PERFORMANCE ANALYSIS OF LEMONGRASS OIL ADDED WITH ADDITIVE BLENDED WITH DIESEL AT VCR-DIESEL ENGINE

KumaranP\textsuperscript{1}, jibin K P \textsuperscript{2} Mohammed Gazel\textsuperscript{3} KiranlalV\textsuperscript{4}

\textit{kumaran5666@gmail.com}\textsuperscript{1}

\textsuperscript{1,2,3,4} Department of mechanical Engineering, AVIT, Chennai

ABSTRACT

In the modern world the availability of recoverable fossil fuel reserves and the environmental problems caused by the use of those fossil fuels, considerable attention has been given to biodiesel production as an alternative to petro diesel. The two most common types of biofuels are ethanol and biodiesel. In this study, plant species, Lemon grass (Cymbopogan flexuous) is discussed as newer sources of oil for biodiesel production. Lemongrass is native to India and tropical Asia. In India, it is cultivated along Western Ghats (Maharashtra, Kerala), Karnataka and Tamil Nadu states besides foot-hills of Arunachal Pradesh and Sikkim i.e., it can be cultivated on wide range throughout India and may favor easy availability. This study investigates the performance of Lemongrass oil and its blends as fuel for a CI engine. The data thus generated were compared with the data obtained using diesel. The engine exhibited a very good performance without any problem of combustion. It is suggested that, Lemongrass oil and its blends can be used as an alternate fuel for diesel engine.

Keywords: lemongrass oil, diesel, n-butanol, biodiesel

1. INTRODUCTION

Many energy fuels such as hydrogen, CNG, alcohols, Biogas, Producer gas and host of vegetable oils are being investigated as potential substitutes for the current high pollutant diesel fuel derived from diminishing commercial sources. With the fossil fuel depleting, biofuel as a renewable source of energy affords immense potential. In India, our domestic production of fuel is simply not able to keep pace with the ever growing needs, compelling us depend heavily on imports. With about 70\% of domestic demand for fuel to be met by imports, there is a huge outflow of valuable foreign exchange.

Besides, the increasing use of fossil fuel has also been resulting in such seriously deleterious problems as Green House Effect affecting the entire humanity. It is therefore impending that a safe alternative is explored and exploited. Naturally, biofuel presents a most viable option as it can be obtained from renewable source of energy.
The fuels of Bio origin may be alcohols, edible and non edible vegetable oils, biomass, biogas etc. some of these fuels can be used directly while others need to be formulated to bring the relevant properties close to conventional fuels. Biodiesel is simple to use, biodegradable, nontoxic, and essentially free from sulfur aromatics. It is better for the environment because it is obtained from renewable resources and has lower emissions compared to petroleum diesel. It reduces emission of particulate matter by 40%, unburned hydrocarbons by 68%, carbon monoxide by 44%, sulphates by 100%, polycyclic aromatic hydrocarbons (PAH) by 80%, and the carcinogenic nitrated PAH’s by 90% on an average. It almost completely eliminates lifecycle carbon dioxide emissions.

The benefits of biodiesel are
- Clean burning
- Renewable fuel
- No engine modification
- Increase in engine life
- Biodegradable and non-toxic
- Easy to handle and store

The following are the disadvantages of biodiesel:
- Slightly higher viscosity
- Lower volatility

<table>
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<th>PROPERTIES</th>
<th>DIESEL</th>
<th>LGO</th>
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<td>DENSITY (kg/m³)</td>
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<td>FLASH POINT (UC)</td>
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<tr>
<td>NET-HEATCONTENT (KJ/kg)</td>
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<tr>
<td>CETANE NUMBER</td>
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</table>

RESULTS AND DISCUSSION

The experiments were conducted on a single cylinder, naturally aspirated, air cooled, VCR DI Diesel engine coupled to an electrical generator. Cylinder wall and cylinder head of the engine were coated with Zirconium Oxide ($Zr_2O_3$) for a thickness of 100 microns. The engine was run at constant speed of 1500 rpm. The performance of the engine was evaluated in terms of Brake thermal efficiency, specific fuel consumption and emission characteristics like HC, CO, NOX and smoke were recorded using diesel fuel, Diesel - Lemongrass oil blended with additive (80:20) and Diesel - Lemongrass oil blend with additive (60:40) blends. In order to determine the cylinder peak pressure and heat release rate, the combustion analysis was performed in the engine. The experimental set-up employed in the investigation is shown in Figure.1 and Figure shows the photographic view of the experimental set-up.

SPECIFIC FUEL CONSUMPTION

The results for the variation in the specific fuel consumption (s.f.c) with increasing brake power of the engine for the Lemongrass oil with additive (n-butanol) blended with diesel...
blends are presented in Figure 2. For all fuels, the specific fuel consumption falls with increasing load. The specific fuel consumption in the case of diesel is higher compared to Lemongrass oil with additive (n-butanol) blended with diesel in the 50% load range. This is mainly due to the combined effect of the relative fuel density, viscosity and heating value of Lemongrass oil with additive (n-butanol) blended with diesel. However, blend containing 60:40 D/LGO with NB has specific fuel consumption close to that of diesel. The specific fuel consumption value was to be at 75% load. The corresponding value of diesel. The specific fuel consumption of was observed using Lemongrass oil with additive (n-butanol) blended with diesel (B20) as fuel which is lower than the SFC obtained with diesel under the same load. The higher density of lemongrass oil has led to more discharge of fuel for the same displacement of the plunger in the fuel injection pump, there by decreasing the specific fuel consumption

maximum brake thermal efficiency with Lemongrass oil with additive (n-butanol) blended with diesel is about 26.8% of B40 where as it is 31.7% with diesel at 75% load condition. The brake thermal efficiency is higher with Lemongrass oil with additive (n-butanol) blended with B40 compared to B20. The Lemongrass oil with additive (n-butanol) blended with diesel have lower viscosity and density than raw lemongrass oil. The reduction in viscosity leads to improved atomization, fuel vaporization and combustion. In addition the ignition delay time is closer to diesel with the ester as the cetane rating is lesser.

HYDROCARBON EMISSION

Figure 4 shows the variation HC emission with power output for Lemongrass oil with additive (n-butanol) blended with diesel blends (B20 & B40) and diesel. It can be noticed from the figure that HC emission of Lemongrass oil with additive (n-butanol) blended with diesel - B20 is lower than that of diesel in 50% load compared to B40. The reason behind this phenomenon may be due to the combustion extending into the exhaust stroke. At full load condition HC emission of Lemongrass oil with additive (n-butanol) blended with diesel is 34 ppm for B40 and, 43 ppm for B20 of Lemongrass oil with additive (n-butanol) blended with diesel oil fuel.
CARBON DIOXIDE EMISSION

The variation of CO\textsubscript{2} emission with respect to brake power is shown in Figure.5. CO\textsubscript{2} emission levels are more or less equal in Lemongrass oil with additive (n-butanol) blended with diesel oil fuel of 20% blend. The CO\textsubscript{2} of the Lemongrass oil with additive (n-butanol) blended with diesel oil fuel of B20 was 1.0 % at full load, 1.4 % for B40, 1.0 % for diesel. The lower brake thermal efficiency and calorific value with Lemongrass oil with additive (n-butanol) blended with diesel oil fuel lead to injection of lesser quantities of the fuel for the fuel for the same power output as compared to diesel.

OXIDES OF NITROGEN EMISSION

Figure.6 shows the variation of NO\textsubscript{X} with power output for diesel and Lemongrass oil with additive (n-butanol) blended with diesel blends. Due to sluggish combustion of raw Lemongrass oil with additive (n-butanol) blended with diesel blends to diesel, the combustion temperature was higher, hence reduced NO\textsubscript{X} emissions. The NO\textsubscript{X} concentration was 129 ppm for B20, 194 ppm for B40 and 126 ppm for diesel at 75 % load condition.

CONCLUSIONS

Experiments were conducted on a single cylinder, water cooled, zirconium coated DI diesel engine using Lemongrass oil with additive (n-butanol) blended with diesel - diesel blends. The following conclusions are drawn based from the experimental results.

- The engine operation with Lemongrass oil with additive (n-butanol) blended with diesel blends:
  - Lemongrass oil added with additive (n-butanol) blended with diesel blends resulted in a slightly reduced thermal efficiency as compared to diesel. With the Lemongrass oil with additive (n-butanol) blended with 20% diesel blend oil the brake thermal efficiency is comparable to diesel values. Maximum brake thermal efficiencies are 26.2% and 26.8% with blends B20 and B40 respectively whereas it is 31.7% for diesel.
HC emission is lower with Lemongrass oil with additive (n-butanol) blended with diesel blends as compared diesel oil. At full load condition HC emission of Lemongrass oil with additive (n-butanol) blended with diesel is 34 ppm for B40 and, 43 ppm for B20 of Lemongrass oil with additive (n-butanol) blended with diesel oil fuel.

CO₂ emission levels are more or less equal in Lemongrass oil with additive (n-butanol) blended with diesel oil fuel of 20% blend. The CO₂ of the Lemongrass oil with additive (n-butanol) blended with diesel oil fuel of B20 was 1.0 % at full load, 1.4 % for B40, 1.0 % for diesel.

The maximum smoke level with diesel oil is 42.6 BSU and it is 38.9 BSU with B20 and B40 of Lemongrass oil with additive (n-butanol) blended with diesel -diesel blend respectively. In the case of diesel it is 50.1 BSU at 75% load condition.

Using Lemongrass oil with additive (n-butanol) blended with diesel -diesel blends resulted in:

- An increase in brake thermal efficiency from 26.2% to 26.8% by increasing the blend from 20 % to 40%
- A good reduction of exhaust gas temperature from 342°C to 280°C
- Reduced smoke levels from 50.1 to 38.9 BSU at B40 of Lemongrass oil with additive (n-butanol) blended with diesel -diesel blend.
- Lowering of CO emission.

REFERENCES


emission in a diesel engine fueled by Biodiesel emulsion combined with EGR”, SAE paper, 2001-01-0649.

