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# Investigation of Emission Characteristics of Stationary C.I. Engine Fueled With Biodiesel

Prof. Bhojraj N. Kale[1], Er. Shubhangi B. Kale[2] Prof. Kamaljeet A. Sikdar[3], Prof.Satish G. Sonwane[4]
Asst. Professor, Mechanical Department, DBACER, Nagpur, India [1, 4]
Asst. Professor Mechanical Department, SSCET, Bradrawati, India [3]
Dy. Executive Engineer, MSETCL, Nagpur, India [2]

*Abstract* – **Increasing oil prices and global warming activates the research and development of substitute energy resources to maintain economic development. Due to gradual depletion of world petroleum reserves and the impact of environmental pollution, there is an urgent need for suitable alternate fuel for use in diesel engines. The resources of alternative energy are environment friendly but they require to be explored on different situations for their advantages, disadvantages and specific application. Thus this experiment was performed to investigate the emission characteristics of stationary diesel engine fuelled with chicken fat oil blended with petroleum diesel. The outcomes under various parameters were believed to be close to that of diesel fuel only.**

*Keywords:* **Stationary CI Engine, Emission Characteristics, CO, NOx**.

## I. INTRODUCTION

Diesel engines are widely used in more or less every walk of life these days like transport, agriculture, industrial sectors etc. It is commonly used due to higher efficiency and easy operation. Fast diminishing fossil fuels has forced the researcher across the world to search alternative substitute of diesel or to reduce the consumption of fossil diesel. Biodiesel is used in compression ignition (diesel) engines to enhance engine combustion performance, improve engine lubrication and reduce air and water pollution caused by the exhaust.

Biodiesel is clean burning alternative fuel produced from domestic, renewable resources. It has potential to take the position of fossil diesel. The biodiesel fuel properties are very near to petrol diesel. Further biodiesel has slightly lower energy content than diesel but it can be utilized neat or its blend with diesel without appreciable engine modification. High oil viscosity is seriously constrained to replace the diesel which causes longer ignition lag, incomplete combustion, poor fuel atomization and carbon deposits on the injector and valve seats. The resources of alternative energy are environmental friendly but they require to be explored on different situations for their advantages, disadvantages and specific application. Due to continuous exhaustion of world natural petroleum storages and the effect of environmental pollution, there is an immediate requirement of proper substitution of fuels for use in diesel engines and this experiment is a little contribution in this direction.

It is necessary to consider diesel‟s characteristics to auto ignite, which is quantified by fuel‟s cetane number, where higher cetane number indicates quick or fast auto ignition. Cetane number for diesel ranges from 40 to 52 while that of kerosene is around 49. The cetane number of fuel indicates the auto ignition capability of the fuel and has a direct effect on delay in ignition. For shorter ignition delay, cetane number must be high and vice versa. The high cetane number of the fuel ensures early and smooth ignition and combustion of fuel. Since these properties are comparable to a blend of diesel with Chicken Fat oil, this blend can be used in the engine.

The major aim of this experimental work is to find out the effect of Chicken Fat oil blend on diesel engine emission and further this work may be extended. Each emission is drawn and compared with diesel and explained as per the plot obtained.

The properties of chicken fat oil as given in following table

Table 1: Properties of Chicken Fat Oil

| SN | Property | Ref. Std. ASTM 6751 | REFERNCE | | DIESEL | Chicken Fat Oil Biodiesel Blend | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Unit | Limit | B100% | B6% | B12% | B18% | B24% | B30 % | B36 % |
| 1 | Density | D1448 | gm/cc | 0.800-0.900 | 0.832 | 0.833 | 0.834 | 0.836 | 0.837 | 0.838 | 0.840 |
| 2 | Calorific Value | D6751 | MJ/ Kg | 34-45 | 42.50 | 42.40 | 42.22 | 42.09 | 41.90 | 41.77 | 41.55 |
| 3 | Cetane No. | D613 | - | 41-55 | 49.00 | 49.45 | 49.73 | 49.90 | 50.13 | 50.29 | 50.51 |
| 4 | Viscosity | D445 | $mm^2$ /sec | 3-6 | 2.700 | - | - | - | 2.96 | - | - |
| 5 | Flash Point | D93 | $^0C$ | - | 64 | 67 | 76 | 86 | 95 | 102 | 107 |
| 6 | Fire Point | D93 | $^0C$ | - | 71 | - | - | - | 102.0 | - | - |

## II. TEST SET UP

The experiment was conducted in a single cylinder four stroke diesel engine available in the college. The setup consists of single cylinder, four stroke VCR (Variable Compression Ratio) Diesel engine connected to eddy current type dynamometer for loading. The setup has stand- alone panel box consisting of air box, two fuel tanks for duel fuel test, manometer, fuel measuring unit, transmitters for air and fuel flow measurements, process indicator and engine indicator. Rota

meters are provided for cooling water and calorimeter water flow measurement. The schematic arrangements of the test engine along with its specification are provided in the following table.

Table 2: Specification of Test Setup

| Engine Type | Make Kirloskar AK234 | Rated Power | 3.5 kW at 1500 RPM |
|---|---|---|---|
| Stroke Length of Piston | 110 mm | Engine Capacity | 553cc |
| No. of Cylinder | 1 | Compression Ratio | 17.5 |
| No. of Stroke | 4 | Variable CR Range | 12.5 to 17.5 |
| Type of cooling | Water cooled | Orifice diameter | 20 mm |

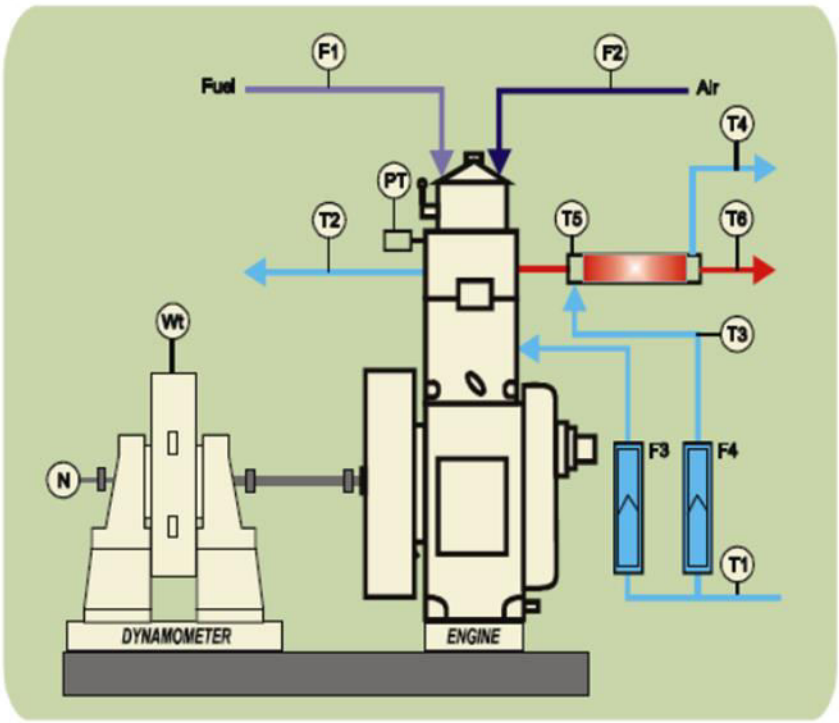



Fig 1. Line Diagram Experimental Test Setup

## III. PROCEDURE

Give the necessary electrical connections to the panel. Check the lubricating oil level in the engine. Check the fuel level in the tank. Allow the water to flow to the engine and the calorimeter and adjust the flow rate to 250-300 lpm and 175-200 lpm respectively. Release the load if any on the dynamometer. Open the three way cock so that the fuel flows to the engine. Start the engine by cranking. Allow to attain the steady state. Note the reading and repeat the experiment for different loads. After the completion, release the load and then switch off the engine. Allow

the water to flow for few minutes and then turn it off. Repeat the experiment by using biodiesel as fuel and analyze the Emission characteristic of the stationary CI engine by using MARS Five gas analyzer

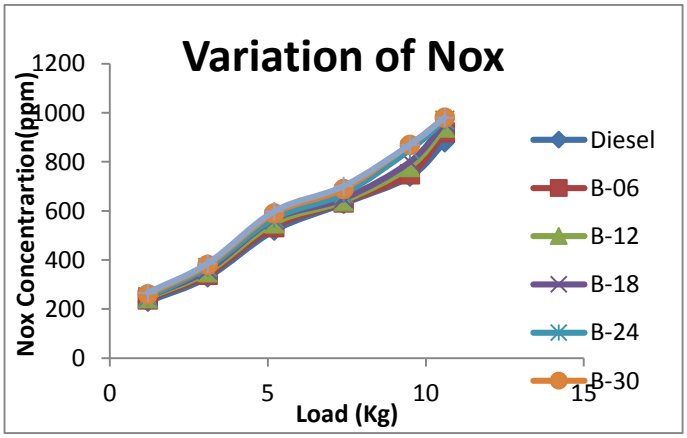

Fig 2. Five Gas Analyzer Line

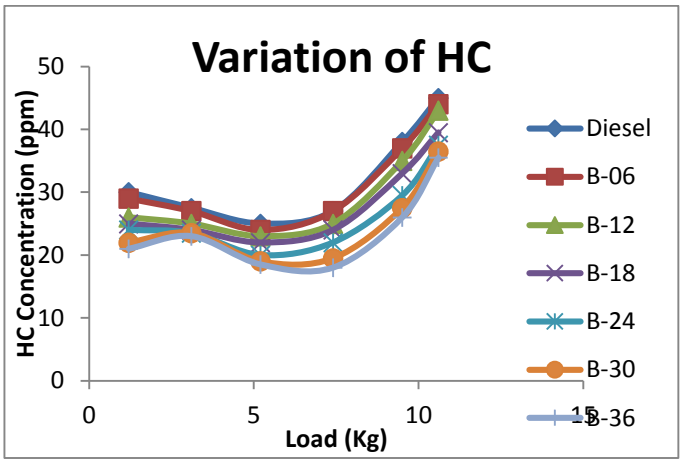
Table 3: Technical Specifications of Five Gas Analyzer

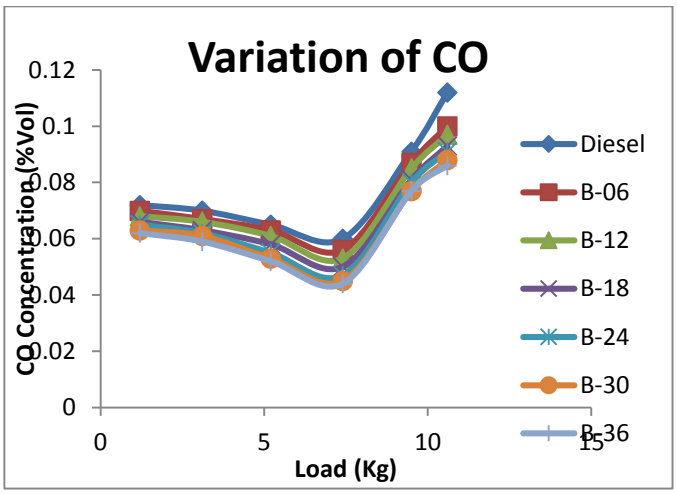
| Measurement | Range | Resolution |
|---|---|---|
| CO | 0-9.99 % Vol | 0.001% Vol |
| HC (Propane) | 0-15000 ppm | 1 ppm |
| CO2 | 0-20% Vol | 0.01% Vol |
| O2 | 0-25% Vol | 0.1% Vol |
| Nox | 0-5000 ppm | 1 ppm Vol |
| Engine RPM | 500-600 rpm | 1 rpm |
| Oil Temperature | 0-150C | 1 |
| Lambda | 0.200-2.000% | 0.001 |

## IV. RESULT

The experimental analysis on four stroke single cylinder diesel engine attached with eddy current dynamometer with various blends of chicken fat oil blended with diesel at different load conditions was performed and following results were concluded.






## V. CONCLUSION

From the above graph it can be concluded that the emission results of chicken fat oil biodiesel is coinsiding with the results of petroleum diesel. Among the entire chicken fat oil biodiesel blend, the results of B06% are merely similar to that of diesel, so it can be used as fuel for stationary CI Engine. This will encourage the researcher to find out more easier and simple way to use biodiesel blends in CI Engine as a fuel without any major modification.

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## AUTHOR(S) BIOGRAPHY

Bhojraj N. Kale is working as an Assistant Professor in Department of Mechanical Engineering at Dr. Babasaheb Ambedkar College of Engineering & Research Nagpur. He is in teaching field from last 12 years. He had guided 15(fifteen) Post Graduates projects, 07 under Graduates projects and 03 diploma projects. He had published 27 papers in Peer Reviewed International Journal of good repute. He also presented more than 25 papers in International & National Conferences. His working area is CI Engines, Renewable Energy Sources and Heat Transfer. He also organized STTP/WS for Faculty members as ell as PG/UG Students. He fetch a research grant for in-house minor project from Meghe Group of Institutions Nagpur. (MGI, Nagpur).