

# Performance Characteristics of Ethanol Diesel Blend with an Additive in Diesel Engine

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**Abstract-** This study investigated the performance parameters of single cylinder direct injection diesel engine using diethyl ether (DEE) blended with ethanol blended diesel. The complete investigation performance of diesel engine is carried in three phases using the 100% diesel in the first phase and in the second phase ethanol is blended in diesel at various proportions of 10%, 20%, 30%, 40% and 50%. From the above experimental results we got the best efficiency at 30% of ethanol blended diesel. In the third phase, we had conducted the experiment by running the engine with the best proportioned ethanol diesel along with Diethyl ether at various proportions of 2.5%, 5%, 7.5% and 10%. The experiment results indicated that with the increase in the concentration of DEE to ethanol blended diesel increases the break thermal efficiency, mechanical efficiency and decreases the specific fuel consumption.

**Keywords-** DI diesel engine, ethanol blended diesel, diethyl ether

## I. INTRODUCTION

Modernization had increased the usage of automobiles throughout the world, which resulted in more usage of petroleum fuels that simultaneously resulted in increase of pollution and depletion of petroleum fuel resources. Hence, we need to search for an alternate solution of using fuels other than petroleum fuels. As ours is an agricultural country, if the alternate fuel searched is produced by our farmers, it may make us self sufficient for them. Ethanol can be produced from agricultural feed stocks and commonly made from very common crops such as sorghum, sugarcane, potato, cassava and corn. The performance enhancement of the diesel engines are improved by different methods such as engine modification, fuel adulteration and exhaust gas treatment. Number of researchers have concentrate their efforts on fuel adulteration techniques because it does not require hardware modifications. The oxygenated additives such as Dim ethyl carbonate (DMC), Methyl tetra butyl ether (MTBE), Dim ethyl ether (DME), Diethyl ether (DEE), have been blended in various proportions in 30% ethanol blended diesel proportion having the best efficiency. The performance and emission characteristics of the diesel engine are observed. The emissions of un burnt CO and HC get reduced for the DEE ethanol blended diesel and

found that DEE can be considered as potential diesel additive for the enhancement of the brake thermal efficiency, mechanical efficiency.

## II. EXPERIMENTAL SETUP AND METHODOLOGY

The engine is supplied by Field Marshal engine Ltd. It is a single cylinder vertical type four stroke, water cooled and compression ignition engine.

Experimental setup is shown in figure



Fig. 1. Experimental Setup

TABLE I  
Specifications of the Engine

Company name	Field Marshal
Engine	Four Stroke, Single cylinder, water cooled, direct injection diesel engine
Rated power	4.416KW / 6HP
Bore(D)	114.3mm
Stroke(L)	139.7mm
Speed(N)	650rpm
Fuel	Diesel
Calorific value	43000 KJ/Kg
Specific gravity of diesel	0.8275
Air tank orifice diameter	20mm
Type of loading	Rope Brake drum dynamometer
Equivalent, brake drum diameter	0.4mm
Compression ratio	16.5:1

TABLE II  
Properties of the Diesel, Ethanol and DEE

Properties	Diesel	Ethanol	DEE
Kinematic Viscosity at 40°C (cst)	3.51	4.95	0.24
Density at 15°C (Kg/m <sup>3</sup> )	830	805	715
Flash point (°C)	49	91	41
Calorific Value(KJ/Kg)	43000	42300	33800
Specific Gravity	0.827	0.84	0.711

In this work diesel with ethanol is blended in various proportions like 10%, 20%, 30%, 40% and 50%. From these proportions 30% ethanol blended diesel having the best mechanical efficiency. Many researchers proved that the efficiency of diesel can be increased by adding additives. To improve this efficiency to some more an additive can be used. Among the additives Diethyl ether as an alternate fuel produced a vast enlightenment. Diethyl ether have oxygen elements and has no C-C bonds, which helps in smokeless combustion that is superior with a diesel fuel. DEE also named as a best cold starting additive in diesel engine and gasoline engines due to its high volatility and low auto ignition temperature. The cetane number of DEE is greater than 125. DEE is in liquid form at normal room temperature helps in handling and storage problems. It is non-corrosive compared to alcohols. The diesel latent heat of vaporization is less than DEE. For the 30% ethanol blended diesel, Diethyl ether is blended in various proportions like 2.5%, 5%, 7.5% and 10%. The performance characteristics were evaluated. If the concentration of DEE increases more than 15% to diesel high knocking sounds were observed.

### III. RESULTS AND DISCUSSION

#### Brake Thermal Efficiency (BTE):

The variations of Brake Thermal Efficiency for various loads of ethanol blended diesel and diethyl ether at various proportions are shown in the below graph. With respect to loads the Brake Thermal Efficiency increases. The Brake Thermal Efficiency value at full load of 30% ethanol and 70% diesel blended fuel and for diethyl ether additive in various proportions (2.5%, 5%, 7.5%, 10%) are 15.02%, 17.89%, 17.92%, 15.86%, 15.02%. The Brake Thermal Efficiency increases for ethanol blended diesel and for additive added in the fuel in various proportions.

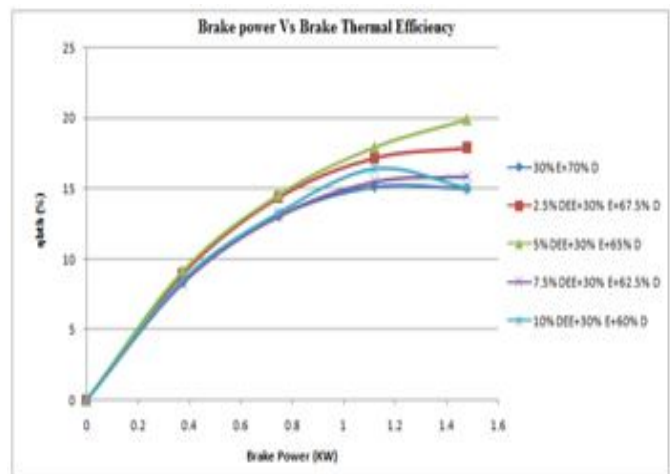


Fig. 2. Brake Power Vs Brake Thermal Efficiency

#### Indicated Thermal Efficiency (ITE):

The variation of Indicated Thermal Efficiency for various blends of fuel at various loads is shown below. Indicated Thermal Efficiency increases with increase in the load. The Indicated Thermal Efficiency values at full load are 27.1%, 25.55%, 22.29 and 20.83% for 2.5% , 5%, 7.5% and 10% DEE in 30% ethanol and 70% Diesel blend. The Indicated thermal efficiency increases by adding additive when compared with 30% ethanol and 70% diesel blends.

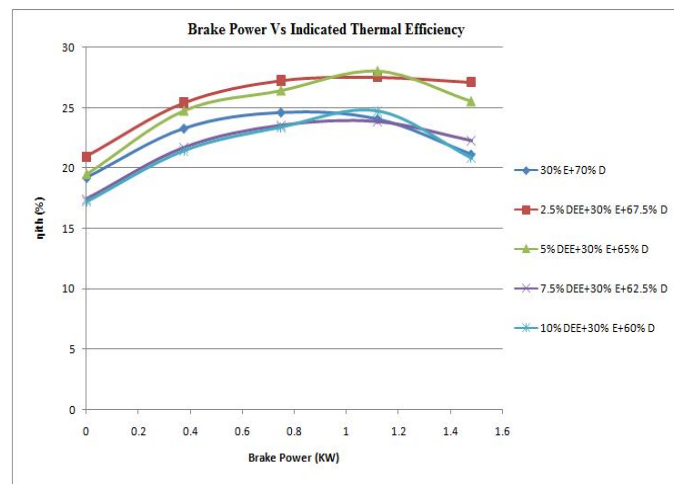


Fig. 3 Brake Power Vs Indicated Thermal Efficiency

#### Carbon Monoxide Emissions (CO)

The variation of the CO emission for various blends against brake power is shown in the figure-5. CO emission for 10% DEE blend is comparatively low and CO emissions for 2.5%, 5% and 7.5% are high when compared with 30% ethanol and 70% diesel blend.

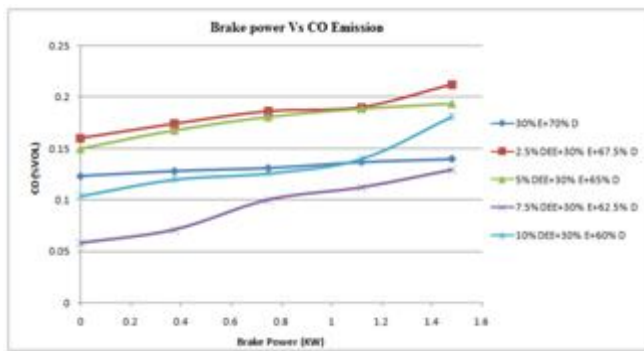
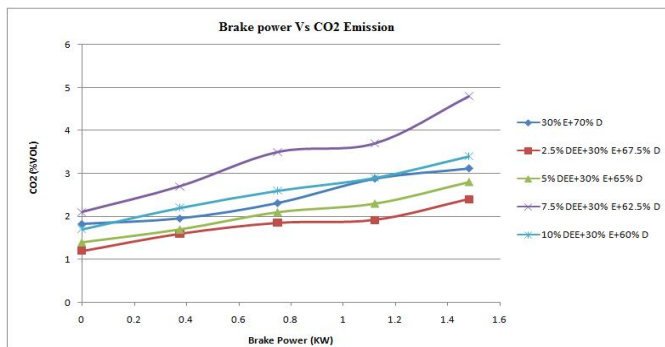


Fig. 4 Brake Power Vs CO Emission

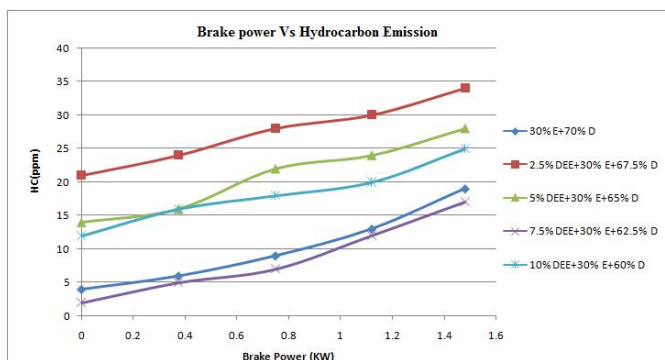
### Carbon Dioxide Emissions (CO<sub>2</sub>)

The variation of the CO<sub>2</sub> emission for various blends against brake power is shown in the figure-6. CO<sub>2</sub> emission for 2.5% and 5% DEE blend is low and for 7.5% and 10% DEE are high when compared with 30% ethanol and 70% diesel blend. The CO<sub>2</sub> emissions increases due to higher oxygen supplementary

Fig. 5: Brake Power Vs CO<sub>2</sub> Emission

### Hydrocarbon Emissions (HC)

The variation of the HC emission for various blends against brake power is shown in the figure-7. HC emission for 2.5%, 5% and 10% DEE blend is high and for 7.5% DEE are low when compared with 30% ethanol and 70% diesel blend. The HC emissions increases due to incomplete combustion.



## IV. CONCLUSION

The performance of diethyl ether additive with ethanol blended diesel fuel are evaluated for single cylinder direct injection diesel engine.

The following conclusions are drawn based on the experimental results.

- ❖ It is concluded that brake thermal efficiency and indicated thermal efficiency increases when compared with 30% ethanol blend and 70% diesel blend.
- ❖ Mechanical Efficiency increases with increase in the concentration of diethyl ether additive in ethanol blended diesel.
- ❖ CO and HC emissions are high and CO<sub>2</sub> emissions are same when compared with 30% ethanol blend and 70% diesel blend.

From the above the main conclusion is by adding DEE in ethanol diesel blend the Brake thermal efficiency, Indicated thermal efficiency and Mechanical efficiency increases.

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