EXPERIMENTAL INVESTIGATION OF SECOND-GENERATION BIODIESEL AND ESTIMATING ITS PERFORMANCE CHARACTERISTICS ON DIRECT INJECTION DIESEL ENGINE

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Abstract: - Nowadays environmental air pollution is one of the major concerns prevailing due to rapid increase in industrialization, increase in transportation, agricultural equipment's. Fossils fuels are the most predominant source for running the engines, since these fuels generate high efficiency and results in better engine performance. However, due to the increase in population, the demand for the fossil fuels increased as there is rise in usage of transportation. Which automatically increased the environmental air pollution resulting in adverse effects on human health and scarcity of the fuel. Biodiesel fuels with four generations stood as an eye-catching option to overcome the problems associated. In this project, second generation biodiesel is opted to investigate the performance characteristics of the engine. For this, initially the raw oil is converted using transesterification process and converted into biodiesel using transesterification process using homogeneous catalyst. The obtained second generation biodiesel is tested on the engine to estimate the performance characteristics of the engine

Key Words: *Neem Oil, Transesterification, Biodiesel, Engine Performance.*

1. INTRODUCTION

Due to a significant rise There is a large demand for petroleum products right now due to the increase in cars on the road and the depletion of global oil supplies. This has led the world to explore alternative sources of energy due to an increase in energy demand over the past two decades. India, as a developing nation, is looking to produce bio-diesel from non-edible oils that can be grown extensively in the country's wasteland. Carbon monoxide (CO), hydrocarbons (HC), and particulate matter (PM) emissions from vehicle exhaust have all decreased as a result of the use of biodiesel. Waste. Concrete can be recycled and used in road construction and as a base material for new construction projects.

Biodiesel presents a capable substitute for traditional diesel oil. Given that they are renewable and share many of the same characteristics as diesel, vegetable oils are a promising replacement for it. Vegetable oils have been extensively researched for use in diesel engines, which have produced about the same power output but with a little reduction in thermal efficiency. With the growing concern for environmental protection and increasingly strict exhaust gas recirculation regulations, reducing engine emissions has become a critical aspect of engine development research. Biodiesel made from Neem, Jatropha, Karanja, sunflower, rapeseed, and other popular sources are currently being considered as substitutes for diesel.

1.1 DETAILED SPECIFICATION OF NEEM OIL

Neem oil is a natural oil derived from the seeds of the neem tree (Azadirachta indica), which is native to the Indian subcontinent. It has been used for centuries in traditional medicine, agriculture, and personal care products due to its various beneficial properties. Here is a detailed specification of neem oil:

Appearance: Neem oil is usually yellowish-brown to dark brown in color. It has a relatively thick consistency and a strong, pungent odor.

Composition: Neem oil contains a wide range of active compounds, including triglycerides, triterpenoids, limonoids, sterols, and fatty acids. The most prominent active compound is azadirachtin, which is responsible for many of its insecticidal properties.

Insecticidal Properties: Neem oil is well-known for its insect-repellent and insecticidal properties. It acts as a potent natural pesticide, deterring and killing various pests such as aphids, mites, whiteflies, mealybugs, and scale insects. Azadirachtin disrupts the feeding, growth, and reproductive processes of insects, thereby inhibiting their development and population growth. Recycling C&D waste reduces landfill waste, preserves natural resources, and mitigates environmental impacts such as greenhouse gas emissions, air pollution, and water pollution. Recycling also brings economic benefits by creating jobs, providing raw materials, and reducing waste disposal costs. Overall, recycling C&D waste promotes sustainability, conserves resources, reduces waste, and stimulates economic growth.

2. BIOFUELS

Energy sources known as biofuels are created from recently generated biomass (plant or animal materials). Although coal and petroleum have been the main energy sources for many years because of their high energy content, abundance, and low cost, biofuels have been around for a while. Although fossil fuels like coal and petroleum also originate from biomass, they vary in that they take millions of years to develop. Due to rising energy costs, depleting fossil fuel supplies, the need for a dependable, renewable source of energy, and as a strategy to combat climate change, biofuels are experiencing a renaissance. Due to their ongoing replenishment, biofuels are a renewable resource. Fossil fuels, on the other hand, cannot be replenished because they need millions of years to form.

The diesel fuel known as "biodiesel," which is produced from either plants or animals, is made up of long-chain fatty acid esters. In order to produce a methyl, ethyl, or propyl ester, lipids like animal fat (tallow), soybean oil, or any other vegetable oil are chemically combined with an alcohol.

Biodiesel is a drop-in biofuel, which means it works with existing diesel engines and distribution networks, unlike the vegetable and waste oils used to power converted diesel engines. You can use biodiesel alone or in combination with petroleum fuel at any time.A heating oil substitute is biodiesel blends. The "biodiesel" a word is referred to as a mono-alkyl ester by the US National Biodiesel Board.

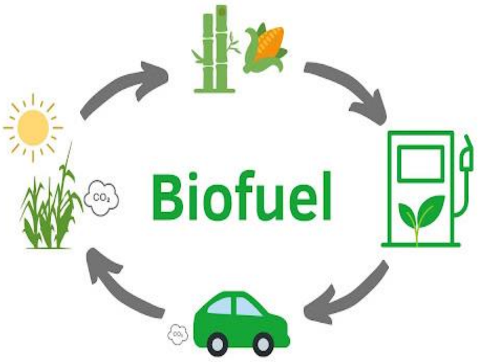

Fig 1 – BIO FUEL

3.Materials and Methods:

3.1 :- **Material**

The following tools and materials are used to make biodiesel: a thermometer, a retort stand, a pipette, a measuring cylinder, a separating funnel, a magnetic stirrer, feed stock, a conical flask, drying equipment, a storage tank, a stopwatch, a hot plate, a catalyst, methanol, and neem oil.

3.2 **Method**

3.2.1 **Transesterification Process:**

The process used to produce biodiesel is broken down into steps below.

Step 1: Weigh the neem oil and methanol in the ratio of 1:3. For example, 100 grams of neem oil, need 300 grams of methanol.

Step 2: Mix the neem oil and methanol in a glass beaker or flask.

Step 3: Add the catalyst (sodium hydroxide or potassium hydroxide) to the mixture. The amount of catalyst needed will depend on the quality of the oil and the amount of methanol used. Typically, 0.5% to 1% of the weight of the oil is used.

Step 4: Stir the mixture vigorously using a stirring rod until the catalyst is completely dissolved.

Step 5: Heat the mixture to a temperature of around 60-70°C, depending on the catalyst used. Use a thermometer to monitor the temperature and make sure it does not exceed 60°C.

Step 6: Continue stirring the mixture for about 1-2 hours, or until the reaction is complete. The mixture will start to turn cloudy as the glycerol separates from the esters.

Step 7 : The lower layer, which is made up of glycerol and soap, was then collected from the bottom of the separating funnel while the biodiesel was put into a separate beaker.

Step 8 : The biodiesel was then washed with warm water to remove any leftover glycerol and soap from the funnel. This was carried out up until the biodiesel in the separating funnel could be seen below the clear water.

Step 9 : After being rinsed, the sample was dried by being placed on a hot plate, and any remaining water in the biodiesel was drained.

Step 10: Transfer the biodiesel to a clean container and wash it with distilled water to remove any remaining impurities.

Step 11: Let the biodiesel dry for a few hours, then it will be ready to use.

FIG 2: PREPARATION OF METHOXIDE

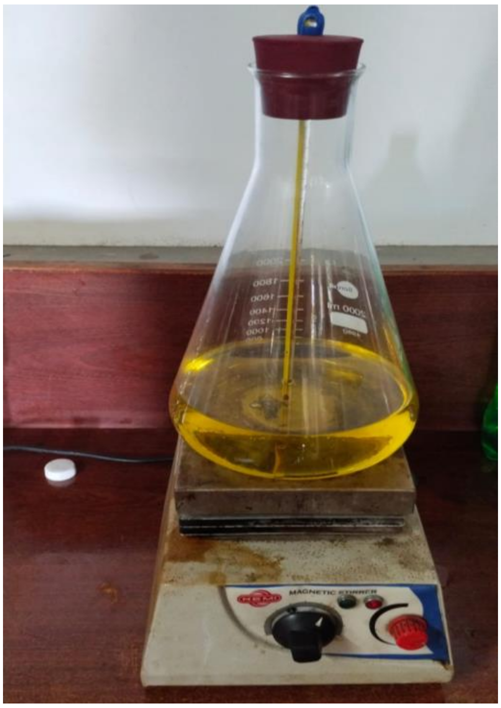

Fig 3: Neem Biodiesel

4. Performance Characteristics of Engine:

4.1 Experimental Setup

The current experiment made use of a single-cylinder, four-stroke, water-cooled, VCR, direct injection vertical diesel engine. Lab View-based software for engine performance analysis. The engine is running at its maximum rated speed of 1500 rpm. Before beginning the experiments, the engine sump tank was filled with fresh lubricating oil. For loading, the engine is coupled to an eddy current type dynamometer. Without stopping the engine or altering the combustion chamber geometry, the compression ratio may be modified by employing a specially designed tilting cylinder block arrangement.

displays the conceptual diagram of the experiment's setup. The table below contains the engine's technical specifications. The setup includes a stand-alone panel box with an air box, fuel tank for a dual fuel test (using neem biodiesel and diesel), manometer, fuel measurement device, transmitters for detecting the flow of both air and fuel, process indicator, and engine indication.

Neem oil was acquired from the India Mart for this project. The obtained raw oil cannot be used in the diesel engine that is currently in use. and at Raghu Engineering College's thermal engineering lab, the conversion to biodiesel was carried out (A). Thus, algae oil is transformed into algae biodiesel by the transesterification process.

Diverse blends of algal biodiesel and mineral diesel fuel were made and tested on the engine at N BD5, N B10, N B15, and N B20. There are made a number of mixtures with various concentrations. Diesel is used to start the engine, then after it warms up, algae biodiesel oil is used instead. A set of readings is collected for 5%, 10%, 15%, and 20% (Neem biodiesel oil), and another set of readings is recorded for the operation of the engine in diesel fuel mode. The engine is started at no load at CR of 16, and the **load is varied from idle to rated load in a number of steps. The table below displays the notations for Neem oil and diesel:**

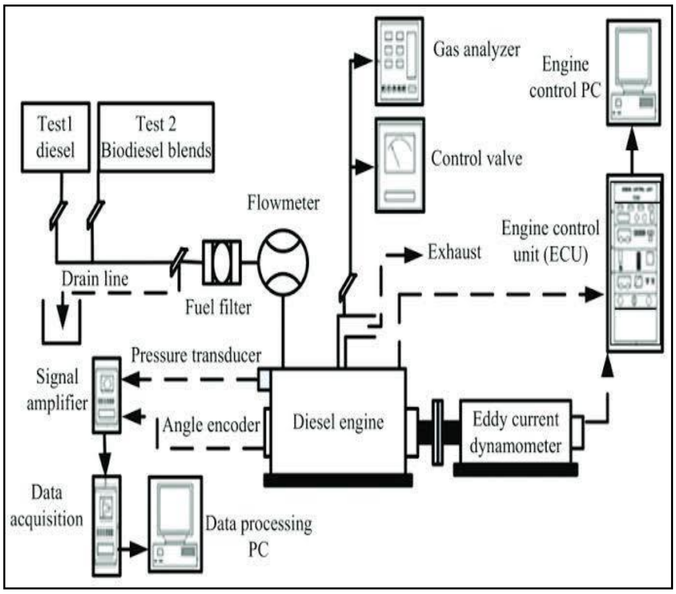

Fig 4: EXPERIMENTAL ENGINE SET UP

TABLE 1 : NOTATIONS OF DIESEL AND NEEM BIODIESEL BLENDS

Notation	Parameters
DF	Diesel Fuel
N B5	Neem B5
N B10	Neem B5
N B15	Neem B5
N B20	Neem B5

TABLE 2: ENGINE SPECIFICATIONS

S.NO	FEATURES	SPECIFICATIONS
1	Make	KIRLOSKAR DIESEL ENGINE
2	Type	Four Stroke Water Cooled
3	No Of Cylinders	One
4	Combustion	Compression Ignition
5	Max Speed	1500
6	Crank Radius	55mm
7	Connecting Rod Length	300mm
8	Cylinder Diameter	80mm
9	Stroke Length	110mm
10	Compression Ratio	14.0 To 20.0
11	Loading	Eddy Current Dynamometer
12	Load(Max)	24n-M
13	Power	3.8kw

5. RESULT

5.1 INDICATED POWER (IP):

However, another element known as Indicated Power (IP) is taken into account when determining the mechanical efficiency. It is defined as the energy produced when fuel burns in a combustion chamber (IP). Always more than brake power is involved. It is the result of adding brake and friction power.

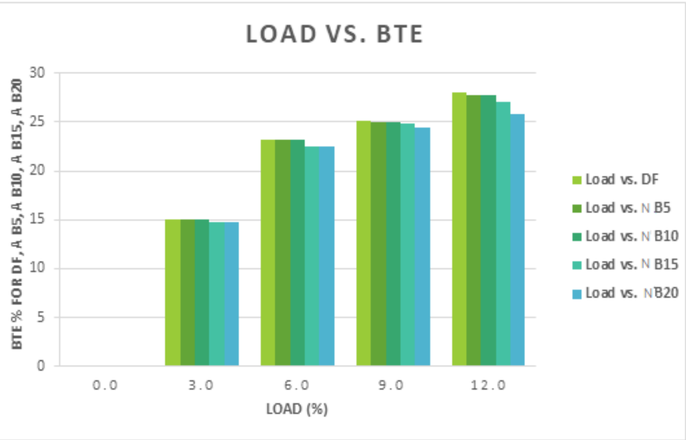

FIG 5: Load vs Break Thremal Effeciency

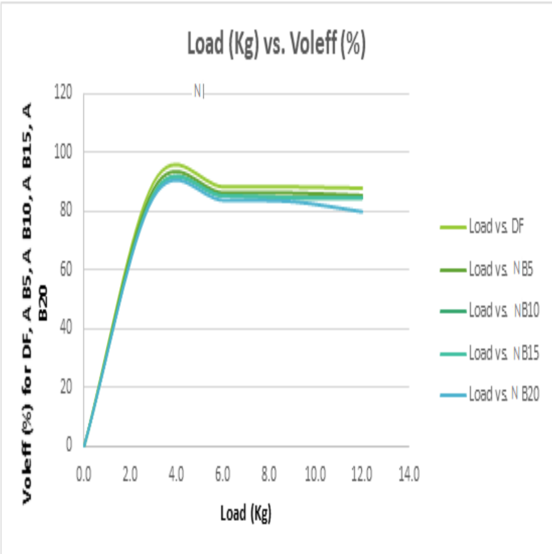

FIG 6: Load vs Volumetric Efficiency

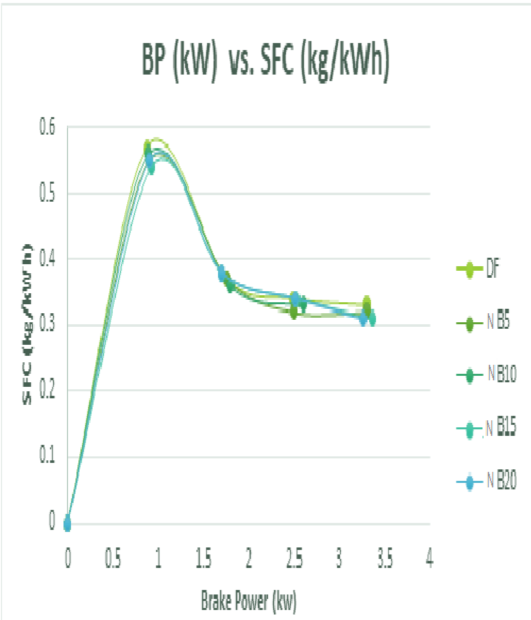

FIG 7: Break Power vs SFC

6. CONCLUSION

As stated in the chapters above, it was determined that the Second-generation biodiesel, also known as Neem, was the best source of green energy for this project. Neem has thus far shown to be a significant source of renewable energy. The thermal qualities for N B100 were discovered in the thermal research lab. The Neem biodiesel is mixed at N B5, N B10, N B15, and N B20. It was discovered that the kinematic viscosity was 5.1 N/mm2, indicating that the Neem biodiesel oil was suitable for use in the current engine The load with respect to brake thermal efficiency, volumetric efficiency, brake power with respect to specific fuel consumption shows better agreement, and it is concluded that algae biodiesel is suitable to run on the existing engine where it enhanced engine performance and reduced emissions. Thus, it can be inferred that by employing second generation neem biodiesel fuels, engine performance may be increased while emissions for the sustainable energy source can be decreased.

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