EFFECT OF DIMETHOXY-METHANE (C₃H₈O₂) ADDITIVE ON EMISSION CHARACTERISTICS OF A DIESEL ENGINE FUELED WITH BIODIESEL

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ABSTRACT

This paper investigates the utilization of Palm Oil Methyl Ester (PAM) blends with diesel in a compression ignition engine. The performance and combustion characteristics of 20% Palm Oil Methyl Ester and 80% Diesel and also with 10% Dimethoxymethane (DMM) have been studied and it was found that the blends could substitute for diesel and used as an alternate source for the future generation. The addition of additive Dimethoxymethane helps to decrease the carbon monoxide emission and opacity. The adverse effect oxide of nitrogen increase due to the biodiesel blends is marginally reduced. It gives better brake thermal efficiency than biodiesel blends.

KEYWORDS: Palm Oil Methyl Ester, Dimethoxymethane, Diesel Engine & Emission Reduction

INTRODUCTION

There are some issues due to technology advancement relating to an alternate fuel to sustain the automobile sector for the future. However our dependence is on diesel and petroleum for fueling the transportation sector and if this continues then this could threaten our energy resource, affect our economy and even affect our environment so badly that it may even take hundreds of years for a seed to sprout [1][2]. Thus, we are in search of an alternate source of fuel to have a sustainable economy. This is possible with the use of Biodiesel which is a renewable source of energy. Though it is not possible to run a CI Engine on 100% biodiesel like jetropha and pongamia without any major modifications in the presently available engine, when blended with diesel in various proportions it would make the world wonder with its Eco-friendly nature [3][4]. Biodiesel is nothing but long-chain alkyl esters which is obtained from animal fat and plant seeds. They are regarded as carbon sink as they absorb 78.5% of carbon in the atmosphere as they burn and even considered as cleaner than fossil fuels [5][6].

Waste oil biodiesel showed an increase in fuel density and decrease in calorific value of fuel [7][8] and also improved power, thermal efficiency and reduction in the specific fuel consumption. Waste cooking oil could be produced through transesterification process [9][10]. The heating the frying oil to reduces the viscosity to that of diesel and it could be used as an alternative fuel in diesel engine [11][12]. The biodiesel and its blend fuels shows that biodiesel/blend fuels have high break specific fuel consumption at low engine speed [13][14].

Preheated Palm Oil Methyl Esters (PAM) in the diesel engine it is seen that the improved the brake power
output and engine performance [15][16]. The specific fuel consumption values of the methyl esters were less than that of the raw vegetable oils and high specific fuel consumption in vegetable oils is due to lower energy content [17][18]. Biodiesel is a mixture of glyceride free long chain fatty acids obtained from oils and fats [19][20]. The diesel Dimethoxymethane (DMM) blends experimentally and reported that the effect of fuel constituents on combustion characteristics, fuel efficiency and emissions of a diesel engine. He also reported that with the use of DMM, CO and smoke emissions can be reduced significantly, while HC emissions and particulate matter increase slightly[21]. To improve the performance of a diesel engine by adding oxygenated fuel additive to control the emission and to improve its performance.

Previous research showed that the reduction of PM and NOx could be achieved by using DMM blends [22]. However, these studies were performed only for diesel and DMM blends, and only few researches have done experimental work on Palm Oil Methyl Ester and DMM blends. In this work the performance of Palm Oil Methyl Ester (PAM) and DMM with diesel in a compression ignition engine have been analyzed. The performance and Combustion characteristics of B20PAMDMM (20% Palm Oil Methyl Ester and 70% Diesel 10% DMM) for various loads have been studies

**OXYGENATED ADDITIVE**

Fuels that have a chemical compound that contains oxygen atoms are called oxygenated additives. Effective burning is possible with the use of oxygenated additives and also the major benefit is it cut down the emission level comes out from the engine exhaust. Oxygenated additive works by allowing the gasoline in vehicles to burn more completely. Oxygenated additive also helps to reduce the utility of non-renewable fossil fuels exhausted. In recent years, Dimethoxymethane (DMM) has been a promising alternative diesel fuel, since it has a high oxygen fraction and high cetane number. Such positive advantages make DMM a good oxygenated additive to be used in diesel engines.

In this study, Dimethoxymethane (CH$_3$OCH$_2$OCH$_3$, DMM) were analyzed and reported. DMM being non-toxic and miscible with diesel fuels. Dimethoxymethane (DMM) is a high oxygen content additive and also has high cetane number, which makes DMM a good oxygenate additive for diesel/oxygenate fuel blends. This study, analyses engine performances and emissions with various compression ratios of a compression ignition engine fueled with Palm oil methyl ester with DMM blends with diesel.

**EXPERIMENTAL**

The research engine test setup with following configuration has been used for this work. Single cylinder, four stroke, Multifuel water cooled VCR engine. Stroke:110mm, Bore:87.5mm, Capacity 661cc, Power 3.5 kW, speed 1500 rpm, CR range 12:1-18:1.
Effect of Dimethoxy-Methane (C₃H₈O₂) Additive on Emission Characteristics of a Diesel Engine Fueled with Biodiesel

Figure 1: Experimental Setup

Eddy current dynamo meter for loading. Experiments were conducted at 17.5 compression ratio with the selected engine loads varied from 0, 3, 6 and 9kg. Before each measurement, the was warmed up and engine running steadily. The brake thermal efficiency, NOₓ, HC, CO emissions as well as the opacity are recorded and analyzed in this study. Figure 1 shows the schematic experimental system and measuring instruments used in this work.

RESULTS AND DISCUSSIONS

Figure 2 show that the variation of brake thermal efficiency with load for diesel, 20% PAM and 20% PAM with 10% DMM. The result revealed that with increasing load the brake thermal efficiency increases. 20% PAM shows lowest brake thermal efficiency compared to the other modes. By adding Dimethoxymethane with palm oil increases the brake thermal efficiency, but still it is lower than diesel. This may be due to the PAM addition which has lower calorific value than the diesel.

Figure 2: Brake Thermal Efficiency in % with Load in Kg
Figure 3 shows the exhaust CO concentration in % with load in Kg for 20%PAM, 20% PAM with 10% DMM fuel blends. A remarkable decrease in CO is present at high engine loads. Moreover, the PAM and DMM blends show greater reduction in CO concentration at higher loads. For diesel, the CO concentration is 26.6 % at full load. For 20% PAM, 20% PAM with 10% DMM the variations are 23.1 and 25 % respectively.

Figure 4 gives HC emissions in ppm versus load in kg. The HC concentration is low in the case of 20PAM blends obviously PAM oxygenated fuel supports better combustion with diesel. The expected reduction of HC not happened with addition of 10% DMM considered as higher oxygen mass (8.46). This may be due to the boiling point of DMM, which is 40°C below the diesel. DMM disperses all areas before the flame reaches, which could be the reason for higher HC. For diesel, the HC emissions vary from 18 ppm at no load to 25 ppm at rated power output. For 20% PAM, 20% PAM with 10% DMM the variations are from 17 ppm to 22 ppm, 18 ppm to 25 ppm respectively.

![Figure 3: Carbon Monoxide in % with Load in Kg](image)

![Figure 4: Hydrocarbon in ppm with Load in Kg](image)

The NO\textsubscript{x} concentration of diesel, 20 PAM and 20 PAM with 10% DMM blends under various loads shown in Figure 5. The NO\textsubscript{x} concentration is high at full load condition particularly with 20 PAM blends with diesel shows more concentration of NO\textsubscript{x}. The addition of DMM in the blend shows reasonable decrease in NO\textsubscript{x} at all loads but slightly higher than diesel fuel. For diesel, the NO\textsubscript{x} emissions vary from 59 ppm at no load to 894 ppm at rated power output. For 20% PAM, 20% PAM with 10% DMM the variations are from 122 ppm to 1356 ppm, 122 ppm to 1077ppm respectively.
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CONCLUSIONS

The performance and emissions of a compression ignition engine fueled with diesel and PAM blends and biodiesel/DMM blends were investigated, and the results are summarized below.

- The engine thermal efficiency decreases with 20% PAM blends with diesel. But there is increases the BTE with biodiesel/DMM blends compared with 20% PAM blends.
- Carbon monoxide concentration is low with biodiesel/DMM blends compared with other blends.
- Oxides of Nitrogen increases slightly for both the 20% PAM blends and biodiesel/DMM blends compared to the diesel.
- Opacity concentration considerable reduced with biodiesel/DMM blends.

Energy crisis caused due to disproportionate dependence on non-renewable energy resources fossil fuels. If the fossil fuel production remains constant, it is estimated that the reserves will be depleted soon. Due to the running down of
the world’s petroleum reserves and the growing environmental concerns, there is an extensive demand for non-conventional sources of energy. Augmented regulations for particulate matter and NOx, and the issues raised on the emission of greenhouse gases like CO$_2$ are the reasons for bio-fuels being subjected to demanding research work all over the world. Biodiesel derived from the transesterification of fats and oils is a possible fuel for diesel engines.

**REFERENCES**


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