# Effect of Fuel additive (STP200559J) On Performance and Emission Parameters of 4-Stroke Single Cylinder Diesel Engine by using Jatropha Biodiesel and Their Diesel Blends

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***Abstract - Rapid growth of automobile industry worldwide increases the fuel demand. Fossil fuels available are exhaustive type of resource and having an adverse effect on environment. So there is need of alternate fuel option which should be environment friendly. Biofuel is the suitable option, biofuel obtain from vegetable seeds like jatropha, karanja etc. which can be easily cultivated. This fuel used in different proportion (Blends) with diesel without any modification in engine. It also reduces the Smoke Emission of Exhaust Gaseous. The aim of the research work is to find out the performance and emission characteristics of biodiesel blends. Biofuel used is extracted from Jatropha seeds and Fuel additive STP200559J is used. Blends taken in proportion (JB15+ 10 ml STP200559J),(JB50+10ml STP200559J),(JB75+ 10 ml STP200559J), (JB100+10 ml STP200559J) and the results critically examines the performance standards i.e. Brake Power, Brake Specific Fuel Consumption, Brake Thermal Efficiency, Smoke emission and Exhaust gas Temp.. The results are calculated for fuel blends with and without using the fuel additive to check the effect on performance and emission standards.***

***Keywords: - JB (Jatropha Biofuel), Brake Power, Brake Specific fuel consumption, Brake Thermal Efficiency, Smoke emission and Exhaust gas Temp.***

## I. INTRODUCTION

Many energy fuels are being investigated as potential substitutes for the current high-pollutant diesel fuel derived from diminishing commercial sources. Vegetable oils may provide one such alternative and their potential has been examined in the past years by several researchers. Our current research effort has been directed towards the use of vegetable oil as a diesel fuel substitute with minimal fuel processing and no engine modification. To take advantage of emulsification as a way of improving the combustion of vegetable oil in a diesel engine, some amount of water was introduced in the vegetable oil during the extraction process. The research paper evaluated the performance emission Parameters for Jatropha fuel blends in a diesel engine with and without using fuel additive Three blends were obtained by mixing diesel and jatropha oil in the following proportions by volume 85% diesel & 15% Jatropha oil, 50% diesel&50% Jatropha oil and 25% diesel &75% Jatropha oil. Fuel additive STP200559J is mixed 1% by volume in each blend.

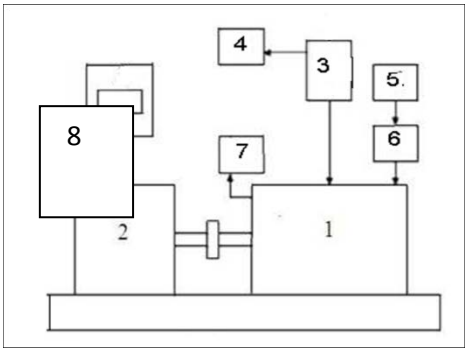
## II. BIODIESEL

The Biodiesel being used in the experiment is derived from Jatropha curcas by transesterification method. Biodiesel blends are denoted as, "Bxx" with "xx" representing the percentage of Biodiesel contained in the blend (i.e.: B20 is 20% Biodiesel, 80% petroleum diesel).

## III. FUEL ADDITIVE

Fuel additives are the chemical that are used to improvise the performance of the engine it is added in fuel in a specific volume. Apart from the above quality it also help to reduce the corrosion effect, it also help to clean the injector and improvises the cetane number. A fuel additive is eco-friendly and reduces the smoke emission and exhaust gaseous. STP200559J is a multifunctional diesel fuel additive with an outstanding keep-clean and clean-up formula. It is added in a fuel tank in a proper proportion and designed to improvise the performance and emission of engine and also works as anti-corrosion and also works as injector cleaner. It is recommended for every diesel engine.

## IV. EXPERIMENTAL SETUP



1. Diesel engine
2. Rope brake dynamometer
3. Air box
4. U-tube manometer
5. Fuel tank
6. Fuel measurement flask
7. Exhaust gas smoke meter
8. Dynamometer reading

Fig. Experimental Setup

Fig. Engine test rig

## V. ENGINE SPECIFICATIONS

| | |
|---|---|
| Cylinders | 01 |
| Strokes | 04 |
| Fuel | Diesel |
| Power | 5 hp @ 1500rpm |
| Cylinder bore & Stroke | 87.5 & 110 mm |
| Compression Ratio | 17.5:1 |
| Dynamometer | Rope brake |
| Cooling | Water cooled |

## VI. TESTING PROCEDURE

Experiment was conducted with jatropha oil and diesel blends with fuel additive1% STP220559J. Blends having proportion of 0%, 15%, 50%, 75%, 100% jatropha oil at various load levels. Using pure diesel engine performance tests was also conducted for comparison purpose. Engine performance will be measure in term of brake specific fuel consumption, air flow rate, and exhaust gas temperature and emissions. Engine should be run for few minutes to attain steady state before the measurements get started. The experiment was repeated thrice and average values of performance and emission get measured. In this experimental setup dynamometer was used to load the engine at varying load of 2-10 kg. Spring balance attached to the dynamometer to measure the torque by means of a 100 x 0.5 N arrangement. Three way, hand operated, two-positional directional control valve added in fuel supply system used to switch from diesel fuel and the test plant fuels. Tachometer is used to measure speed of the shaft at each loading. Under gravity and the volumetric flow rate fuel supplied to injector pump and measured the time taken for 10 ml of fuel to flow through a graduated measuring device. A smoke emission of exhaust gas was monitored by portable combustion analyser fitted near the exhaust valve. Exhaust gas temperature was measured by thermocouples.

## PROPERTIES OF JATROPHA OIL AND ITS BLENDS RELATIVE TO DIESEL FUEL

Transesterified Jatropha oil was selected for this study. The Biodiesel blended with diesel in 15% (JB15), 50% (JB50), 75% (JB75), 1000% (JB100) and 100% diesel were evaluated under this study. A bomb calorimeter was used for determining the Calorific value of the test fuel in terms of kJ/kg. Flash point, Fire point and Cetane No. of the test fuel were evaluated using the standard procedure. The values obtained are:

| PROPERTIES OF SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|
| SR NO | SAMPLE | DENSITY (kg/m3) | VISCOSITY (cst) | FLASH POINT (° C) | FIRE POINT (° C) | CETANE NO. | CALORIFIC VALUE (kJ/kg) |
| 1 | JB15 | 840 | 3.18 | 67 | 71 | 48 | 41520 |
| 2 | JB50 | 849 | 3.89 | 78 | 86 | 38 | 40000 |
| 3 | JB75 | 856 | 4.72 | 90 | 95 | 49 | 39250 |
| 4 | JB100 | 872 | 5.68 | 170 | 176 | 51.45 | 39170 |
| 5 | DIESEL | 830 | 2.7 | 64 | 69 | 51 | 42500 |

## VII. RESULTS AND DISCUSSION

The following parameters are used to evaluate the Performance of diesel engine using biodiesel and its blends with and without using Fuel additive STP200559J (a) Brake specific fuel consumption,(b) Brake thermal efficiency,(c) Smoke Emission and (d) Exhaust gas Temp.

### A) BRAKE SPECIFIC FUEL CONSUMPTION

**Fig.1 Brake Power Vs B.S.F.C. with using additive**

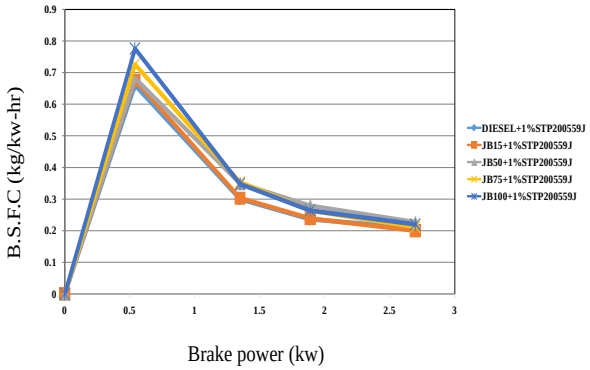



**Fig.2 Brake Power Vs B.S.F.C. without using additive**

Fig.1 shows the effect of additive STP200559J results in low Brake Specific Fuel consumption for ratio JB15 while for diesel the BSFC is higher. The variation in the brake specific fuel consumption with increasing torque on the engine for the various fuels. For all fuels, the specific fuel consumption falls with increasing load/torque on the engine. However, values for the JB15 blend are generally lower compared to the other fuels at all loads. Fig.2 shows the effect without using additive results in low BSFC for JB15 ratio and higher for diesel and there is decrease in specific fuel consumption for other compositions From the above figures it observed that the minimum BSFC is achieved for JB15 ratio with using fuel additive STP200559J and it is maximum for diesel fuel without using additive. As increases in the brake power BSFC reduces for JB15 blend ratio and it minimum when additive is used as compared to without using additive. The effect of additive shows the minimum fuel consumption as compared to without using additive for every composition

### B) BRAKE THERMAL EFFICIENCY

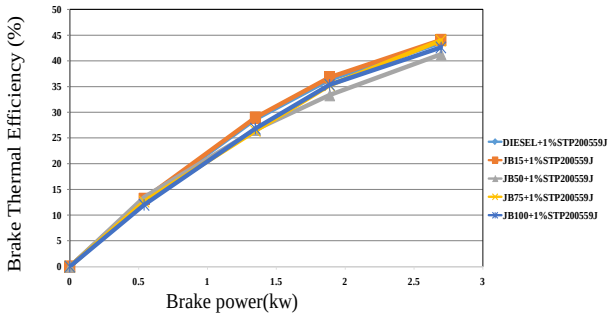



**Fig.3 Brake Power Vs Brake Thermal Efficiency with using additive**

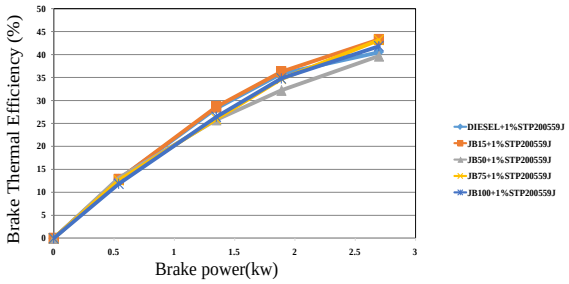



**Fig.4 Brake Power Vs Brake Thermal Efficiency without using additive**

Fig.3 shows the result effect of additive on brake thermal efficiency. Brake thermal efficiency increase as the brake power increases. The maximum brake thermal efficiency is observed for JB15 ratio similarly for other fuel ratios the brake thermal efficiency is higher. In fig.4 one can see the effect when additives are not used in the blend the brake thermal efficiency increases as the brake power increases again the value of brake thermal efficiency is higher for JB15 ratio.

### C) SMOKE EMISSION

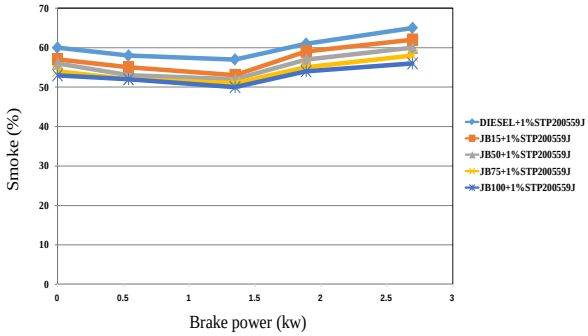



**Fig.5 Brake power Vs Smoke with using additive**

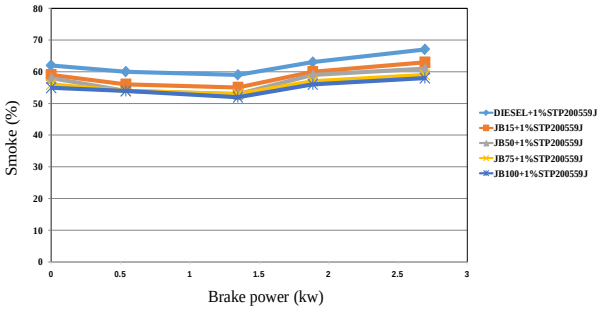



**Fig.6 Brake power Vs Smoke without using additive**

Fig. 5 shows the effect additive on emission of exhaust gaseous i.e. smoke. There is variation in smoke with respect to brake power higher the value of smoke for diesel fuel and lower for pure biodiesel, as the percentage of diesel in blend decreases the percent smoke level decrease. This may be due to late combustion in the expansion and exhaust.Fig.no.6 shows that there is an increase in the smoke level for pure diesel and lower for pure biodiesel As both the figures are compared it is seen that there is

improvement in smoke level when additive is used i.e. using of additive in fuel blend gives lower percentage of smoke. Lower percent of smoke means there is good combustion of fuel and low emission of CO and hydrocarbon and other particulate and it is significant for environment.

### D) EXHAUST GAS TEMPERATURE

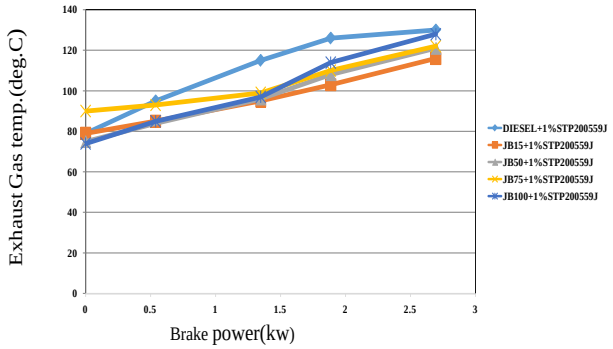



**Fig.7 Brake Power Vs Exhaust Gas Temp. with using additive**

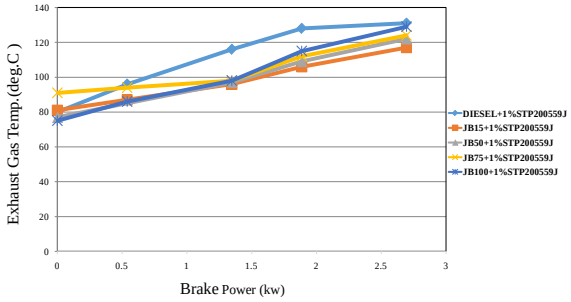



**Fig.8 Brake Power Vs Exhaust Gas Temp. without using fuel additive**

From Fig.7 it is observed that the exhaust gas temperature for biodiesel blends and jatropha oil is lower than diesel for all loads. It is higher for diesel fuel and lower for JB15 ratio and in fig.8 it is seen that exhaust temp. is higher for diesel and lower for JB15 blend. As compared to both figures it is found that there is decrease in the exhaust temperature when additive is used with fuel. By using the additive exhaust gas tamp. lower down for varying brake power. Lower the value of exhaust gas temp. leads to minimise the global warming scenario.

## VIII. CONCLUSION

1) Break Thermal efficiency for JB15 with additive STP200559J is higher than other blends. For JB15 brake thermal efficiency is 44.05%and 43.28% with and without using additive respectively.

2) Brake specific fuel consumption is lower for JB15 with additive STP200559J as compared to other blends and it is higher for diesel fuel without using additive. For JB15 BSFC is 0.197 kg/kw-hr and 0.200 kg/kw-hr with and without using additive respectively for higher loading conditions and for diesel it comes out to be 0.205 kg/kw-hr and 0.209 kg/kw-hr with and without using additive respectively for higher loading conditions.

3) Smoke emission level is low for all blends with using additive STP200559J and it is slightly higher for all blends without using additive. Higher emission level is for diesel as compared to other blends. For JB15 smoke emission is 62%and 63% with and without using additive respectively and for diesel it is 65%and 67% with and without using additive respectively for higher loading conditions.

4) The exhaust gas temperature is lower down for all compositions with using additive STP200559J and it is slightly higher for all compositions without using additive. Exhaust gas temp. is higher for diesel fuel and lower for JB15 blend in both case i.e. with and without using additive. The percentage rise by volume of the Jatropha oil in the fuel blends leads to amplify the exhaust gas temperature. The decrease in the exhaust gas temperature is due to the effect of water present in the Jatropha oil. For JB15 exhaust gas temp. is 116°C and 117°C with and without using additive respectively and for diesel it is 130°C and 128°C with and without using additive respectively for higher loading conditions.

On the above whole, it is concluded that JB15 with additive STP200559J is the optimum blend ratio which gives the higher performance as compared to other composition and using additive STP200559J improvises the performance of the engine. The biodiesel blends will be a good substitute fuel for diesel engine for different applications.

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