ISSN: 0974-2115
www.jchps.com Journal of Chemical and Pharmaceutical Sciences

Experimental investigation on performance and emissions of CI engine using neam/diesel blend

Shankar R*, Balaji G
Department of Mechanical Engineering, SRM University, Kattankulathur- 603 203
***Corresponding author: E-Mail: shankarrkjb1988@yahoo.com**

ABSTRACT

The main focus of the project is to make an experimental analysis using neem diesel blend as an alternative fuel source for diesel engine. In this experiment neem oil is blended with diesel fuel in various proportions on volume basis, 5, 10, 15 & 20 percent. Properties of each blend were assessed using proper measuring instruments. The experiment was carried out in single cylinder diesel engine at 1500 rpm for its performance and emission characteristics. Among various blends, D15N fuel profile provides similar results of diesel fuel but in a lower range in terms of thermal efficiency and fuel consumption and at the same time delivers good results in lower emission levels of hydrocarbon, carbon monoxide, and smoke emission.

KEY WORDS: Neem diesel blend, Engine Performance & emission.

1. INTRODUCTION

In the current trend, energy plays a major portion in the economy of each nation worldwide. Fossil fuel such as coal, oil, and natural gas contribute a major portion in the world's energy consumption (Sivalakshmi and Balusamy, 2013). At present, diesel engines slowly took a step ahead over petrol engines in the transportation sector due to their higher efficiency. Countries imported fossil fuels from other countries for their economic growth (Bo Zhang, 2016). Among the available options, biodiesel seems to be a promising solution for the fossil fuel crisis sustain in nation. Usage of vegetable oil in a diesel engine is an existing technology (Shehata, 2015).

For this study, Neem oil was procured from an authorized chemical shop. The main focus of this study is concentrated on the preparation of bio-fuel blends. Based on ASTM standards, the thermo physical properties namely density, kinematic viscosity, cetane number, calorific value and flash point were listed out (Avinash Kumar Agarwal and Rajamanoharan, 2009). As neem oil can be easily blended with diesel fuel, various blends, namely 5, 10, 15, 20 percent of neem is blended with diesel on volume basis were prepared (Dhinesh, et al., 2016). The core process of this study was to investigate and analyse performance characteristics, combustion parameters, and tailpipe emissions of diesel engine fuelled with various blends of neem oil bio-fuel (Hasan Alia, 2015).

2. MATERIAL & METHODS

Experimental setup: Production of Neem oil is simple & machinery involved was also readily available. Numerous methods namely solvent, enzymatic, etc., were available for extraction of oil from neem seeds. Annually, about 540,000 ton of seeds can be obtained from 1 hectare which will yield about 107,000 to foils and 425,000 to cake.

Blending of Neem oil with Diesel: Blending is the process of minimizing the concentration of solute in solution; usually it can be achieved by mixing with more solvent. Neem oils also can be mixed directly with diesel in order to check engine performance & emission characteristics. Results from 15% of neem oil blend with diesel fuel in diesel engine have provided good results. Using calibrated burette, Diesel and neem oil were blended and stored in separate containers. Sample of around 500 ml is taken for the analysis. Studies on blending various other non-edible oils with diesel fuel and testing in diesel engines have been carried out.

Table.1.Comparison of fuel properties of raw Neem oil & diesel fuel

Property	DF	NF
Density @15˚C (gm/cc)	0.830	0.930
Kinematic viscosity (cSt)	4	37.2
Calorific value (MJ/Kg)	45.4	38.2
Flash Pt (˚C)	165	240
Cetane index	45	38

Table.2.Properties of raw Neem oil & its blend

Property (NDB)	DF	D5N	D10N	D15N	D20N
Density @15˚C (gm/cc)	0.83	0.84	0.84	0.85	0.85
Kinematic viscosity (cSt)	4	3.1	3.5	3.8	4.3
Calorific value (MJ/Kg)	45.4	45.4	44.2	43.5	43.2
Flash Pt (˚C)	165	168	102	92	80
Cetane index	45	52	50	49	48

Engine setup:

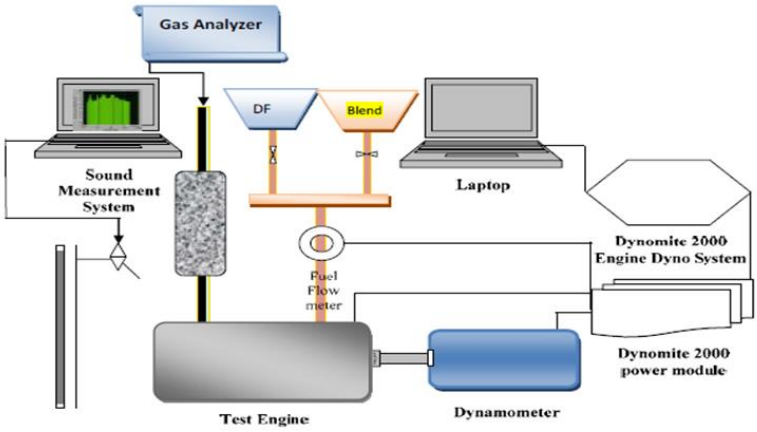

Fig.1. Schematic diagram of Engine Experimental setup

Test Procedure: Test conducted in CI engine with different percentage of neem and diesel blend. At each test brake thermal efficiency, BSFC, Ignition delay period, Exhaust gas temperature, HC, CO, Smoke emission were calculated through readings. For taking this readings gas analyzer, digital dynamometer was used.

3. RESULT AND DISCUSSION

Performance Analysis:

Brake Thermal Efficiency: Engine Brake thermal efficiency is defined as how efficiently the fuel is burnt inside the combustion chamber & gets transformed into useful work output. Parameters which play major role in brake thermal efficiency are kinematic viscosity, calorific value, cetane index and also oxygen content present in the fuel. From figure it is obvious that D15N blend lies closer to diesel compared with the other neem blends.

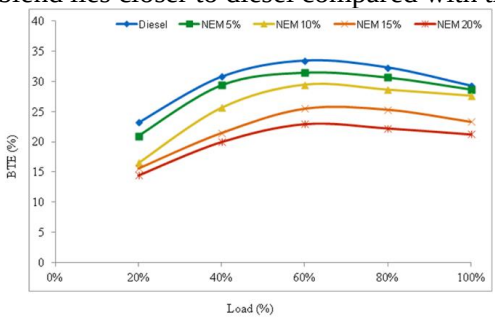

Figure.2. Variation of BTE with engine load

Brake Specific Fuel Consumption: With respect to the performance characteristics of diesel engine fuelled with diesel fuel blended with neem oil. It is defined as the ratio of obtained energy from fuel burnt per hour with respect to the brake power of the engine. In other words, Amount of energy consumption by the engine per kilowatt power in one hour. In part load and full load condition D15N blend results in increased fuel consumption. The figure clearly illustrates that ND blend gives results that lies closer to diesel fuel than other blends.

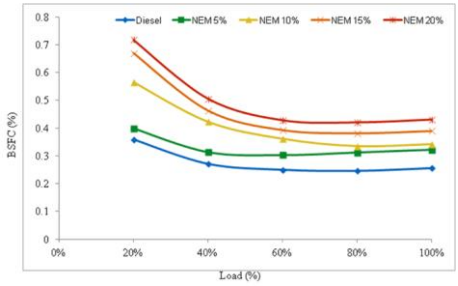

Figure.3.Variations of BSFC with engine load

Combustion Analysis:

Ignition Delay: Ignition delay is an important parameter to determine the ignition quality and the fuel knocking tendency. The time interval between the start of injection and the start of combustion defines the ignition delay period. Higher the fuel cetane number will ensure shorter ignition delay and better diffusion part of combustion as compared with premixed combustion. In general biodiesel has higher cetane number than the diesel and that is the case for Neem diesel blend.

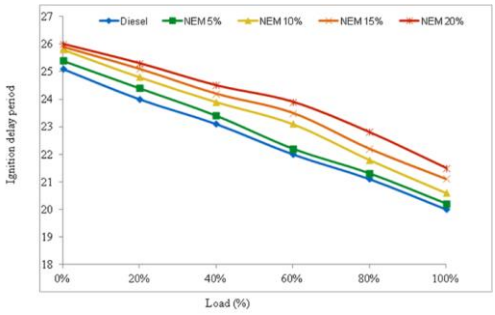

Figure.4. Variation of Ignition delay period with engine load

Exhaust Gas Temperature: It can be envisage that exhaust temperature decreases with increasing neem content. Low energy Potential of neem causes less combustion temperature. N15 having the lowest energy content. Blend results produces lower exhaust temperatures at all engine loads. Neem/diesel blends has latent heat of vaporization reduces the exhaust temperature.

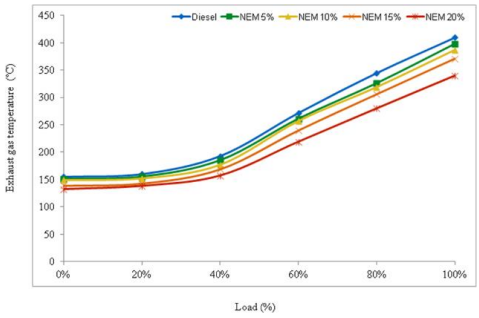

Figure.5.Variation of Exhaust gas temperature with engine load

Emission analysis:

Hydrocarbon monoxide: Hydrocarbon emission varies with respect to engine brake power based on blending percentage of neem oil & diesel fuel. From Fig.4 comparing to diesel fuel, neem oil and its blends emit lower hydrocarbon. This is due to oxygen presence in biofuel which enhances combustion and reduces the formation of hydrocarbon emission. As load increases, emission occurrence also gradually increases due to the presence of more fuel which need to be burned inside the combustion chamber. i.e., Air to fuel ratio is increased to maintain engine power output at higher load levels.

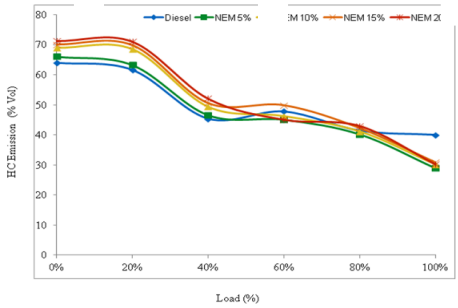

Figure.6. Variations of HC emission with engine load

Carbon Monoxide: Emission of carbon monoxide is due to the scarcity of oxygen in the combustion process though it is only an intermediate combustion product. To achieve complete combustion, carbon monoxide needs to be converted into carbon dioxide. From graph it is proven that diesel emits more carbon monoxide when compared with neem oil and its blends. It is due to scarcity of oxygen in diesel fuel and this deficiency is overcome by the oxygen atoms available in neem oil.

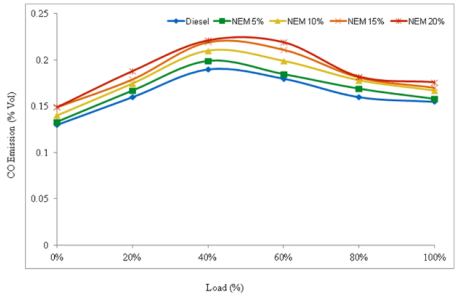

Figure.7. Variations of CO emission with engine load

Smoke Opacity: Smoke emission in diesel engine occurs due to unbalanced mixing of air and fuel ratio, i.e., insufficient air in the combustion zone. Fig. shows the smoke opacity varies with respect to the brake power of diesel fuel and neem blends. From the figure it is observed that neem and its blends in all load conditions causes increase in smoke emission as compared with diesel fuel. This result is observed due to the non-availability of aromatic compounds, lower level of C/H ratio and oxygen presence in biofuel enhance combustion level and contribute to the improvement in oxidation level of fuel. Blends results in higher emission of smoke opacity.

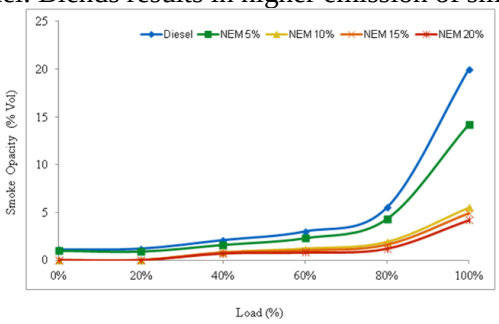

Figure.8.Variations of Smoke opacity with engine load

4. CONCLUSION

Vegetable oil like neem observed to have better fuel properties. During testing neem diesel blend, It is found that 15% blend provides better results. Major challenge is to reduce production cost low enough. Results proved that 15% blend can be operated in diesel engine without any modification made to the engine.

- Ignition delay gets longer for all neem/diesel blends.
- Brake thermal efficiency decreases for all neem/diesel blends.
- BSFC also decreased for neem/diesel blends.
- Smoke opacity not increased so much for 15% neem/diesel blends.
- 15% neem diesel blend content reduces smoke and NOx emissions.
- HC and CO emissions increased with neem/diesel blends.

REFERENCES

Avinash Kumar Agarwal, Rajamanoharan K, Experimental investigations of performance and emissions of Karanja oil and its blends in a single cylinder agricultural diesel engine, Applied Energy, 86, 2009, 106–112.

Bo Zhang, Changwei Ji, Shuofeng Wang, Performance of a hydrogen-enriched ethanol engine at unthrottled and lean conditions, Energy Conversion and Management, 114, 2016, 68–74.

Dhinesh B, Isaac Joshua J, Ramesh Lalvani, Parthasarathy M, Annamalai, An assessment on performance, emission and combustion characteristics of single cylinder diesel engine powered by Cymbopogon flexuosus biofuel, Energy Conversion and Management, 117, 2016, 466–474.

Hasan Alia Md., Mohammad Mashed**,** Md. Rowsonozzaman Rubelb Md., Rakibul Hossain Ahmadb, Biodiesel from Neem oil as an alternative fuel for Diesel engine, Procedia Engineering, 56, 2013, 625 – 630.

Shehata M.S, Ali M.A. Attia, Abdel Razek S.M, Corn and soybean biodiesel blends as alternative fuels for diesel engine at different injection pressures, Fuel, 161, 2015, 49–58.

Sivalakshmi S, Balusamy T, Effect of biodiesel and its blends with diethyl ether on the combustion, Performance and emissions from a diesel engine, Fuel, 106, 2013, 106–110.