

# **Experimental Investigation on the Performance of VCR Diesel Engine Fuelled by E-NM<sub>2</sub>-Diesel blend**

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**ABSTRACT:** The main reason for using alternative fuels in compression ignition engine is that the consumption and demand of petroleum products are increasing every year due to urbanization, increase in vehicular density and power requirement is going up and to reduce emission produced by today's diesel engine, which in turns require a clean burning fuel that perform well under the variety of operating conditions. A preliminary literature review suggests that smoke and NO<sub>x</sub> can be reduced by adding additives with diesel fuel. In this investigation Ethanol and Nitromethane was used as an additive to improve the performance and emission characteristic of a compression ignition engine. The performance and emission characteristics of an engine run on diesel at compression ratio 17.5:1 were evaluated and compared with engine operating on, E-NM<sub>2</sub>-Diesel(9.8%+.2%+90%). The graph plotted for performance (BTE and BSFC).

**KEYWORDS:** VCR diesel engine, Diesel, Ethanol, Nitromethane.

## **I. INTRODUCTION**

The objective of this investigation is to enhance the performance and emission characteristic of a VCR diesel engine fuelled by E-NM<sub>2</sub>-Diesel blend. The large increase in number of automobiles in recent years has resulted in great demand for petroleum products. Crude oil is the lifeblood of the modern world, which serves in all the sectors that includes transportation, agricultural, commercial and domestic and power generation. In the year 2009, the world consumed an estimated 84 to 85 million barrels of oil. There is a growing demand and cost of liquid fuel in every country. In the last six decades, India's energy consumption rate increases by 16 times and currently, India stands 6th in the world of oil consuming countries with an oil utilization of 2,438,000 barrels per day because of fast rate of population growth. At this rate, the fossil fuel will not be available for a long time as the gap between supply and demand increases large. The production of crude oil in India is estimated to have a decreasing trend after the year 2010. But there will be an increase in the vehicle population every year which will demand an increase in crude oil imports. With this scenario the need for an alternate fuel arises to maintain the economy of the country. The use of alternative fuels is the only possible solution, which can be obtained either from the renewable sources or non-conventional sources.

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## 1.1 Scarcity of crude oil

The main reason for any country to depend heavily on crude oil is transportation. Most of this oil is imported from foreign countries and the major source of foreign crude oil is the Persian Gulf (this region provides one-fourth of the world's current consumption of oil and nearly two thirds of the world's oil reserves). Reliance on this fossil fuel must end due to insufficient supply and distribution instability. Oil is a finite resource, which means that its supply is limited and cannot be reproduced. It took millions of years for these oil reserves to accumulate and they have been used in less than two hundred years. It is estimated that the current known reserves of oil on earth will only be able to supply total world demand for the next 40 years. Alternative fuel sources come to existence when these reserves are completely exhausted. In the short-term future, there are alternative reserves available. This oil shortage created havoc and illustrates the need to rely more on non-foreign sources of fuel. It was at that time the countries began research and development of alternative fuels.

## 1.2 Fuel Additives

Fuel additives have been one of the most prolific innovations of liquid engineering as well as material science giving Natural fuel sources and additional properties which help us drive that little extra out of them. A diesel fuel additive helps by liberating the chemical energy of the fuel on boilers or the flame zone of an automotive engine and breaking down carbon deposits on engine parts. This way, the formation of soot and particulate emissions are reduced and less fuel is wasted. Boiler performance is also improved and requires less maintenance because of its smoother operation. Fuel additives are compounds formulated to enhance the quality and efficiency of the fuels used in motor vehicles; researchers have developed a range of additives which give these fuels an added property which serves a pressing need from consumers by improving the performance of engine.

## 1.3 Ethanol

Ethanol commonly called ethyl alcohol, drinking alcohol, or simply alcohol is the principal type of alcohol found in alcoholic beverages, produced by the fermentation of sugars by yeasts. It is a neurotoxic psychoactive drug and one of the oldest recreational drugs used by humans. It can cause alcohol intoxication when consumed in sufficient quantity. Ethanol is a volatile, flammable, colorless liquid with a slight chemical odor. It is used as an antiseptic, a solvent, a fuel, and, due to its low freezing point, the active fluid in post-mercury thermometers. The largest single use of ethanol is as an engine fuel and fuel additive. Its structural formula,  $\text{CH}_3\text{CH}_2\text{OH}$ , is often abbreviated as  $\text{C}_2\text{H}_5\text{OH}$ ,  $\text{C}_2\text{H}_6\text{O}$  or  $\text{EtOH}$ .

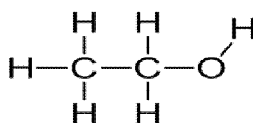


Fig. 1 shows the structure of Ethanol

## 1.4 Nitromethane

Nitromethane is an organic compound with the chemical formula  $\text{CH}_3\text{NO}_2$ . It is the simplest organic nitro compound. It is a slightly viscous, highly polar liquid commonly used as a solvent in a variety of industrial applications such as in extractions, as a reaction medium, and as a cleaning solvent. As an intermediate in organic synthesis, it is used widely in the manufacture of pharmaceuticals, pesticides, explosives, fibers, and coatings.

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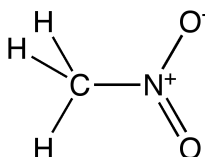


Fig. 2 shows the structure of Nitromethane

## II. RELATED WORK

Gong Yanfeng et al. [3] used 2-methoxyethyl acetate (MEA) as a new oxygenated additive to decrease exhaust smoke of diesel. In this investigation some fuel blends containing 10%, 15% and 20% MEA were prepared and researchers analysed the effects of MEA on engine's power, fuel economy, emissions and combustion characteristics on a single cylinder diesel engine. E. Sukjit et al. [4] assessed the effects on combustion and emissions characteristics of preselected biodiesel components (i.e. methyl esters). In this experimentation, individual fatty acid methyl esters (FAMES) were added to alcohol blends sequentially to recognize the effect of carbon chain length and degree of unsaturation on combustion and emissions. The effect of alcohol addition on the properties of fuel blends using ethanol and butanol was also studied. Zheng Chen et al. [5] evaluated the performance and emissions of a passenger-car diesel engine fuelled with butanol- diesel blend as the supplement to the conventional diesel fuel. In this investigation, diesel fuel (Bu00), butanol (20%), ediesel (80%) (by vol.) (Bu20), butanol (30%), ediesel (70%) (Bu30), and butanol (40%), ediesel (60%) (Bu40) fuels were prepared and tested on a high-speed direct injection diesel engine at various loads and at two engine speeds of 2000 r/min and 4000 r/min. Mojtaba Saei Moghaddam et al. [6] evaluated the performance, combustion and exhaust emission characteristics of a diesel engine using Nitrogenated- Diesel Additives blends fuel. In this investigation, Nitrogenated additives (Nitroethane and Nitromethane) were used to improve combustion performance, brake specific fuel consumption (BSFC), and reduce exhaust emission from diesel engine. The physiochemical properties of the standard diesel and blended fuel were also studied.

## III. EXPERIMENTAL SETUP

Fig. 3 shows a single cylinder, direct injection, four-stroke, vertical, water-cooled, naturally aspirated variable compression ratio multi-fuel engine, with a bore of 80 mm and a stroke of 110 mm was selected for the research study. This test engine, which is a compact engine; having rated power output of 3 to 5 HP, manufactured by Technical Teaching Equipment, Bangalore (India). The engine has a provision of loading by eddy current dynamometer. The engine can be started by hand cranking/self start and it is provided with a centrifugal speed governor.



Fig. 3 shows the Experimental Set up

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## IV. EXPERIMENTAL RESULTS

### 4.1 Performance Parameters

#### 4.1.1 Brake Thermal Efficiency

Fig. 4 shows the variation of the BTE with brake power at CR 17.5. When brake power increases, brake thermal efficiency of E-NM<sub>2</sub>-diesel blend at compression ratio 17.5 increases as compared to pure diesel.

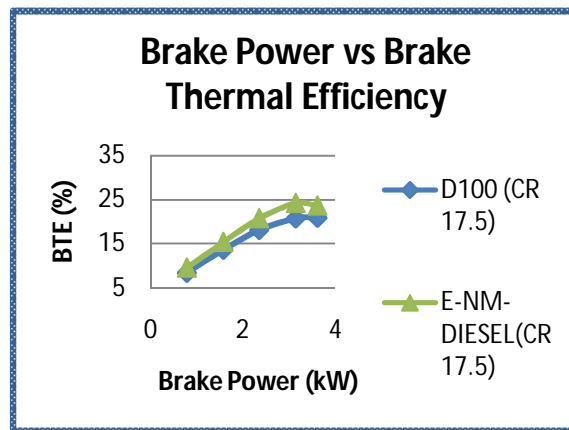


Fig. 4 shows the change in Brake Thermal Efficiency with Brake Power

#### 4.1.2 Brake Specific Fuel Consumption

Fig. 5 shows the variation of brake specific fuel consumption with brake power at CR 17.5. When brake power increases, the brake specific fuel consumption of the E-NM<sub>2</sub>-diesel blend at compression ratio 17.5 is slightly higher as compared to diesel.

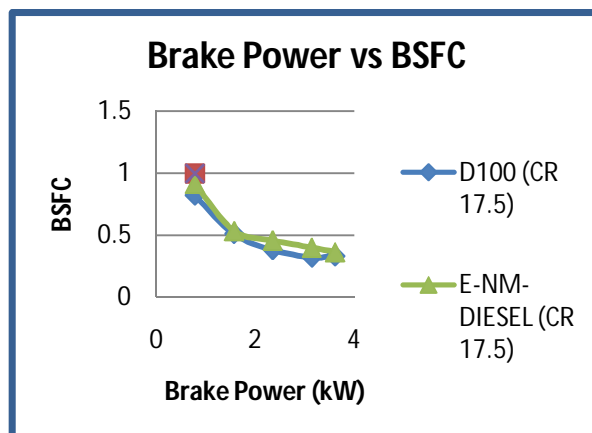


Fig. 5 shows the variation in Brake Specific Fuel Consumption with Brake Power

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## V. CONCLUSION

We have discussed the results of the experiments to be done to enhance the performance of E-NM<sub>2</sub>-Diesel blends at compression ratio 17.5. We had also optimized the emission characteristics of CI engine at compression ratios 17.5 for E-NM<sub>2</sub>-Diesel blends. From this research work we conclude the followings:

- Brake thermal efficiency is increasing at compression ratio 17.5 for E-NM<sub>2</sub>-Diesel blends as compare to Diesel at compression ratio 17.5. The maximum Brake thermal efficiency at full load is 24.16%.
- Brake Specific fuel consumption is slightly higher at compression ratio 17.5 for E-NM<sub>2</sub>-Diesel blends as compared to Diesel at compression ratio 17.5.
- From Performance parameters, E-NM<sub>2</sub>-Diesel blend at compression ratio 17.5 is taken as optimum for the test engine.

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