EXPERIMENTAL ANALYSIS ON 4 – STROKE SINGLE CYLINDER DIESEL ENGINE BLENDED WITH NEEM OIL AND NANO POWDER

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Abstract:

As the energy consumption increases day by day and also due to the scarcity of conventional fuels, the crude oil price was going up day to day and there will be no more conventional fuels in future and also increasing the environmental pollution by the usage of crude oils there is a need for the search of alternative fuel sources for the automobile applications. There are many alternate fuels we already existing like bio-diesel, bio-mass, alcoholic fuels, hydrogen, non-fossil methane and non-fossil gases (like LPG, CNG) and other bio-mass sources which were useful for different applications, out of these bio-diesels are one of the prominent alternative fuel for diesel engines.

Therefore in the present investigation the oil taken is the neem oil which was obtained by the neem plants.

After finding the optimum blend in the third stage the test to be conducted again on the engine to find out the performance and emission parameters by adding nano powder to the optimum blend. The main purpose of adding the nano powder is to know ignition and brake thermal efficiency along with emission parameters. Finally the performance parameters and emission parameters obtained by the above tests are compared with the optimum blend.

Key Words: Diesel engine , Neem oil,ceo$_2$ nano powder, blending, performance

I. INTRODUCTION:

Now a day's neem plants are available everywhere in our daily life. The seeds obtained from neem plants are collected. The first step in obtaining oil from neem for Bio-diesel is to remove the seed-coat and husk in a process referred to as De-hulling. Once the nuts are cracked, the oil-bearing seeds are cleaned and dried. Seed cleaning involves the removal of the seed coat and the separation of the chaff. Seed drying can be done by placing the seeds under the sun or by heating carefully on the fire for a short while. Once this is done, the next step is to begin the crucial extraction process. Trans-esterification reaction is the transformation of an ester, a triglyceride (vegetable oil) into another ester in the presence of acid or base as a catalyst. In the production of biodiesel, the products are mixtures of fatty esters (biodiesel) and glycerol.

Fig:1: Different stages of seeds

[Sk.Mohammad Younus and et.al]. Due to the scarcity of conventional fuels and the crude oil, the price was going up day to day and there will be no more conventional fuels in future and also increasing the environmental pollution by the usage of crude oils, there is a need for the search of alternative fuel sources for the automobile applications. Therefore in the present investigation the oil taken is the tyre pyrolysis **oil** which was obtained by the pyrolysis of the waste automobile tyres.

[Zannatul Moiet Hasib and et. al]. This paper represents the prospect of mustard oil as a renewable and alternative fuel. To cope up with present load-shedding situation and to reduce the dependency on imported fuel, Bangladesh government is encouraging the use of renewable energy sources. Since dieselengines have versatile uses including small irrigation pumping systems, and standby small electricity generators, use of diesel fuel is much higher than any other gasoline fuels. In Bangladesh mustard oil has been in use as edible oil throughout the country.

[Babita Singh and et. al]. Due to scarcity of crude oil price and increase in the environmental pollution there is a necessity to search for alternative fuels for internal combustion engines. In this investigation a 1:1 ratio mixture of waste frying oil and castor oil was used as a raw material in pyrolysis process. The pyrolysis oil obtained was then blended with diesel fuel at different ratios and the different blends were used as fuels in a diesel engine.

II. DIESEL ENGINE:

The fig shows 4- stroke single cylinder diesel engine

Fig 2. Overview of an engine

Table: 1. Engine Specifications:

ENGINE	FOUR STROKE SINGLE CYLINDER
MAKE	KIRLOSKAR
FUEL	DIESEL
BORE	87.5 mm
STROKE LENGTH	110 mm
STARTING	CRANKING
WORKING CYCLE	FOUR STROKE
METHOD OF COOLING	WATER COOLED
METHOD OF IGNITION	COMPRESSION IGNITION

III. FUEL PREPARATION:

Fig 3 : Blending of fuel

Table: 2. Oil Mix Proportions

Notation	Fuel Quantity (ml)	Bio-Diesel Quantity(ml)	Diesel Quantity (ml)
N10	500	50	450
N20	500	100	400
N30	500	150	350

IV. PROPERTIES OF FUEL:

A. Viscosity:

The viscosity of different fuel blends are found by using Red Wood viscometer-I

Table: 3.Viscosity of different oils:

S.No	Name of Fuel	Viscosity(stokes)
1	Diesel	0.08
2	Neem oil	0.10
3	N10	0.09
4	N20	0.104
5	N30	0.11

Fig 3 shows types of blended oils

Fig 4. Different Blended oils:

B. Flash point and Fire Point:

The flash points and fire points of different blended oils can be found out by using pen sky marten's flash and fire point apparatus.

Table: 4. Flash and Fire Points of Different Oils:

Name of fuel	Flash point(˚c)	Fire point(˚c)
Diesel	40	55
B10neem oil	50	65
B20 neem oil	55	70
B30 neem oil	65	80

C. Calorific Value:

The calorific values of different blended oils are obtained by using Bomb Calorimeter.

Table: 5. Calorific Values of Different Oils:

Name of fuel	Calorific value(MJ/kg)
Diesel	42.50
B10neem oil	41.90
B20 neem oil	41.23
B30 neem oil	41.89

D. WORKING:

The four stroke diesel (CI) engine operates on diesel cycle. The piston reciprocates inside the cylinder, which is connected to the crankshaft by connecting rod. The valves operated by means of cams and push rods. Water is circulated through the provision made around the cylinder called engine cooling water jackets for cooling purpose. The four strokes taking place are mainly suction, compression, expansion (power stroke) and exhaust strokes.

The dynamometer is fixed to the engine flywheel and are mounted on a M.S channel frame and further mounted on vibro mounts. Panel board is used to fix burette with a three way lock, digital temperature indicator with selector switch, digital RPM indicator and U-tube manometer.

1. Digital temperature indicator to measure different temperatures sensed by respective thermocouples.
2. Digital RPM indicator to measure the speed of the engine.
3. A manifold burette is provided to measure the rate of fuel consumed while running the engine.
4. Hart ridge smoke meter is provided to measure the smoke density at different loading conditions.
5. Exhaust gas or multi gas analyzer is provided to measure the exhaust emissions.

Fig 5: Smoke meter

Fig 6: Exhaust gas Analyzer

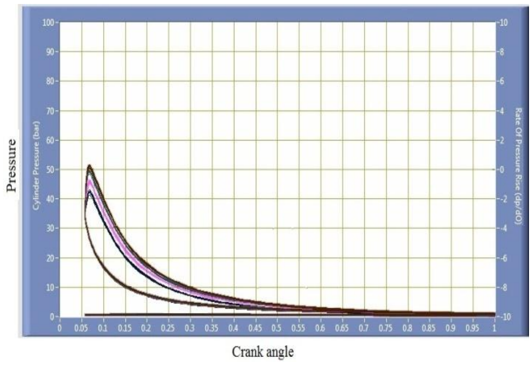

Fig 7. Crank angle vs Pressure at different loads

These graphs are obtained from IC engine Combustion Software when the engine is connected to computer and also when the engine is in running condition.

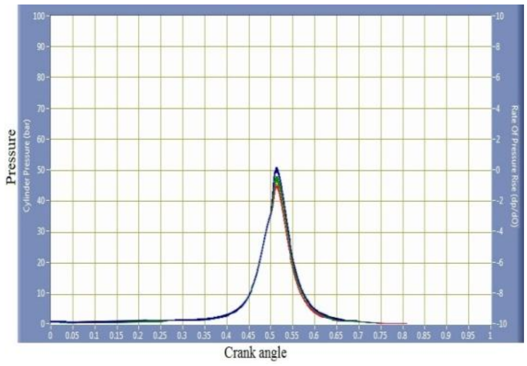

Fig 8. Crank angle vs Pressure at different loads

V. PERFORMANCE CURVES:

The performance and emission characteristics of a high speed diesel engine at various loads from no load to full load fueled with neem oil and its diesel blends with additive like nano particles discussed below as per the results obtained.

A. Mechanical Efficiency:

Engine is made to run at constant speed 1500 r.p.m. By using different oil blends the load on the engine is gradually increased manually .At every load and for every blend time taken for fuel consumption is noted. The indicated power is obtained by drawing a graph between BP and Mfc. With this the η_{mech} is obtained. The below graph is drawn by taking Bp on X-axis and η_{mech} on Y-axis

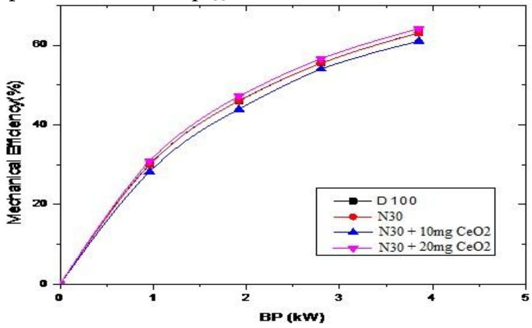

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Fig.9. Brake power vs Mechanical efficiency

The performance characteristics of different blended oils are obtained by performing the experiment at different loads .With that values different graphs are drawn .From that graphs it is observed that N30 is h aving highest performance .To this N30 oil blend we added 10mg cerium oxide nano powder and 20mg cerium oxide nano powder and again the performance test is conducted.

B. Volumetric Efficiency:

Here the Volume of air actually entering at different loads and at different blends are noted by making the engine to rotate at constant speed.Swept volume remains constant as the engine is at constant speed.The below graph is drawn for comparing the amount the amount of air entered for different brake powers.

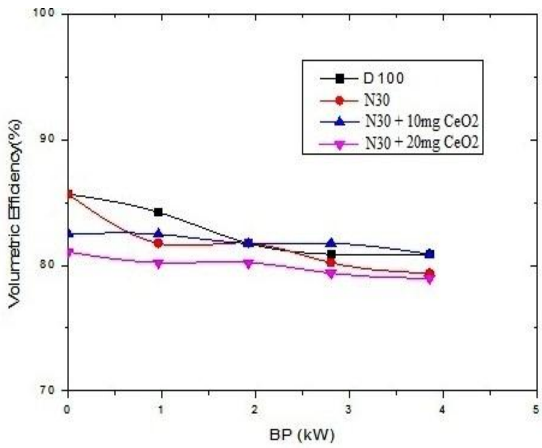

Fig.10. Brake power vs Volumetric efficiency

C. Smoke Density:

Here the engine exhaust system system is connected to smoke meter for obtaining the smoke density in exhaust gases at different loads and at different blends.A graph is drawn by taking BP on X-axis and Smoke density on Y-axis.With this graph we can get the Max. smoke density .

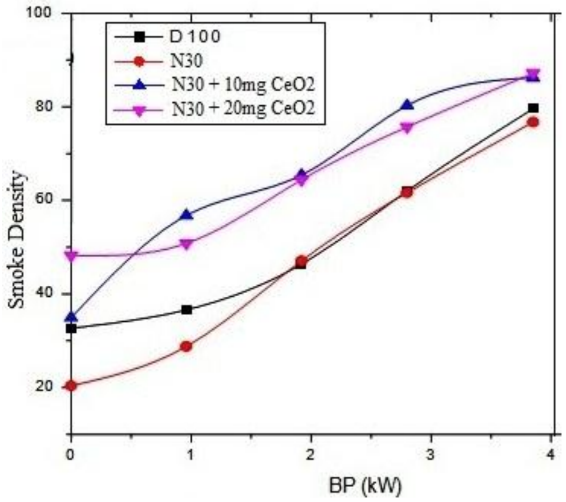

Fig.11. Brake power vs Smoke density

D. Unused Oxygen:

Here the engine exhaust system system is connected to Exhaust Gas Analyser for obtaining the % of O_2 in exhaust gases at different loads and at different blends.A graph is drawn by taking BP on X-axis and % of O_2 on Y-axis.With this graph we can get the information on % of O_2.

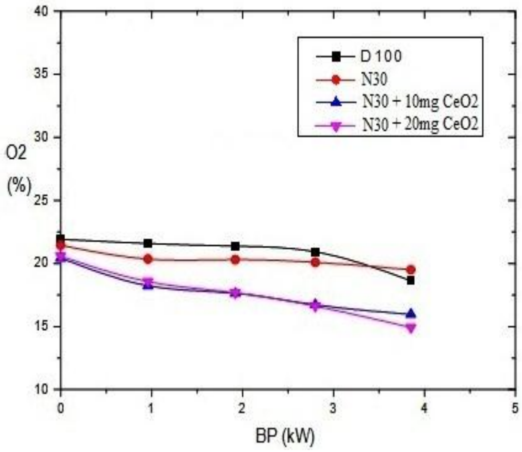

Fig.12. Brake power vs unused oxygen

E. Nitrous Oxide:

Here the engine exhaust system system is connected to Exhaust Gas Analyser for obtaining the NO_x in exhaust gases at different loads and at different blends.A graph is drawn by taking BP on X-axis and NO_x on Y-axis.With this graph we can get the information on NO_x.

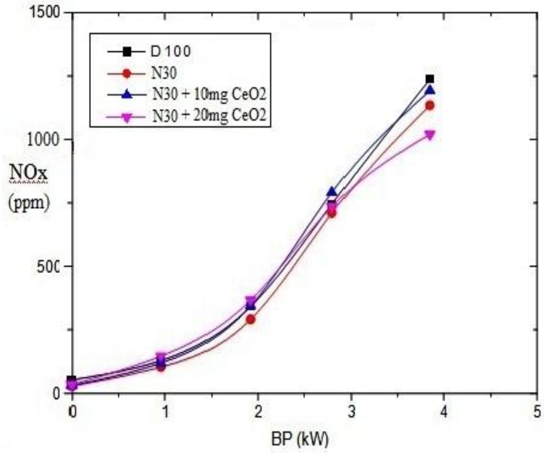

Fig.13. Brake power vs NO_X

F. Carbon Monoxide:

Here the engine exhaust system system is connected to Exhaust Gas Analyser for obtaining the % of CO in exhaust gases at different loads and at different blends.A graph is drawn by taking BP on X-axis and CO on Y-axis.With this graph we can get the information on CO.

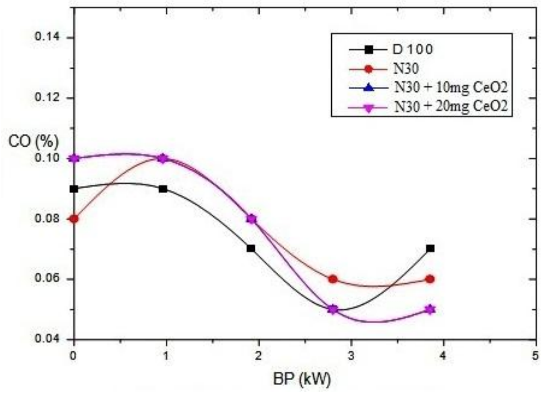

Fig.14. Brake power vs Carbon monoxide

VI. CONCLUSIONS:

The experimental tests are conducted on 4-stroke, single cylinder, water cooled and direct injection diesel engine by using Neem oil blends of N10, N20 and N30 pure diesel at constant speed of 1500 rpm. From the first set of results it can be conclude that the blend N30 has given the better performance in the sense of brake thermal efficiency, specific fuel consumption and emission parameters. No engine seizing, injector blocking was found during the entire operation while the engine running with different blends of neem oil and diesel. So N30 can be used as alternative fuel and we can save 20% of diesel that we are importing and increase the economy. In the second stage again the test is conducted on the engine by taking the blend N30 along with the addition of Nano Powder of CeO_2 in the quantity of 10mg (N30+10mg of CeO_2), 20mg (N30+20mg of CeO_2) at the same operating conditions. Among these two compositions the one (N30+20mg of CeO_2) has given the better performance in the following parameters.

From the above discussion it can be concluded that the neem oil can be used as an alternative fuel in diesel engines with the addition of nano powder CeO_2 operating without any modifications of engine.

VII. REFERENCES:

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