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# A Study on Compression Ignition Engine Performance Using Diesel-Cnso-Eea Blend

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**ABSTRACT**

*Diesel engines are major contributors of many air polluting exhaust gasses such as Carbon monoxide, Unburnt hydrocarbons, Oxides of Nitrogen and other harmful compounds. It has been shown that formation of these air pollutants can be significantly reduced by blending oxygenates into the base diesel. In this study, the effect of 2-Ethoxy Ethyl Acetate blend with diesel and cashew nut shell oil was evaluated experimentally and the results were compared with neat diesel fuel. A single cylinder, four stroke compression ignition diesel engine was used for the experimental tests.*

**KEYWORDS : Cashew nut shell oil, diesel, ethoxy ethyl acetate, engine, alternate fuel.**

**Introduction:**

Emission substances like carbon monoxide, undurnt hydrocardons, oxides of nitrogen, etc. generated from compression ignition engine, make serious environmental problem and has been noticed as a growing target to be reduced due to tightening emission requirements. The difficulties to simultaneously reduce the emission levels have introduced the various fuel additives such as Dimethyl Ether (DME), Dimethyl Carbonate (DMC), Diethyl Ether (DEE), 2 Ethoxy Ethyl Acetate (EEA), etc that has been nominated as a potential alternative fuel due to no carbon-carbon bond. The EEA has been adopted as an additive for ignition improvement in diesel fuel due to its excellent auto-ignition characteristics. Main advantages of the fuel additives are its high cetane number (similar order of diesel), high oxygen content with generating low particulate matter and low noise level during engine operation compared to diesel [1-4].

Anbumani and Ajit Pal Singh [5] investigated the performance of diesel engine using mustard and neem oil blends and reported that the engine run at 20% blend of oils showed a closer performance to pure diesel. Also, the mustard oil at 20% blend with diesel gave best performance as compared to neem oil blends in terms of low smoke intensity, emission of HC and NOx. Ramadhas et al [6] investigated a diesel engine using rubber seed oil biodiesel blends and found that the lower blends increases the efficiency of the engine and lowers the fuel consumption compared to the higher biodiesel blends. Ruijin Zhu et al [7] investigated the particulate emission characteristics of a compression ignition engine fuelled with diesel–Dimethyl carbonate blends and reported that the smoke opacity, the particulate mass concentration as well as the total number of particulates are all reduced with the use of Dimethyl Carbonate as additive in diesel fuel. Senthil et al [8] investigated the effect of 2 Ethoxy Ethyl Acetate as a blend component in compression engine and reported that the engine runs smoothly with emission level comparably lower than diesel.

In the present study, performance and emission characteristics of a single cylinder, four stroke, direct injection, compression ignition engine fuelled with diesel-cashew nut shell oil-2 Ethoxy Ethyl acetate blend was evaluated.

**Experimental setup:**

Experiments were carried out in a vertical, single cylinder, naturally aspirated, four stroke, constant speed, water cooled, direct injection diesel engine. The specification of the engine is shown in table 1. The engine was operated at a constant speed of 1500 rpm. The series of tests were carried out using Diesel and cashew nut shell oil blends.

**Table 1. Specification of Test Engine**

| | |
|---|---|
| Make & Model | Kirloskar AV-1 |
| Type | Single cylinder, four stroke, direct injection, water cooled |
| Power (kW) | 3.7 |
| Bore (mm) | 80 |
| Stroke (mm) | 110 |
| Speed (rpm) | 1500 |
| Dynamometer | Eddy current dynamometer |

**Results and Discussions:**

The variation of brake thermal efficiency with respect to load is shown in Fig 1. The brake thermal efficiency increases with increase in load. The brake thermal efficiency of the diesel-CNSO-EEA blend is slightly lower than the diesel in all the loads starting from no load to full load. This is due to poor mixture formation as a result of low volatility, higher viscosity and higher density of cashew nut shell oil than neat diesel fuel. At maximum load, the brake thermal efficiency of diesel-CNSO-EEA blend is 5.51% lower than diesel.

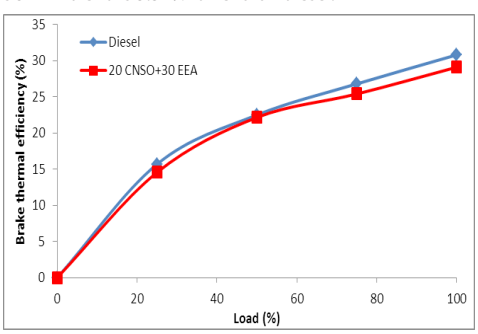


**Fig. 1 Brake thermal efficiency**

The variation of specific fuel consumption with respect to load is shown in Fig 2. The specific fuel consumption of the diesel-CNSO-EEA blend is slightly higher than that of diesel in higher loads. At maximum load, the specific fuel consumption of diesel-CNSO-EEA blend is 2.85% higher than neat diesel fuel.

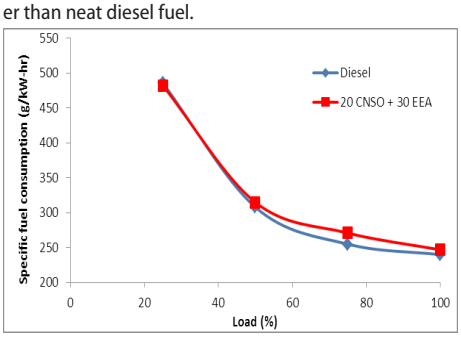


**Fig. 2 Specific fuel consumption**

The variation of exhaust gas temperature with respect to load is shown in Fig 3. The exhaust gas temperature increases with increase in load. The diesel-CNSO-EEA blend produces higher exhaust gas temperature than diesel because of oxygen content which enables the combustion process and hence the exhaust gas temperature is higher. At maximum load, the exhaust gas temperature of diesel-CNSO-EEA blend is 6.3% higher than neat diesel fuel.

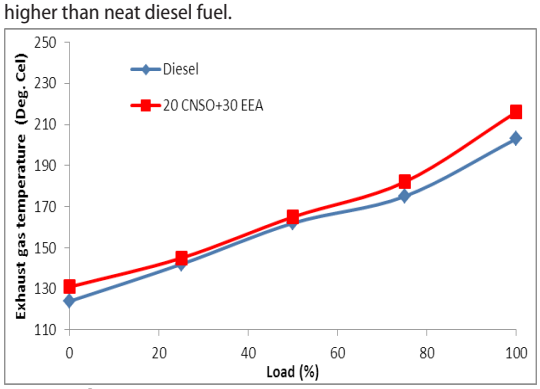


**Fig. 3 Exhaust gas temperature**

The variation of carbon monoxide emission (CO) with respect to load is shown in Fig 4. The CO emission increases with increase in load. The diesel-CNSO-EEA blend produces lower CO emission compared to diesel because of oxygen content which enables the combustion process and hence the CO emission is low. At maximum load, the CO emission of diesel-CNSO-EEA blend is 5.4% lower than neat diesel fuel.

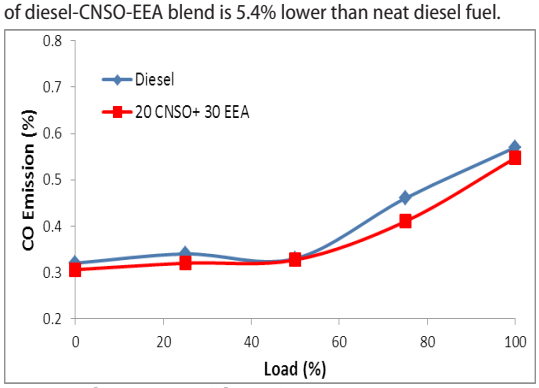


**Fig.4 Carbon monoxide emission**

Figure 5 shows the variation of unburnt hydrocarbon (HC) emission with respect to load. The unburned hydrocarbon emission increases with increase in load. The unburned hydrocarbon emission of diesel-CNSO-EEA blend is lower than neat diesel fuel. At maximum load, the HC emission of diesel-CNSO-EEA blend is 3.5% lower than neat diesel fuel.

The variation of oxides of nitrogen (NOx) emission with respect to load is shown in Fig 6. The NOx emission increases with increase in load. The diesel-CNSO-EEA blend produces higher NOx compared to diesel because of oxygen content which enables the combustion there by increasing the in-cylinder temperature and NOx emission. At maximum load, the NOx emission of diesel-CNSO-EEA blend is 4.84% higher than neat diesel fuel.

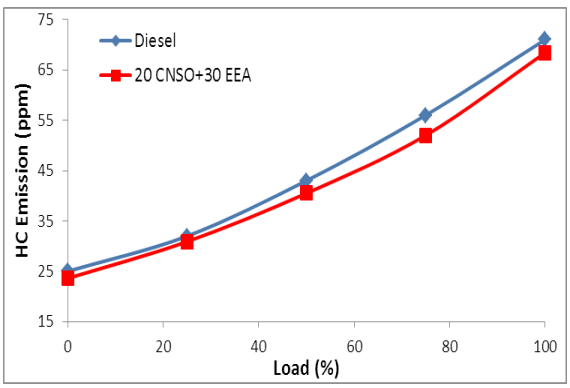


**Fig. 5 Unburned hydrocarbon emission**

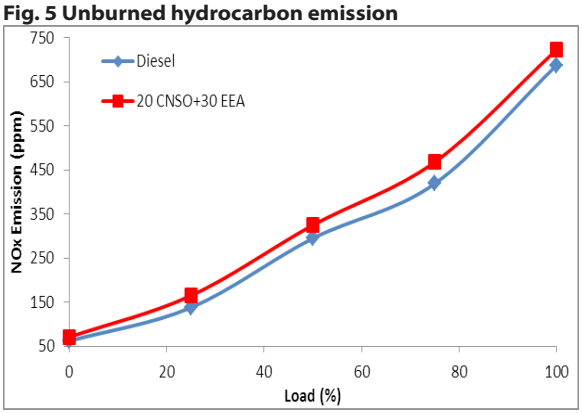


**Fig. 6 Oxides of nitrogen emission**

## Conclusion:

Experiments were conducted with single cylinder, four stroke, compression ignition diesel engine using diesel and diesel-cashew nut shell- 2 ethoxy ethyl acetate blend. From the above investigation, it was found that the diesel-cashew nut shell- 2 ethoxy ethyl acetate blend can run the engine without any modifications. The performance of the engine is acceptable and the emissions levels are lower than neat diesel fuel.

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