A Study of Performance and Characteristics of Diesel Engine using Mixture of Waste Milk Scum oil and Pongamia Pinnata oil as a Bio-Diesel

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Abstract - *It is clear that the value of this rare fuel will go on increasing in view of the increase in automobile number in present days and as a result demand for fuels. The insufficiency of conventional fuels lead to its over-dependence by nations, escalating emission pollutants and their rising costs has made the renewable energy sources more attractive than other types when compared. So to nullify troubles, alternative energy is the best answer and their fore lot of research is going out in this field. Several researchers are concentrating on bio-diesel as substitute fuels as these can be adopted instead of the conventional CI engines with not more modification in present once. Bio-diesel can be extracted from different raw materials like vegetable, biomass, algae, simarouba, milk scum, Pongamia pinnata etc. In which Milk scum oil and Pongamia pinnata oil is one of them. We considered as they available in cheap cost and renewable. Hence the proposed work of study would be an attempt for study purpose experiment Milk scum and Pongamia pinnata biodiesel-diesel blend with various ratios on a CI engine and to look for its possibility so as to have a substitute for diesel fuel, which is being used continuously from past many more years, and to overcome petroleum crisis in upcoming days.*

Key Words: **Energy, temperature, Milk scum oil, Pongamia pinnata oil**

1. INTRODUCTION

Sir Rudolf Diesel is English scientist who introduced CI engine to world for the first time in the history. Air compression inside the engine combustion chamber will help for ignition in CI engines. At high pressure fuel is injected into the engine, due to high pressure liquid form of fuel is change into tiny drops which helps in increasing oxidation of sprayed fuel and also helps in turn leads to full combustion of the fuel injected into the engine cylinder from the injector .In CI engines diesels, kerosene, biodiesel etc all types of fuels can be used to run engine. Once combustion finishes enormous quantity of combustion gases are released which are at high temperature, pressure which helps in running of CI engine.

2. METHODOLOGY

Milk scum is waste by product of the dairy which is collected in tank in the dairy scum collector section. It is also as ETP waste (Effluent Treatment Plant). The main 5 sections in the cycle is as follows Screen Chamber, Fat removal unit, Acid phase reactor, Aeration tank, Clarifier Screen chamber. Their detail and respective procedure in the dairy to get milk scum as a waste.

2.1 EXTRACTION OF MILKSCUM OIL:

Raw scum of milk of quantity 10 kilogram is taken from the dairy pit and solid waste substance is remove by hand picking and filtration. Raw milk scum collected is dropped into heating equipment to take off moisture and dust particles which is collected at bottom of heating equipment due to difference in their densities and all the process temperature of 110 degree is maintained. Approximately 4-5 kilograms of raw milk scum liquid from oil we got after the filtration process finishes. Test sample of required amount is taken to test and tests are started.

Fig -1: **WASTE MILKSCUM STORAGE TANK AT GUBBI DAIRY**

2.2 EXTRACTION OF PONGAMIA PINNATA OIL:

Pongamia pinnata tree is basically a tropical evergreen tree initially originates in India for first time. In India, Pongamia pinnata is known as "Honge" in Kannada word or "karanja" in Hindi, and it is majorly used to prepare biodiesel by using seeds for this tree which can substitute fuel (diesel) to some extent as blend and its eco friendly nature made it used widely from past several years especially in INDIA. Tree is

originally bright dark green in colour. It can rise up to range of 50 to 75 feet tall and around 10 to 12 feet in diameter of the base trunk of the tree. Initially we collected the seeds and put it into oil expeller machine manually to get oil from expeller output port and it is collected it in collector tank and leave it for few hours to settle down the dust particles in the oil and it is filtered through filter paper to remove dust from it. At last expelled oil is heated to get rid of moisture. Required quantity of oil is taken to test.

Fig -2: **Pongamia Pinnata Dry Seeds**

FREE FATTY ACID TEST:

Take iso-propanol of quantity 10ml and pour it in glass conical flask. Phenolphthalein is used as indicator in this test adds few drops of indicators into conical flask which already contain iso-propanol in it. Take 1 gram of raw oil (milk scum oil or Pongamia pinnata oil) and it is added to conical flask to flask which contains previously mixed solution of propanol and phenolphthalein indicator mixture. Take NaOH of (0.01) concentration solution fill it to burette and start titration by adding NaOH drop wise till solution in conical flask turn into pink colour. Amount of NaOH solution in burette used for titration in. The amount of NaOH (0.01) concentration solution consumed by fatty acid decides FFA in the oil. By using formula we can calculate value of FFA of the Oil. FFA= {(28.2 *normality of NaOH *titration value)/(weight of the oil)} .

"Transesterification" process can be defined as process of converting tri glycerids in presence of alcohol into mono esters and glycerin.

Prepared oil from pervious stage which is ready is now transesterified into mono esters of the fatty acids. Acid value of Milk Scum oil and Pongamia pinnata oil was found to be xxx and xxx mg NaOH/g and Transesterification process is done directly. By using reaction flask ,reflux flask thermometer and stirrer Transesterification is carried out , once completed it is left for 1-2 hours for the formation of acid layer which is removed out initially and remaining oil is gone through water wash process in which remaining acid content or the particles in the oil is removed with hot water wash. Oil getting from hot water wash is heated below boiling temperature of the oil around 110 degrees Celsius to remove the still remaining moisture content in the prepared oil.

Fig -3: **GLYCERIN LAYER FORMED**

Fig -4: WATER WASH

3. PERFORMANCE PARAMETERS Of CI Engine Using Different Diesel And Biodiesel Blends

3.1. EXPERMENTAL FUELS

Prepared biodiesel is blended with commercial diesel at different percentage by volume namely B20, B40, B60, B80 and diesel D. and engine performance is check for each fuel blend sample with constant speed that is 1500 rpm at different load conditions.

3.2. EXPERIMENTAL SETUP AND PROCEDURE

Experimental setup consists of single cylinder four stroke water cooled engine which is connected series with eddy current dynamometer. Engine specification is note down below. Engine is run at constant speed of 1500 rpm. The

"Legion brother" software was used to check performance of engine. Experiment is conducted for different blends of fuels with constant 1500rpm. Engine specification is shown below.

Table -1: Engine Specification

SLNO	PARAMETERS	SPECIFICATION
1	Type	AV 1 (kirloskar made)
2	Nozzle opening	200 bar
3	Governor type	Mechanical centrifugal type
4	Number of cylinders	Single cylinder
5	Number of strokes	Four stroke
6	Fuel	Diesel
7	Compression ratio	16.5:1
8	Cylinder	80mm
9	Stroke length	110mm
Electrical dynamometer		
10	Type	Foot mounted, continuous rating
11	Alternator rating	3KVA
12	Speed	1500RPM
13	Voltage	220 V AC

Fig-5: Experimental Setup

Fig-6: Emission Gas Analyzer

PROPERTIES	DIESEL	MILKSCUM OIL	PONGAMIA PINNATA OIL
Calorific value MJ/Kg	43.0000	40.2190	37.636.2
Flash point °C	44	132	140
Fire point °C	49	140	146
Viscosity cst	3.8	5.6	5.4
Density g/cm3	0.835	0.8959	0.9161

Table-2: Properties Of Diesel And Biodiesel

4. RESULTS:

4.1. Break Power V/S Brake Specific Fuel Consumption:

BSFC may be defined as ratio of weight of the fuel to that of Break Power. BSFC value is more for pure diesel and its less for B80 blend, from this we can conclude that less value blend is more efficient one when compared with all blends and with diesel

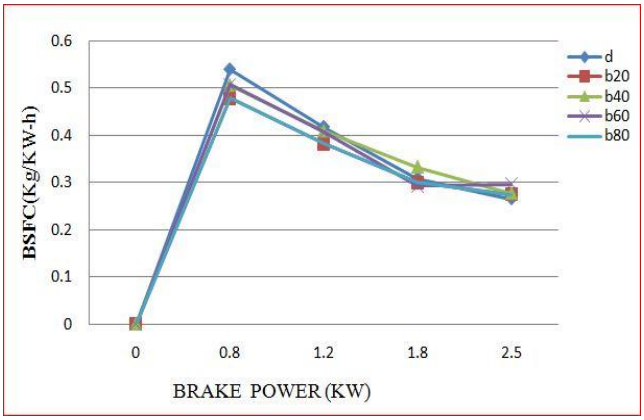

Chart -1: BP v/s BSFC

4.2. BRAKE POWER V/S BRAKE THERMAL EFFICIENCY:

Brake thermal efficiency is defined as ratio of brake power energy to the input fuel energy in appropriate units. Variation of brake thermal efficiency along with pure diesel and its blends of biodiesel at different loads condition are shown in below figure. The thermal efficiency are identified that initial load conditions and for lower load conditions it is identical for all blends, it will be more for the pure diesel. Due to less specific fuel consumption and more heating value of diesel. The thermal efficiency is decreases with increasing the percentage of the blends.

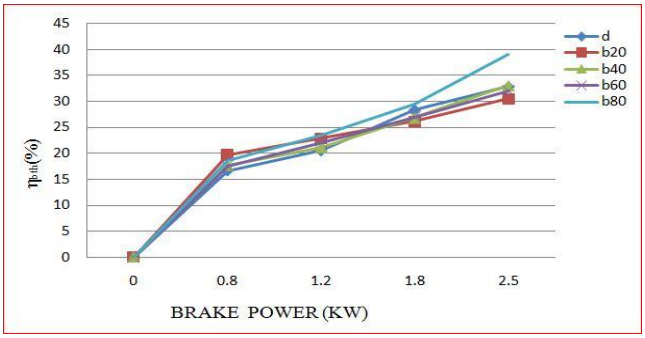

Chart -2: BP V/S BRAKE THERMAL EFFICIENCY

4.3. BP V/S EXHAUST GAS TEMPERATURE:

The exhaust gas temperature (EGT) gives correct information the combustion in engine. Below Figure it is represented the comparison exhaust gas temperature of diesel and biodiesel and its blends at changing load situation. The biodiesel contains oxygen which enables the combustion process and hence the exhaust gas temperatures are higher. EGT is more B20 blend and it decreases as blend ratio increases.

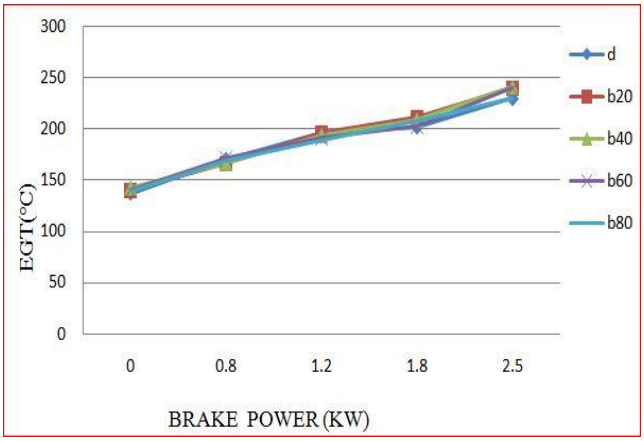

Chart -3: Bp v/s Exhaust Gas Temperature.

4.4. CO EMISSION V/S BP:

Carbon Monoxide is considered as one harmful gas emission of engine as it is measured by exhaust analyzer in percentage ratio. Carbon monoxide is one of the compounds formed as by product of combustion. As combustion proceeds to completion, oxidation of CO to CO2 occurs through recombination of CO and oxygen in presence of suitable oxidants. If these recombination processes are incomplete due to less available of oxygen or due to low gas temperature. As result CO will come as it is to exist. Below Figure shows the carbon monoxide emission of pure diesel, biodiesel and blends at different loads condition. B80 shows the lower CO emission compared to neat diesel at all loads.

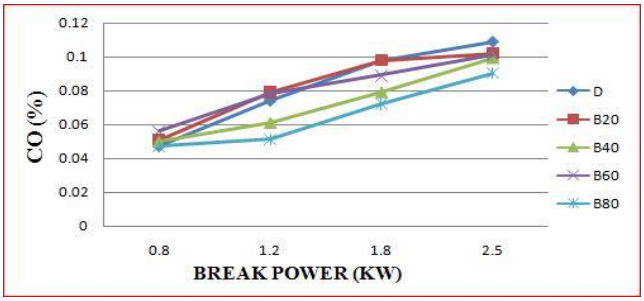

Chart -4: CO EMISSION V/S BP

4.5. NOx EMISSION V/S BP:

Nitrogen oxides is by product gas coming out from engine due to combustion and it is measured by an exhaust analyzer in terms of parts per million (ppm). NOx emissions are extremely undesirable. Three conditions which favors NOx formation are higher combustion temperature, more oxygen content and faster reaction rate. Below Figure shows the variation of NOx with brake power. It is observed that the NOx emission was more for the biodiesel compared to that of diesel at all the loads. This could be due to increase in the exhaust gas temperature

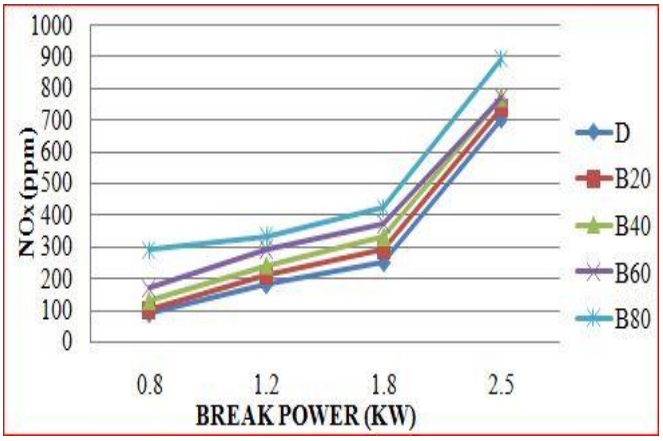

Chart -5: NOx EMISSION V/S BP.

4.6. HC EMISSION V/S BP:

Hydro carbon is one of engine emission compound which is air pollutant and hazardous for environment as well as human inhale. From below figure we can notice that increase in the blending ratio with diesel decreases HC emission. It value is more in pure diesel and decreases with blending and value will be least for B80 blend and it is good for environment.

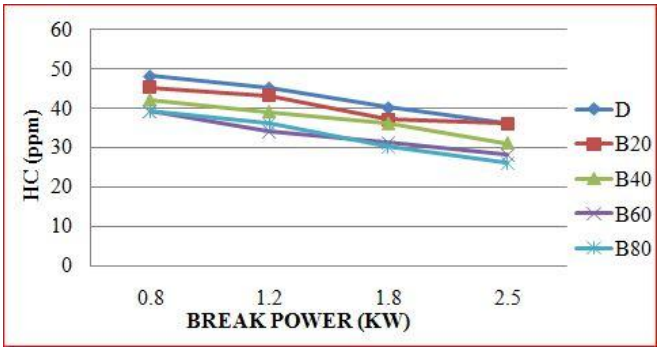

Chart -6: HC EMISSION V/S BP

5. CONCLUSIONS

Preparation of biodiesel from raw materials to make it as fuel to run engine. It is carried out in series procedure starts with pickup seeds and raw scum to final esterification process. Taking out methanol from bio-diesel in name of recovery. Fuel properties like density, calorific value, viscosity, flash point are find out for both biodiesel. BTE, BSFC are find out at different load conditions. Engine performance is carried out for all blends and as result B20 is optimum blend among them. By using biodiesel which decreases emission of environmental pollution gases. Which inturn acts as eco friendly fuel.

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BIOGRAPHIES

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