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Assessment of Biomass Potential in Engine Emission Reduction

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The twin crisis of environmental degradation and fossil fuel depletion has confronted the world with the upcoming threat to seek the solution for some alternate fuel. The present condition of environment forces the search of some suitable alternate fuel. The present degradation of environment is also mainly influenced by the diesel vehicles. The emissions released by these diesel vehicles not only degrade the environment but also increase the number of health diseases. The present research on bio-fuels will lead to develop a sustainable solution to this problem and also create a harmonic relationship between the economy and ecosystem. The present research will provide the optimized blending ratio compression ratio and other operating parameters to be selected while approaching to sustainable output. The present study will depict the behavior of different bio-fuels poured in VCR engine at different compression ratio at different operating parameters. The outcomes of this research paper reveals the discussion on the potential assessment of different biofuels in the reduction of engine emissions.

Keywords: Biofuels, VCR engine, Potential assessment

Introduction

The optimum utilization of biofuels also depends on the availability of these biofuels. The biodiesel feedstock's can be categorized in oil crops, including rapeseed oil, soya bean and henceforth[1]. Oil trees includes palm oil and pistachio (Chinese). They all have the owing characteristics of renewables and environment. The major importance in this regards is of Fatty Acid Methyl Ester (FAME)[2]. Biofuels derived from these plants also contains less amount of sulphur content. They possess several important characteristics of good lubrication which in turn reduces friction losses and engine wear[3]. Biofuels also amplifies the life of fuel injection system. Biofuels has lower energy density in comparison to petrol due to which they possess lower fuel efficiency in contrast to fossil fuels[4]. The snowballing demand of alternative fuels has created a pressure to seek out the optimal alternate to this twin crisis problem[5]. The unique property of biofuels like bio-degradability, lubrication etc. seeks the attention of researchers for its utilization in IC engines[6].

Experimental Setup

The apparatus selected for the experiments is VCR Multi fuel engine. The specification of engine are listed in Table 1. The operating variables are compression ratio from 6 to 10, blending ratio ranging from 5% to 15%. The behavior of engine on the utilization of blended fuel with ethanol and marine algae was recorded by a coupled software namely IC Engine soft for the purpose of analysis.

Results and Discussions

The analysis of the emission recorded on the use of blends if ethanol and marine algae oil was kept fixed at 1500 rpm and at load with the variation of 2 to 4bar.The emission characteristics of any fuel taken as alternative for its utilization in IC Engine plays an

Table 1 — Dual Fuel Engine Specifications

Engine Specifications	Details
Model Name	VCR multi fuel engine
Length of Connecting rod	234 mm
Number of strokes	4
No. of cylinders	1
Diameter of Cylinder	87.5 mm
Power	3.5 kW
Stroke Length	110 mm
Dynamometer arm length	185 mm
Orificediameter	20 mm
CR range	6:1 to 10:1
Range of Speed	1200 to 1800 RPM

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important role. The predefined characteristics of designed fuel of ethanol and algae are measured by using AVL emission analyser. The parameters which were measured are NO, HC and NO_x. The due consideration towards these parameters is necessary because they possess an impact on the environment. The analysis was performed by changing the load through dynamometer from 1 bar to 4 bar and the plotting is done with reference to different emission parameters like CO,HC and NOx. Every reading was noted at different compression ratio of 6, 8 and 10. The fuel which was tested for their performance in engine is named as ethanol and algae fuel and it is blended with gasoline at a ratio of 5%, 10% and 15% named as MSE 5, MSE10, MSE 15, MSA5, MSA10 and MSA15 respectively.

Carbon Mono oxides emissions

As the engine is confronted with the increased loading then the CO emission is also increased and that trend can also be seen in the figure 1. The trend of CO emission by the utilization of algae oil and ethanol was seen higher at lower compression ratio and at higher compression ratio, its value is retarded. This trend was followed at the utilization of both fuel blends. In all the cases and at all the operating variables, the emissions of both algae and ethanol are lower in comparison to gasoline. The maximum reduction in the value of CO emission was recorded by the usage of algae oil. The behavior of the reduction in CO emission after the use of algae and ethanol use in IC engine was due to the fact that when the load on the engine is increased, higher rate of combustion is required which in turn requires higher rate of oxygen supply to assist the combustion rate. When the biofuel blends of algae and ethanol are utilized, they provides larger rate of oxygen for combustion, hence complete combustion takes place inside the chamber and the retardation in CO emission was noted by their use in IC engine. Although, when the load is increased from a certain limit then the time required for the complete combustion is reduced which leads towards the higher rate of CO emission.

Hydrocarbon emissions

Different problems associated with the engine like engine misfiring, poor vaporization of fuel and low quality of fuel are also the reason of hydrocarbon emissions in the IC engine. These problems inside the engine leads towards the inproper combustion inthe engine which in turn leads towards the higher rate of HC emissions to the environment. The emission of hydrrocarbon from the engine is a result of incomplete combustion which may be due to several reasons like improper vaporization, misfiring of engine and time required for the complete combustion. Figure 2 depicts the behaviour of biofuel blends in terms of HC emissions. The figure 2 clearly shows that as the engine loading parameter is increased, the emission of HC is also increased as a result of incomplete combustion. At higher loading condition, it was noted that the time required for the combustion is lesser and the amount of fuel supplied

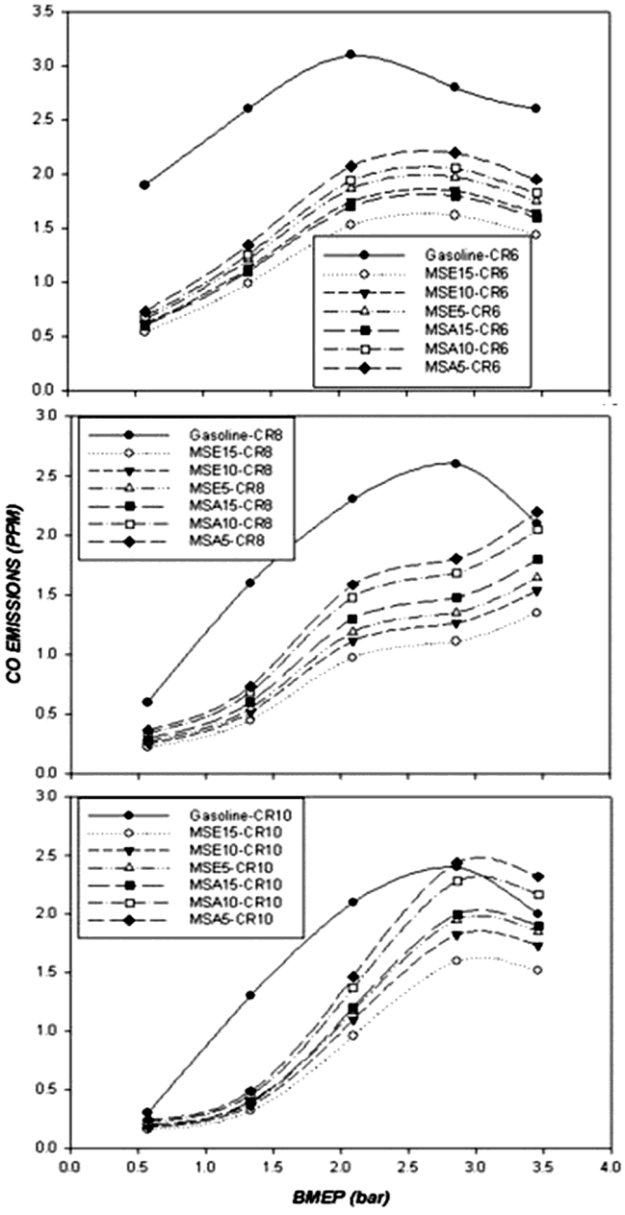

Fig. 1 — Emissions of CO of biofuels blends at different compression ratio.

to be combusted is not properly burnt out hence the quantity of unburnt hydrocarbons is increased as the load on the engine is increased.In terms of the comparison of both biofuels, it was noted in that algae represents the optimal value and reduction in the hydrocarbon emission in comparison of ethanol and gasoline at all the operating conditions and at all the operating variables as well as on all the compression ratio.

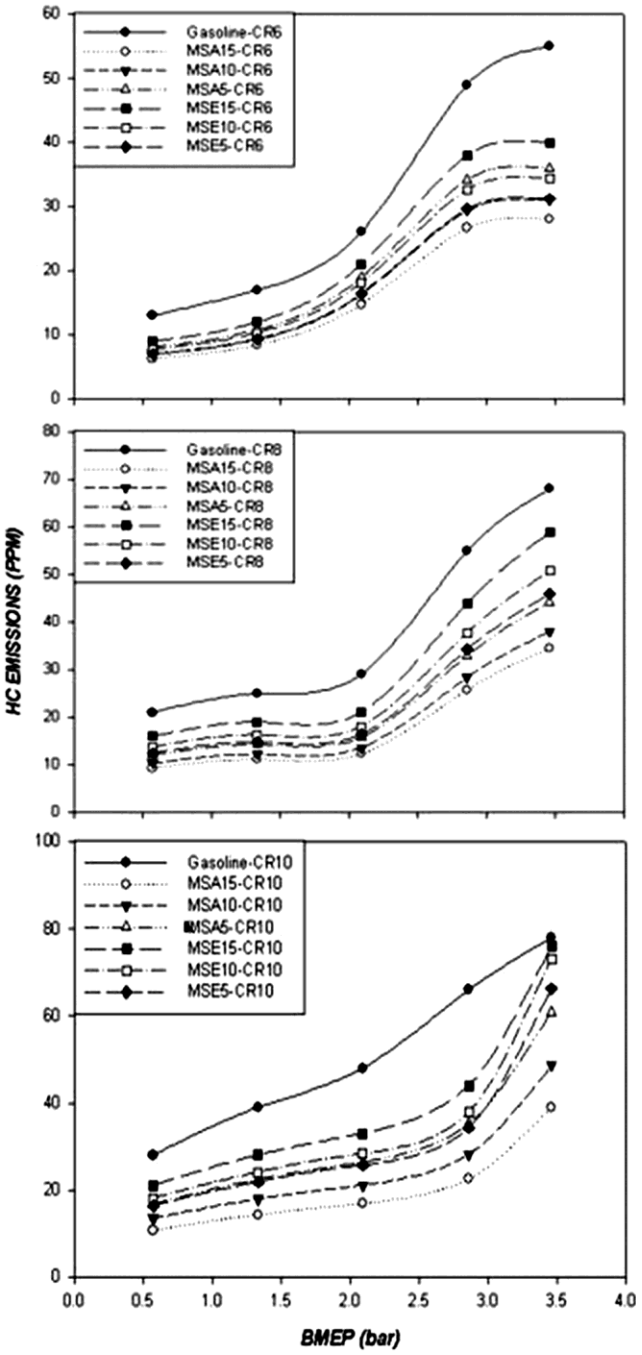

Fig. 2 — Emissions of HC of biofuels blends at different compression ratio.

Nitrogen oxides emissions

NO_x is a function of temeperature. As the temeperature inside the engine is increased, the foemationa nd emission of NO_x is also increased. The behaviour of algae and ethanol blends in comparison to gasoline is shown in the figure 3. The trend of the graph represented shows that as the loading conditon is ow, the temperature inside the engine is also low, hence the emission of NO_x is

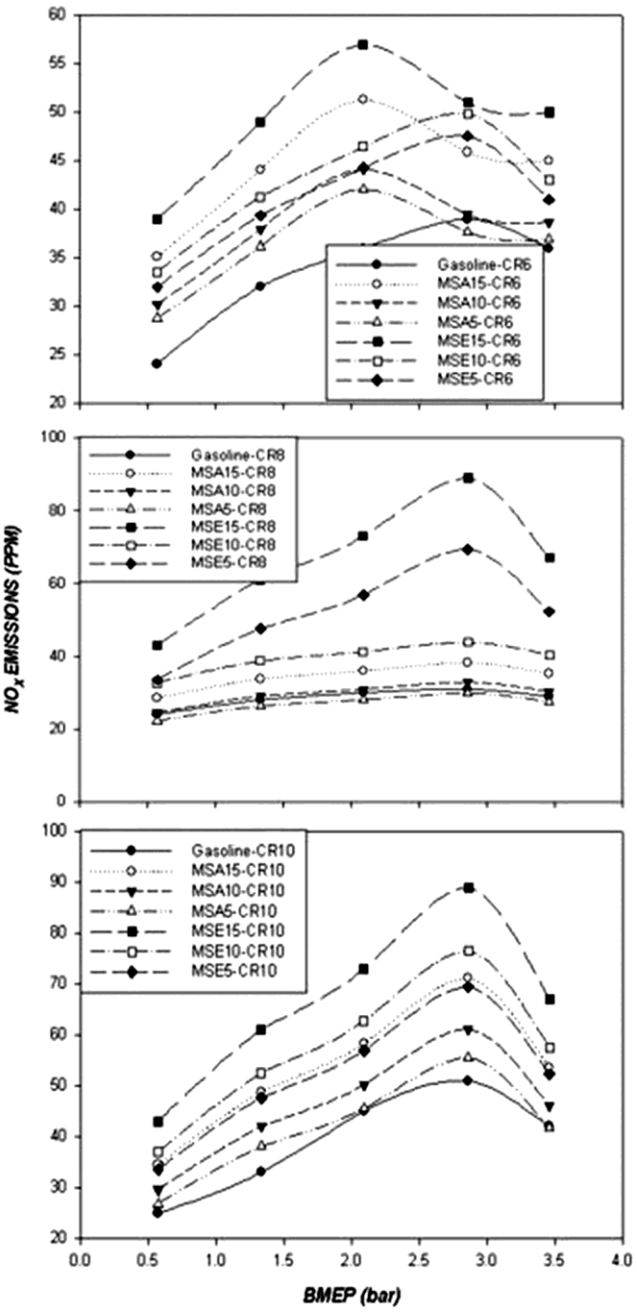

Fig. 3 — Emissions of NO_X of biofuels blends at different compression ratio

also. As the loading condition of the engine is increased, the temperature of the engine tends to be also amplified, hence the emissions of NO_x is also increased. In terms of comparison of all tested fuels, algae shown the gretaer release of NO_x in all operating conditions like compression ratio, blending ration and loading condition in comparison to gasoline and ethanol. Ethanol also has the higher rate of NO_x emission in comparison to gasoline and inferior than algae.

Conclusion

The present analysis shows that algae and ethanol comprises of promising characteristics for its utilization in IC engine as an alternative fuel. Algae-gasoline and ethanol-gasoline blends has shown the reduction in the emission of CO and HC due to their optimal physio-chemical properties. The presence of excess oxygen in these biofuels assist the process of combustion and relatively reduces the rate of HC and Co emission release also increases and amplifies the rate of combustion. Although, the presence of excess oxygen also triggers the emission of NO_X on its utilization as an alternative fuel. This characteristic also increases the cylinder temperature which in turn increases the formation and emission of NO_x.

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