Performance Test of Diesel Engine for Waste Cooking oil Biodiesel Blended with Diesel

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***Abstract*—Biodiesel, a renewable fuel made by transesterification of vegetable oil with alcohol, is becoming more readily available for blending with conventional diesel fuel for use in transportation applications. Fossil fuels such as petroleum, coal and natural gas, which have been used to meet the energy needs of mankind, are associated with negative environmental impacts such as global warming. Similarly, the fossil fuels accumulated over series of geological activities are irreversibly consumed at a rate more than million times faster than they were formed. This has left us in a precarious position especially for petroleum products. The hike in price of petroleum and its products, both in national and international scenes is frequent for two reasons; the mounting demands and fast depletion of reserves, the duo of which call for alternative source of energy. Similarly in developing countries, the price paid for petrol, diesel and petroleum products now dominates over all other expenditures and forms a major part of country's import bill. Biofuel/Biodiesel made from natural oils and fats is being considered as a promising substitute for petrol diesel. Although biodiesel cannot entirely replace fossil fuel, the following reasons however further justify its development.**

• It provides a market for excess production of vegetable oils.

• It decreases the dependence on imported petroleum.

• It does not contribute to global warming due to its closed carbon cycle.

• The exhaust emissions of carbon monoxide, unburned

Hydrocarbons and particulate emissions from biodiesel are lower than fossil fuel. Though much has been done in the area of biodiesel production especially with the use of various feed stock; soya bean oil, corn oil, peanut oil, olive oil, cotton seed oil, safflower, rape seed oil/canola, line seed oil, sunflower, coconut oil, palm kernel oil, jathropha seed oil etc as further evidenced in the report of but still, few research has been carried out on the use of WCO for biodiesel production.

Keywords— WCOBD; Biodiesel; fossil fuels; global warming

I. INTRODUCTION

Waste Cooking Oil (WCO) is a bio-fuel whereas high Speed Diesel is a fossil fuel. Fossil fuel may become extinct in near future but "WCO" is a renewable fuel extracted from the residual waste of used cooking oil. Bio-fuels are also advantageous when ecological factors are taken into account. Using WCO pollution can be controlled to certain extent . This is very cheap and renewable, they are safe to store and non volatile, biodegradable, release comparatively less carbon-di-oxide and has clearer exhaust.

Thus it can be best considered as the most favorable alternative fuel. Even from the economic perspective, the cost of WCO is less than that of Standard Diesel. The limitation is the production of oil . Since the extraction of oil is done in small scale, the cost of extraction is little high. The cost can be reduced when extraction is done on large scale. The present work is to conduct experiment on single cylinder CI Engine with various proportion of WCO in diesel and compare it with stand alone fossil fuel.

II. EXPERIMENT

Study of VCR engine performance (Computerized mode)
To study the performance of 1 cylinder, 4 stroke, Diesel engine connected to eddy current dynamometer in computerized mode.

A. Adjustment of The Compression Ratio

Slightly loosen the 6 nos. vertical Allen (socket headed) bolts provided on both sides of the tilting cylinder block.
Loosen the lock nut of the Adjuster and rotate the Adjuster by using spanner for tilting the cylinder block.
Adjust the desired compression ratio by referring the scale provided on the CR indicator (near the Adjuster)
Tighten the lock nut of the Adjuster.
Gently tighten the vertical Allen bolts (6 nos.).

B. Procedure

Ensure that all the nut bolts of engine, dynamometer, propller shaft, base frame are properly tightened. Ensure that sufficient lubrication oil is present in the engine sump tank. This can be checked by marking on the level stick.Ensure sufficient fuel in fuel tank. Remove air in fuel line, if any.

Switch on electric supply and ensure that PPU (Piezo powering unit), DLU (Dynamometer loading unit), Load indicator and Voltmeter are switched on. Start Computer and open "EngineSoftLV" (Double click "EngineSoftLV" icon on the desktop) Select "Engine Model" open "Configure" in View. Check configuration values & system constants with the values displayed on engine setup panel. "Apply" the changes, if any. Click on "PO- PV Graphs" tab.

Start water pump. Adjust the flow rate of "Rotameter (Engine)" to 250-350 LPH and "Rotameter (Calorimeter)" to 75-100 LPH by manipulating respective globe valves provided at the rotameter inlet. Ensure that water is flowing through dynamometer at a pressure of @ 0.5 to 1 Kg/cm2.
Keep the DLU knob at minimum position. Change the Fuel cock position from "Measuring" to "Tank" Start the engine by hand cranking and allow it to run at idling condition for 4-5 minutes.

Click on "Scan Start" on the monitor, Ensure that Speed, Temperatures and Manometer reading are correctly displayed on the PC. These readings should tally with those displayed on the engine panel. Increase the load on the engine by rotating knob on the DLU and confirm the load reading on the indicator and computer are same.

Adjust DLU knob and to set 0.5 kg load on Load Indicator. Wait for 3 mins., ensure that load is constant during this period. Change the Fuel cock position from "Tank" to "Measuring". Click "Log on" on. The fuel metering is ON for next 60 seconds. During first 30 seconds enter engine water flow, calorimeter jacket cooling water flow in LPH (and compression ratio for VCR engine). Click OK after recording fuel reading. Enter the file name under which the records to be stored. The first reading data is now saved. Change the Fuel cock position from "Measuring" to "Tank".

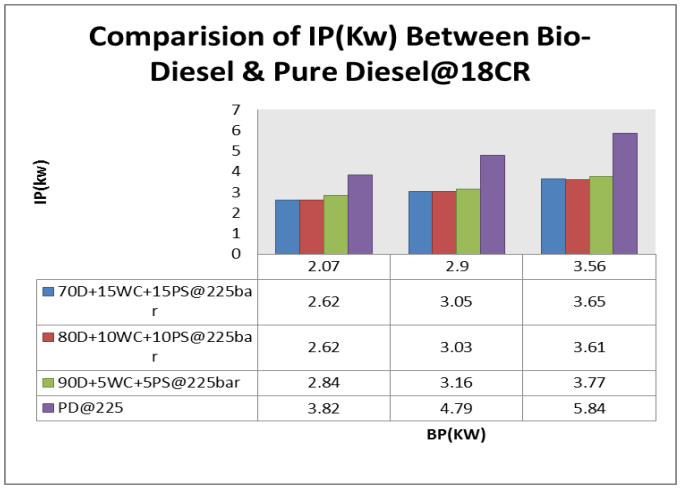
Adjust DLU knob and to set 3 kg load on Load Indicator. Wait for 3 mins., ensure that load is constant during this period. Change the Fuel cock position from "Tank" to "Measuring". Click "Log on" on. The fuel metering is ON for next 60 seconds. During first 30 seconds enter engine water flow, calorimeter jacket cooling water flow in LPH (and compression ratio for VCR engine). Click OK after recording fuel reading. The second reading data is now saved. Change the Fuel cock position from "Measuring" to "Tank".

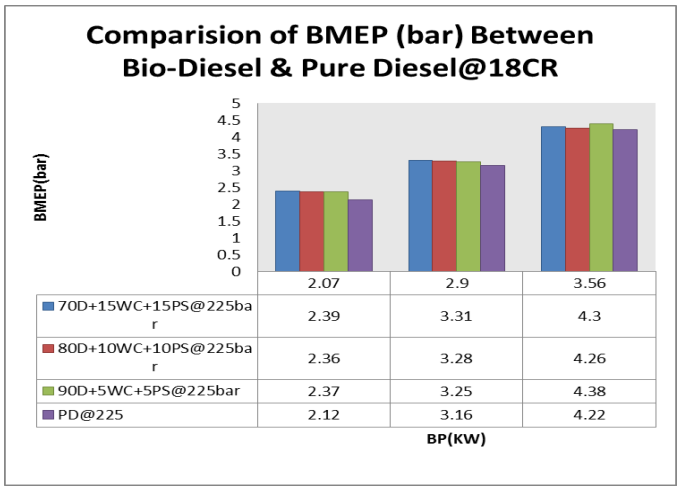
Repeat above step for various loads e.g. 6, 9,12,15,18 kg. (For VCR engine do not exceed 12 Kg load.) After finishing all the readings remove the load on the engine by DLU, Click "Scan Stop" on PC. Stop the engine by pressing engine stop lever. Allow the water to circulate for about 5 minutes for engine cooling and then Stop the pump. Click "File Open" on PC, Select the File under which the readings are stored and click "OK". On all the screens the first reading (of 0.5kg) is shown. To view next readings click "Next Data".

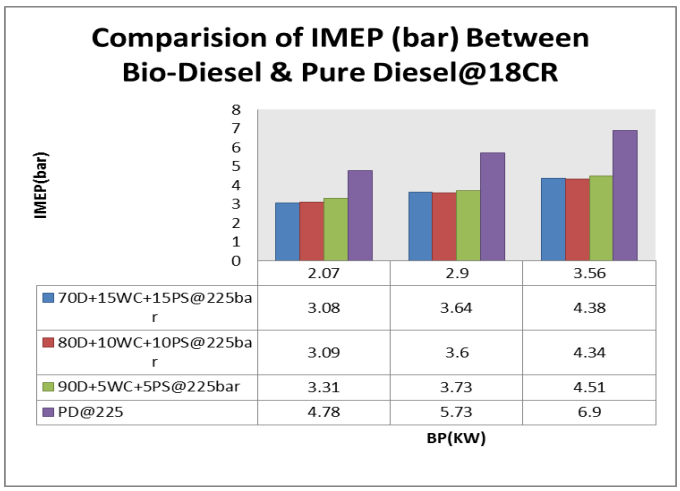
The results are displayed on all the three screens. For printing the results click "Print" and select appropriate option. Click "File Close" after printing & checking. Click "Exit" and then Shut Down the computer.

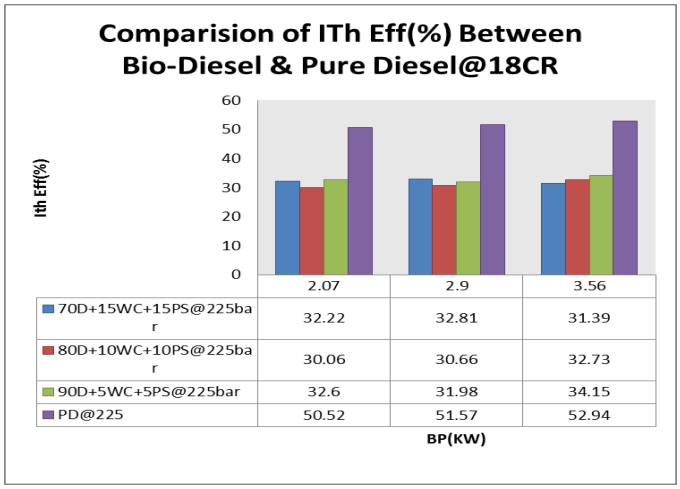
III. Performance and Comparison

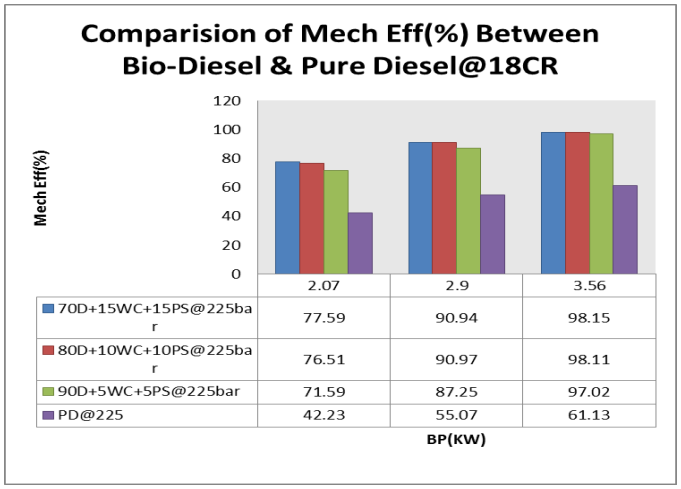
WCOBD & Palm Stearin with Diesel at Different Mixture, at 225bar injection Pressure & 18CR.
The graphs below shows the comparison for indicated power, mean effective pressure for indicated and brake, indicated thermal efficiency, brake thermal efficiency, volumetric efficiency and brake specific fuel consumption.

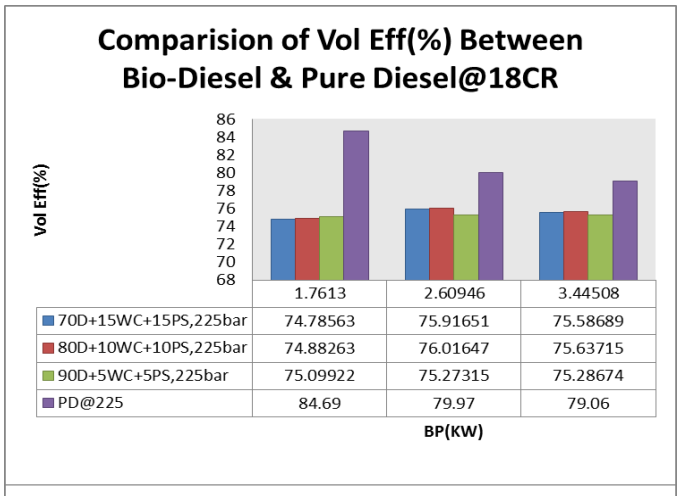


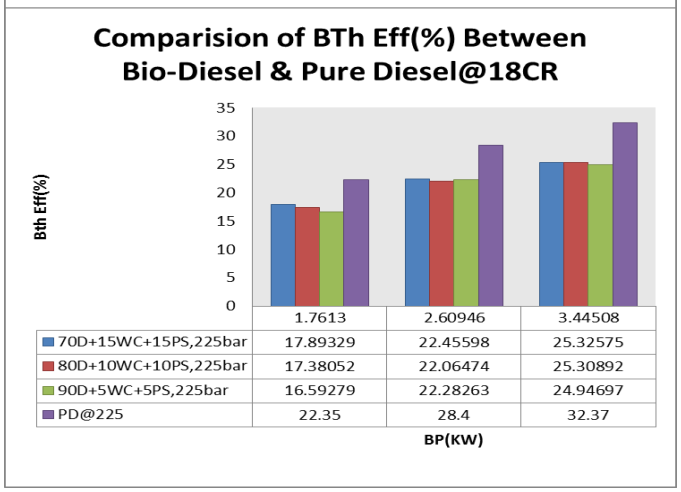


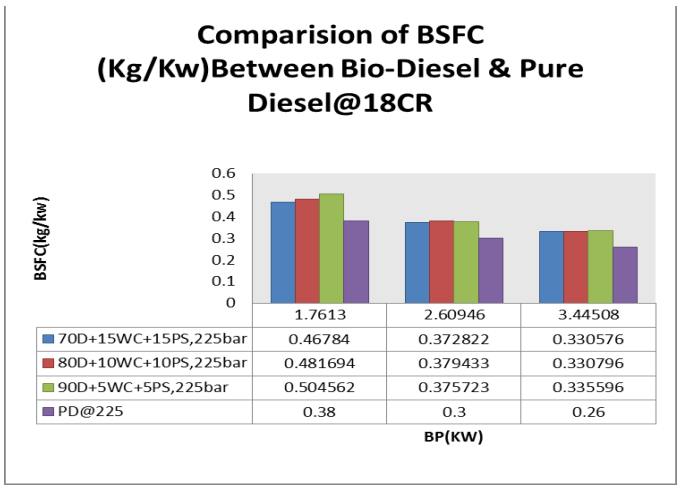






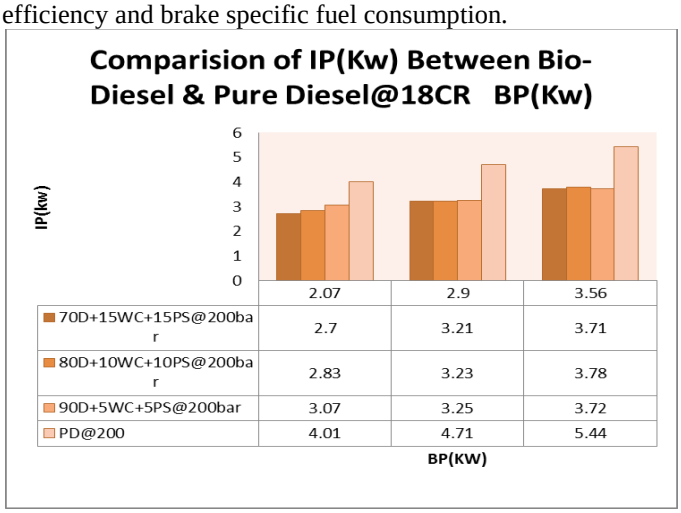


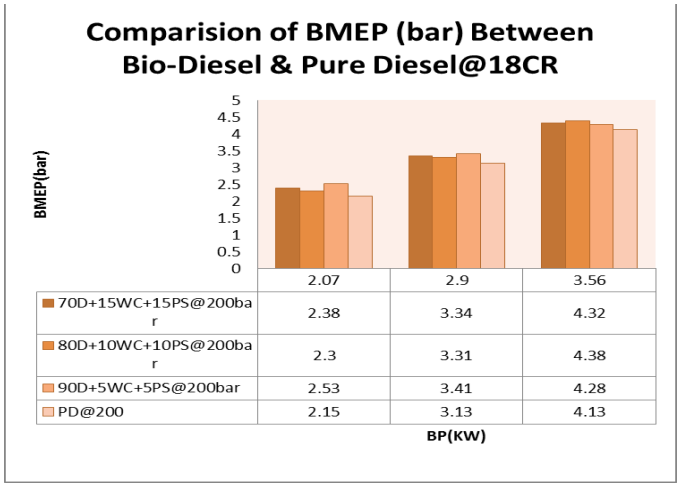


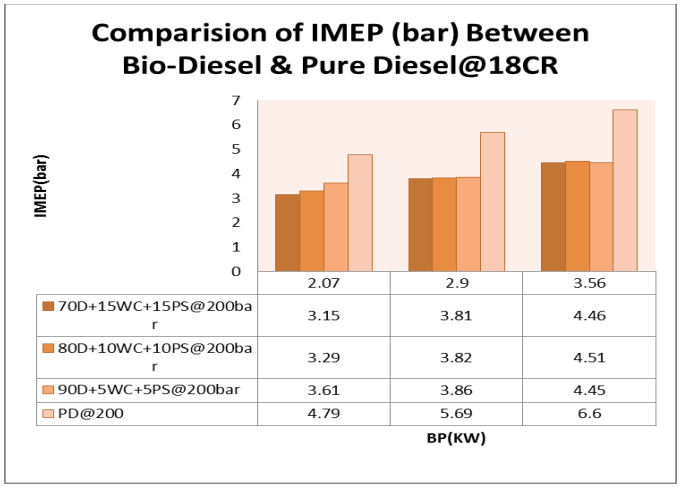


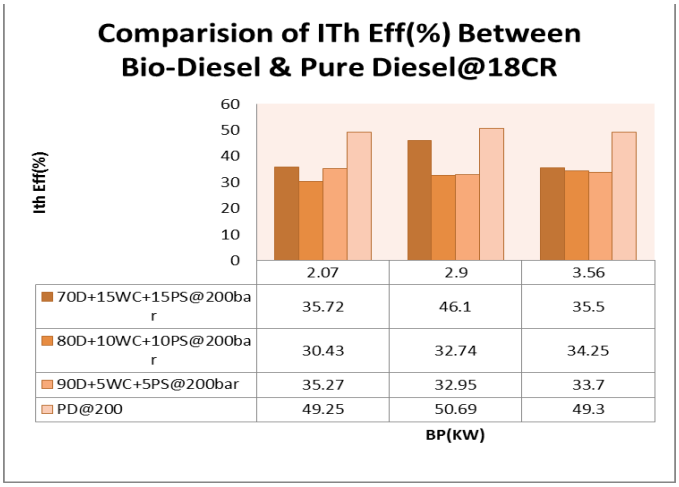
WCOBD & Palm Stearin with Diesel at Different Mixture, at 200bar injection Pressure & 18 Compression ratio.

The graphs below shows the comparison for indicated power, mean effective pressure for indicated and brake, indicated thermal efficiency, brake thermal efficiency, volumetric efficiency and brake specific fuel consumption.

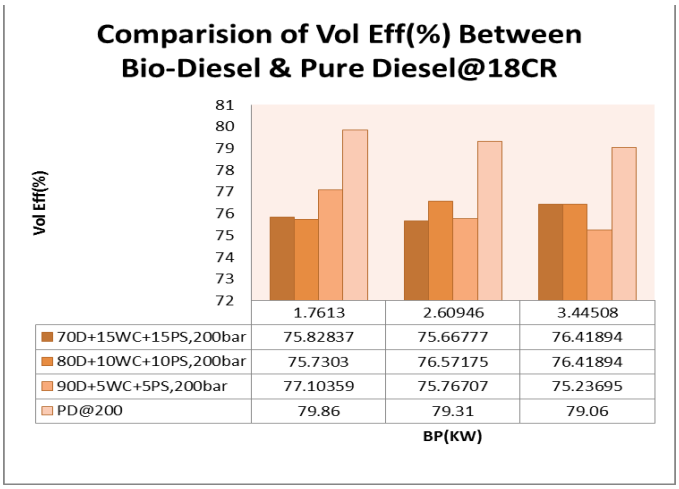




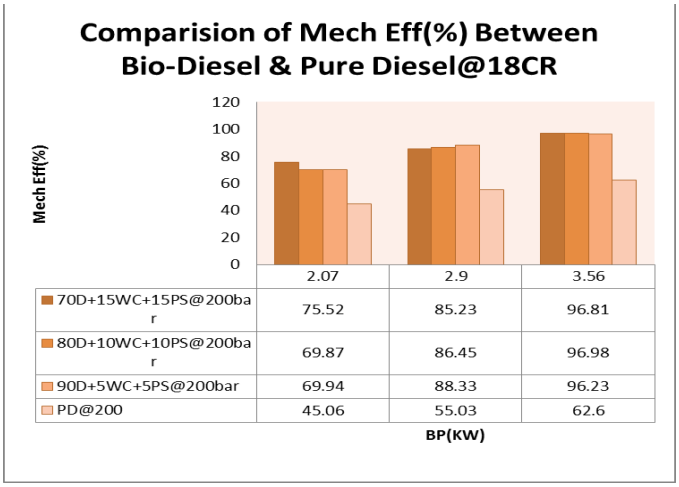




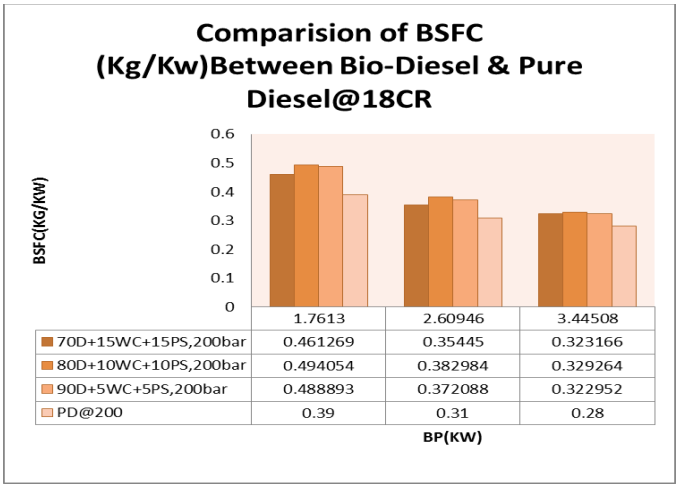
	2.07	2.9	3.56
70D+15WC+15PS@200bar	35.72	46.1	35.5
80D+10WC+10PS@200bar	30.43	32.74	34.25
90D+5WC+5PS@200bar	35.27	32.95	33.7
PD@200	49.25	50.69	49.3



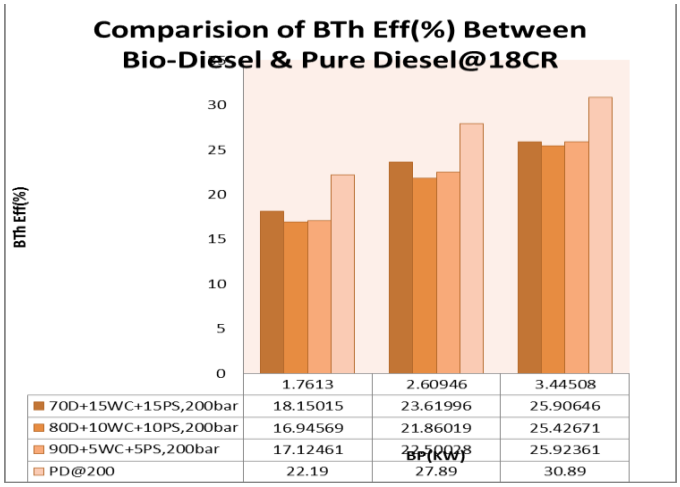
	1.7613	2.60946	3.44508
70D+15WC+15PS,200bar	75.82837	75.66777	76.41894
80D+10WC+10PS,200bar	75.7303	76.57175	76.41894
90D+5WC+5PS,200bar	77.10359	75.76707	75.23695
PD@200	79.86	79.31	79.06



	2.07	2.9	3.56
70D+15WC+15PS@200bar	75.52	85.23	96.81
80D+10WC+10PS@200bar	69.87	86.45	96.98
90D+5WC+5PS@200bar	69.94	88.33	96.23
PD@200	45.06	55.03	62.6



	1.7613	2.60946	3.44508
70D+15WC+15PS,200bar	0.461269	0.35445	0.323166
80D+10WC+10PS,200bar	0.494054	0.382984	0.329264
90D+5WC+5PS,200bar	0.488893	0.372088	0.322952
PD@200	0.39	0.31	0.28



	1.7613	2.60946	3.44508
70D+15WC+15PS,200bar	18.15015	23.61996	25.90646
80D+10WC+10PS,200bar	16.94569	21.86019	25.42671
90D+5WC+5PS,200bar	17.12461	22.50078	25.92361
PD@200	22.19	27.89	30.89

IV Problems Faced During Usage of Bio-Diesel

• **Viscosity**: As has been mentioned earlier, BD has comparatively higher viscosity then the conventional diesel, this sometimes comes as a hindrance at cold regions ,where the temperature is likely to fall below 250 C. Fuel becomes thick in consistency and is more likely to get blocked in the minor cavities of fuel injector.

• **Blockage**: Citing viscosity an issue, the problem of blocking of valves and injector was faced.

• **Mixing**: Precise blending of fuel is very important, minor negligence may be reflected in the comparison and data collection.

V ENVIRONMENTAL AND HEALTH BENEFITS

The use of BIO-DIESEL will help preserve our environment. Bioactive™ is completely biodegradable and contains no toxic or harmful elements. It is non-flammable, safe to handle, and poses no danger to the environment[5]. Best of all, it is made from a renewable resource that is abundant. It will also improve the air that we breathe. Air pollution is a serious problem worldwide and the rising incidence of pollution-related illnesses has become a serious concern. Extensive field and laboratory tests prove that Bioactive™ dramatically reduces smoke emissions through complete combustion. With the elimination of air pollution caused by smoke, a cleaner air will result in better respiratory conditions of people.

VI GENERAL ADVANTAGES

• **National security**.

Since it's made domestically, it reduces our dependence on foreign oil.

• **National economy**

Using bio-diesel keeps our fuel buying pesos at home instead of sending it to foreign countries. This reduces our trade deficit and creates jobs.

• It's sustainable & non-toxic.

• **Emissions**

Bio-diesel is nearly carbon-neutral, meaning it contributes almost zero emissions: global warming.

• **Engine life**

Studies have shown it reduces engine wear by as much as one half, primarily because it provides excellent lubricity. Even a 2% bio-diesel/98% diesel blend will help.

• **Drivability**

We have yet to meet anyone who doesn't notice an immediate smoothing of the sngine with bio-diesel. It just runs quieter, and produces less smoke.

VII General Disadvantages

• Primarily, bio-diesel is not readily available in retail market but that available are with commercial suppliers, however whose production has not yet been commercialized. With the novel move by the railways in India and the RTC in the East while Andhra Pradesh, this idea gained momentum and has been a success to much extent.

• Bio-diesel is not suitable to any engines, more of the older one.

VIII Conclusion

The Engine was running smoothly with the use of Bio-Diesel. The Bio-Diesel was added in the Diesel -Blend resulted in better performance and reduced smoke. The brake power for blends doesn't show much deviation from petroleum diesel The Brake specific fuel consumption is increased with the blends when compared to diesel. Brake thermal efficiency increased with all blends when compared to the conventional diesel fuel.

- The Bio-Diesel added in the Diesel -Blend resulted in better performance and reduced smoke.
- The brake power for blends doesn't show much deviation from Petroleum Diesel.
- The Brake specific fuel consumption is increased with the blends when compared to Diesel. And is maximum for B20 then again decreases of B30.
- Brake thermal efficiency increased with all blends when as the percentage of biodiesel increases.
- Mechanical Efficiency of the Bio-Diesel Blends was much higher when compared to the conventional Diesel fuel.

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