000ml of Coconut is taken in a conical flask of 2000ml capacity. From the Beaker Methyl alcohol which is mixed with potassium hydroxide is poured into the conical flask. The flask is fitted with water cooled condenser and placed on a Heater. The temperature is set for 70°C and left for 4 hours. Then the D is taken from the Heater and allowed to cool for 48 hours. Thus Biodiesel is prepared.

<table>
<thead>
<tr>
<th>Property</th>
<th>Coconut Biodiesel</th>
<th>Diesel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density (kg/m³)</td>
<td>924</td>
<td>829</td>
</tr>
<tr>
<td>Kinematic viscosity (Ns/m²)</td>
<td>38</td>
<td>352</td>
</tr>
</tbody>
</table>

### IV. RESULTS AND ANALYSIS

This paper compares variation of break power with loads for all the blends and diesel and also break power, indicated thermal efficiency, volumetric efficiency of the optimum biodiesel blend (i.eC20) with diesel at optimum compression ratio.

#### A. PERFORMANCE PARAMETERS

1. Break power:

Break power of the engine is the significant parameter among the performance characteristics of the engine. On comparing break power for all the blends Break power is observed to be more than diesel for 4 and 8kg loads. Optimum break power was...
obtained for C20 at 8kg load and at 18 compression ratio. The graph indicates how the break power varies with load for various blends and diesel.

Load Vs Break Power

2. Break thermal efficiency

At zero load Break thermal efficiency obtained for optimum blend decreased and at the remaining two loads (ie4, 8kgs) similar values were observed compared to diesel.

3. Indicated thermal efficiency

Indicated thermal efficiency for optimum blend decreased significantly for all the loads compared to conventional diesel fuel.

4. Volumetric efficiency

Volumetric efficiency for optimum blend is similar to diesel for all the loads at optimum compression ratio for optimum blend

The following graphs shows how performance characteristics varies with break power for optimum blend and diesel

BP Vs Performance Characteristics for C20

BP Vs Performance Characteristics for D100

B. EMISSION PARAMETERS

1. Emission of carbon monoxide

Carbon monoxide is responsible for global warming e .The emission of carbon monoxide is reduced significantly for optimum blend at optimum compression ratio compared to diesel.

2. Hydro carbons

A great reduction in hydro carbons is achieved for all the loads for optimum blend at optimum compression ratio.

3. Carbon dioxide

Carbon dioxide is reduced significantly for all the loads for optimum blend at optimum compression ratio compared to conventional diesel fuel.

The following graphs show how emission parameters vary with load for optimum blend and diesel.

BP Vs Emission Parameters for D100

Bp Vs Emission Parameters for C20

V. CONCLUSION

The optimum break power is obtained for (C20) at 18 compression ratio and at 8kg load. It is also observed that the break power obtained at the above specifications is more than for diesel at the same compression ratio and load. In view of emission parameters like carbon monoxide, carbon dioxide and hydro carbons significant reduction is achieved which is a positive impact for environment.

VI. FUTURE SCOPE

In the present investigation the performance and emission parameters are evaluated at constant operating speed by varying the loads and compression ratio. In the future work the investigation will be carried out at different operating speeds and at different loads by using different blended vegetable oils.

VII. REFERENCES


