

# Effect Of Biogas Blends On Emission From Compression Ignition Engine

A Arul Peter

**Abstract:** Experimental investigation on emission of diesel engine was made using the blends of biogas with diesel. The engine was operated by diesel and the blends of biogas 15%, 25% and 35% with diesel. Except oxides of nitrogen 35% biogas blend yielded optimum results. The emission from 35% blend was appreciable. At maximum torque level better results were obtained in case of carbon monoxide, hydrocarbon and smoke emissions. It was concluded that increase in biogas percentage with diesel yielded reduction in emission level.

**Index Terms:** Biogas, CO, HC, CI engine, NOx, Emission.

## 1. INTRODUCTION

A DAPTION of renewable fuel is new trend to meet the growth as well as the demand of the modern society. One of the renewable sources is biogas from anaerobic digestion of animal and agricultural wastes. It contains methane and carbon dioxide. Carbon dioxide was removed by sending the pressurised biogas through water. The biogas mix with diesel was utilised to run the diesel engine to get the results.

A study on diesel engine was made using biogas which yielded controlled emission [1,2]. Special study on flow rate of dual fuel mix was made using venturi type gas mixture on diesel engine [3]. Alternative gaseous fuel was used to run the engine and the emission was studied for dual mode [4]. Emission study was made on by using biogas for variable compression ratios on spark ignition engine [5,6]. The effect on emission was studied by applying blended biogas with diesel on compression ignition engines [7,8] In this work the investigation on emission from diesel engine operated at different torque levels by using diesel and three blends of biogas mix with diesel. The outputs under biogas mix were compared.

## 2 MATERIALS AND METHODS

Compressed biogas from anaerobic digestion was mixed with diesel at different proportions injected to the diesel engine of 7.5kW which runs at 1500 rpm. The engine was coupled with dynamometer, AVL gas analyser, smoke meter and torque sensor. Biogas blends of 15%, 25% and 35% with diesel was the fuel to run the engine to study the emissions.

## 3 RESULTS AND DISCUSSION

### 3.1 Torque Vs Brake thermal efficiency

The torque vs brake thermal efficiency (bte) for various fuels was experimented on the engine and the results were plotted in the fig 1. Diesel has high energy content than the blends of biogas. It produces more brake power from lower to higher torques. The reduction in brake thermal efficiency was observed at all load conditions whenever the proportion of

biogas increased with the blends of diesel from bio 15, 25 and 35 with diesel. This was due to reduction in energy content of the blend with diesel compared to diesel alone. It was found that nearly 22% reduction in bte for bio 35 blend with diesel compared to diesel at maximum torque.

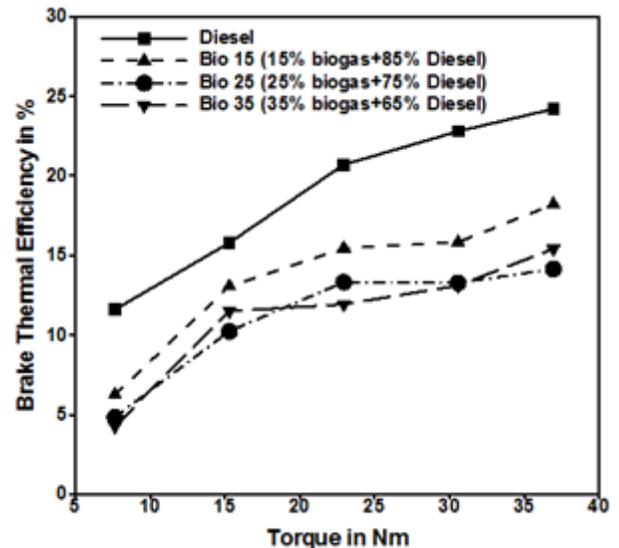


Fig . 1. Torque Vs Brake thermal efficiency

### 3.2 Torque Vs specific fuel consumption (sfc)

Fig 2 shows torque vs sfc for diesel, bio15, 25 and 35 blends with diesel. The consumption of diesel was low compared to the other blends for producing torques from minimum to maximum. The decreasing trend was observed for all kinds of fuel from low to high torques. It was noted increase in sfc whenever the proportion of biogas increases with diesel. The reason was due to decrease in calorific value of blends compared with diesel.

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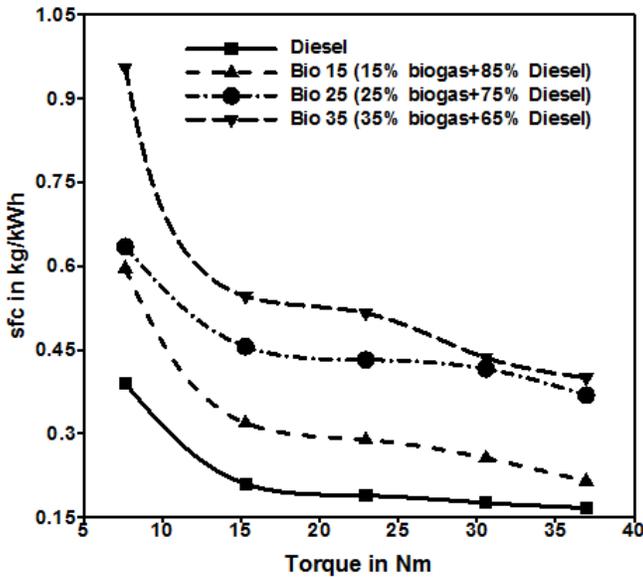


Fig. 2 .Torque Vs specific fuel consumption (sfc)

**3.3 Torque vs carbon monoxide (co)**

It was observed more CO was emitted at all torque levels when the engine was operated with diesel in comparison with the blends of biogas depicted in fig 3. Bio 35 blend exhibited low CO emission at all levels of torque due to complete combustion of fuel. 20% reduction in CO emission was observed at high torque in comparison with diesel.

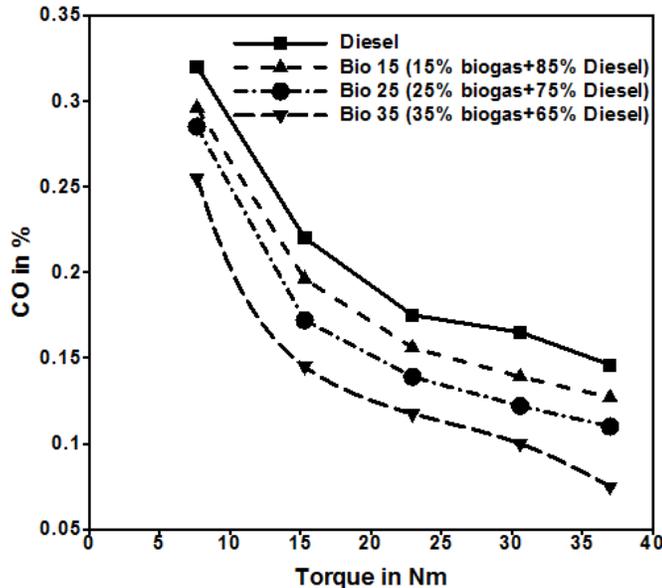


Fig. 3 .Torque Vs carbon monoxide(CO)

**3.4 Torque vs Hydrocarbon (HC) emission**

The emission of hydrocarbon (HC) for different fuels was plotted at all torques in fig 4. Complete combustion was achieved when the proportion of biogas blend increases with diesel. It was reflected in the plot of HC emission. Bio 35 blend exhibited complete combustion and emitted low HC at all levels of torque.

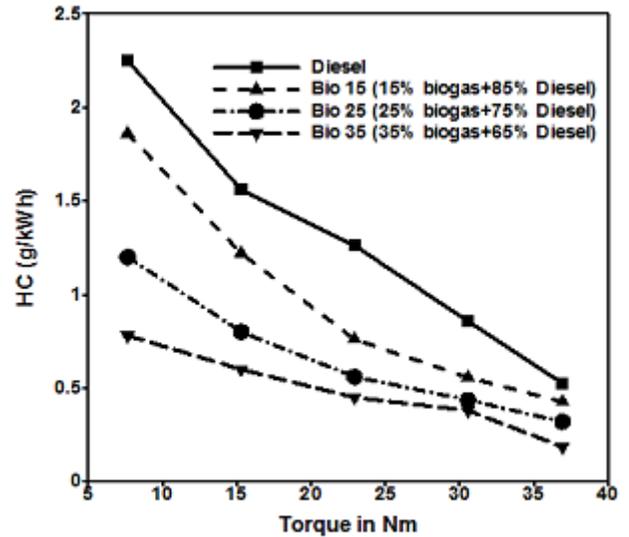


Fig. 4. Torque Vs Hydrocarbon (HC)

**3.5 Torque vs Nitrous oxides (NO<sub>x</sub>)**

Nitrogen combined with oxygen at high temperature produces oxides of nitrogen. It was shown in fig 5. The inference was combustion temperature increases from low to high torque generation. Bio 35 blend the combustion temperature was high. The emission of NO<sub>x</sub> was more at all torques compared with other fuels.

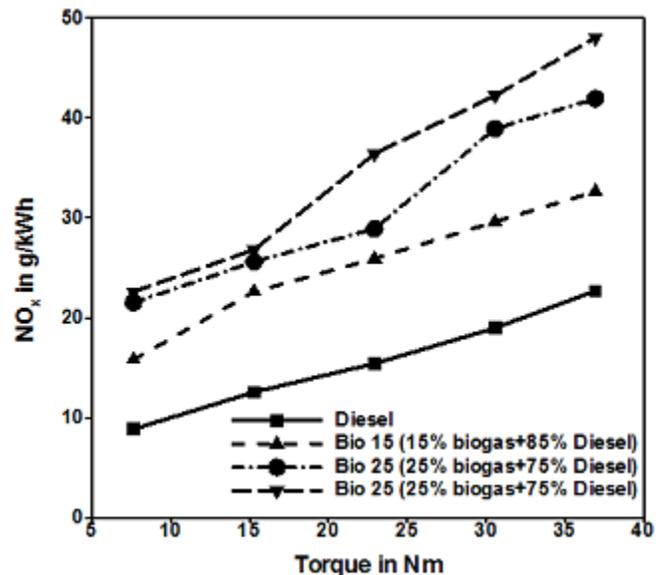


Fig. 5 .Torque Vs Nitrous Oxides (NO<sub>x</sub>)

**3.6 Torque vs smoke opacity**

It was observed diesel emitted more smoke compared with other fuel shown in fig 7. Bio 35 blend emitted low smoke due to complete combustion at all torque levels. The increasing trend was observed from low to high torque for all fuels.

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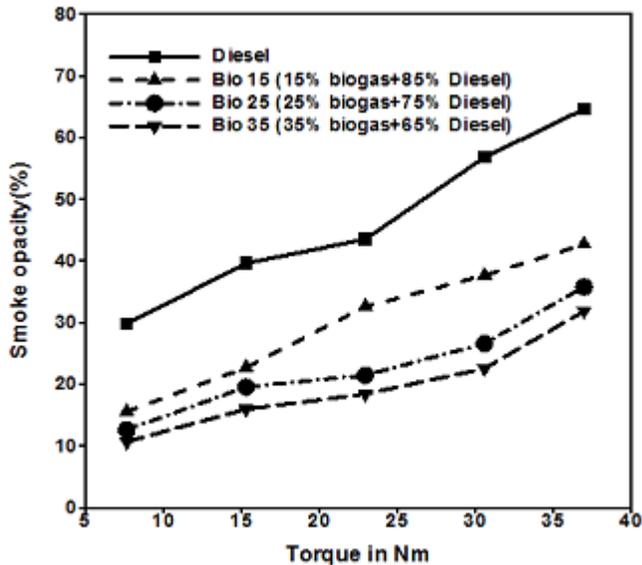


Fig 7. Torque Vs smoke opacity

## 4 CONCLUSION

### 6.1 Figures and Tables

It was observed diesel has high bte at all conditions and in the same case it emitted more CO, HC and smoke compared to other fuels. Low NO<sub>x</sub> was emitted in case of diesel alone was a fuel. Bio 35 blend with diesel has excellent emission characters except NO<sub>x</sub> emission though it produces low brake thermal efficiency from the observations.

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