

# Performance of Albizia Saman Oil Blend In Ci Engine

Manjunathan.M<sup>1</sup>, Vivek.T<sup>1</sup>, Sathishkumar.S<sup>2</sup>

UG Students, Department of Automobile Engineering, Dr.Mahalingam College of Engineering and Technology,  
Pollachi, Tamil Nadu, India<sup>1</sup>

Assistant professor, Department of Automobile Engineering, Dr.Mahalingam College of Engineering and Technology,  
Pollachi, Tamil Nadu, India<sup>2</sup>

**ABSTRACT:**The potential of using albiziasaman (vagai) oil as feedstock for the production of biodiesel was investigated. Due to increase in fossil fuel consumption in day to day life there is need to shift to alternative fuels to reduce both the emission and to save non renewable energy to our future generations .The best way is using the vegetable oil and non edible oil as fuels in engines because it reduces the co2 emissions as well as saves non renewable energy. Already successful research is done using jatropha oil as CI engine fuel and this is widely used as engine blend in almost all goods trains in India.

Albiziasaman oil is extracted using cold hydraulic press method. The properties of the oil are calculated. These seeds contain 10% of oil. Using these oil N5&N10 blends is taken and performance of engine under various load conditions is obtained using VCR engine.

**KEYWORDS:**Biodiesel, Blending, VCR Engine.

## I. INTRODUCTION

Majority of the world's energy needs are supplied through petrochemical resources, coal, oil and natural gas. The consumption of fossil fuels is on increase from year to year. As the fossil resource is non-renewable, so fuel price is gouging as a consequence of spiraling demand and diminishing supply.

Diesel fuel has higher energy density than other gasoline fuel. Therefore, diesel engines are widely used in heavy duty transportation, power generation and also in agricultural sectors. As a result, the depletion rate of diesel fuel is much higher than other gasoline fuels, which subsequently causes higher price of diesel fuel than other gasoline. In India, resource of petrochemical fuels is very limited. So, for energy demand, India is fully dependent on crude oil import from Middle Eastern countries.

The increasing amount of Green-House Gases (GHG) such as CO which is causing global warming and climate change, as well as the declining reserve of fossil fuels, and more importantly, the high fuel prices have strongly increased the interest in the use of bio-oils and biodiesel for land, transport and power generation. The sources of bio-fuels are renewable, and the use of bio-fuels ensures reduced 2 amount of particulate matter, HC and NOX emission to the environment. Thus bio-fuels can emerge as an excellent alternative to fossil fuels.

The use of vegetable oils as an alternative fuel for diesel engines dates back to around a century. Depending upon soil condition and climate, different nations are looking for different vegetable oils for example, soybean oil in U.S.A., rapeseed and sunflower oil in Europe, palm oil in Malaysia and Indonesia, coconut oils in Philippines are being considered to substitute of diesel fuel [1]. The potential of bio-diesel production from albiziasaman oil have been found to be a promising fuel for diesel engine in a very few number of studies.

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## II. RELATED WORK

The seed from the Albiziasaman tree is collected. More amounts of seed are needed to get the oil. The seed is completely dried under the influence of sunlight for several days. The shell is removed after drying the seeds. The seeds are dried again after removing the shell. Then the oil is taken from the seed. The oil may contain dirt's so it should be filtered. The filtered oil undergoes Transesterification process. By means of transesterification process the oil's properties can be improved. Then the oil is blended with diesel. The blending ratios are B5 and B10 for the oil taken. The properties of oil were tested. The blend is analysed in the VCR engine. In the VCR Engine the various compression ratio can be used. The details of a VCREngine is given below, IC Engine set up under test is Research Diesel having power 3.50 kW @ 1500 rpm which is 1 Cylinder, Four stroke, Constant Speed, Water Cooled, Diesel Engine, with Cylinder Bore 87.50(mm), Stroke Length 110.00(mm), Connecting Rod length 234.00(mm), Compression Ratio 15.00, Swept volume 661.45 (cc).

## III. ABOUT ALBIZIA SAMAN

**albiziasaman** is a species of flowering tree in the pea family, fabacis. its range extends from Mexico south to Peru and Brazil, etc. common names include saman, rain tree and monkeypod.

saman is a wide-canopied tree with a large symmetrical crown. it usually reaches a height of 25 m (82 ft) and a diameter of 40 m. the leaves fold in rainy weather and in the evening, hence the name "rain tree" and "five o'clock tree" (pukul lima) in Malay. several lineages of this tree are available, e.g., with reddish pink and creamish golden colored flowers.

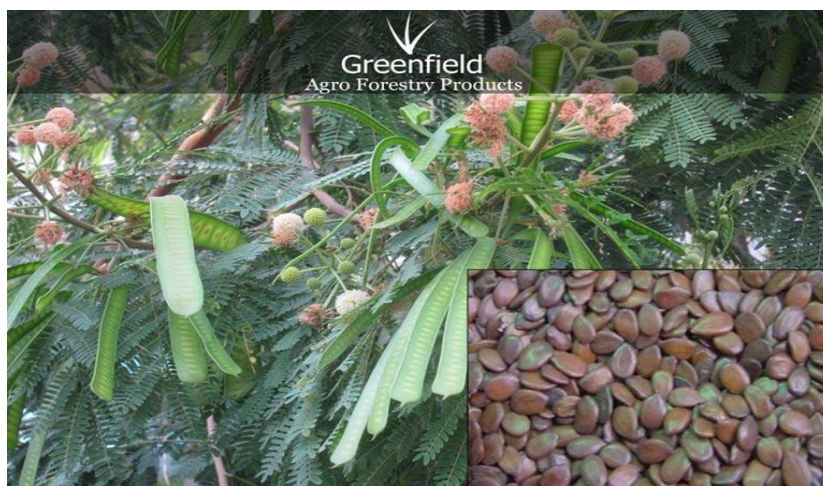


Figure 1- ALBIZIA SAMAN

## IV. PROPERTIES OF OIL

### 4.1 DENSITY

This is defined as the ratio of the mass of the fuel to the volume of the fuel at a reference temperature of 15°C. Density is measured by an instrument called hydrometer. The knowledge of density is useful for quantity calculations and assessing ignition quality. The unit of density is kg/m<sup>3</sup>.

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## 4.2 SPECIFIC GRAVITY

This is defined as the ratio of the weight of a given volume of oil to the weight of the same volume of water at a given temperature. The density of fuel, relative to water, is called specific gravity. The specific gravity of water is defined as 1. Since specific gravity is a ratio, it has no units. The measurement of specific gravity is generally made by a hydrometer. Specific gravity is used in calculations involving weights and volumes.

## 4.3 VISCOSITY TEST

The viscosity of a fluid is a measure of its internal resistance to flow. Viscosity depends on temperature and decreases as the temperature increases. Any numerical value for viscosity has no meaning unless the temperature is also specified. Viscosity is measured in Stokes / Centistokes. Sometimes viscosity is also quoted in Engler, Saybolt or Redwood. Each type of oil has its own temperature - viscosity relationship. The measurement of viscosity is made with an instrument called Viscometer.

The viscosity test is carried out using saybolt viscometer in various temperatures

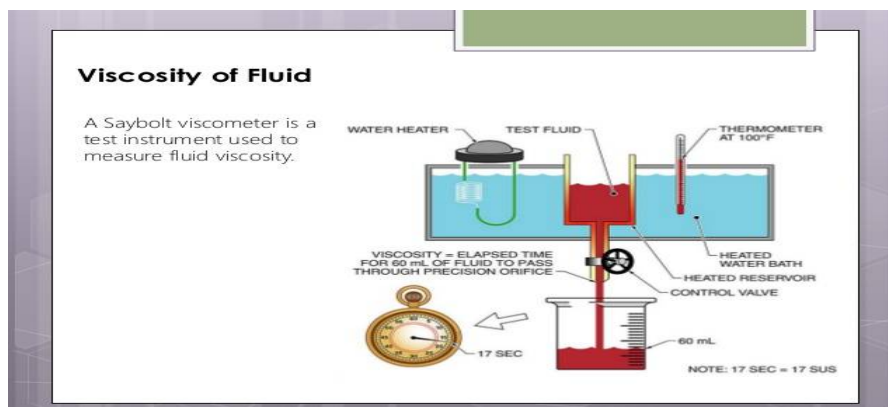


FIGURE 2 – SAYBOLT VISCOMETER

The below table shows the results

Table4.1-viscosity test

TEMPERATURE(Celsius)	TIME (s)	WEIGHT (kg)
40	85	0.052
60	56	0.052
80	40	0.052
100	28	0.052

- Kinematic viscosity( $\nu$ )= $At - (B/t)$  unit (centistroke)  
Where 'A' and 'B' are empirically determined constant  
 $A=0.22$  ;  $B=195$
- Dynamic viscosity( $\mu$ )= $\nu \times \text{density}$  unit (centipoise)

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Table4.2-viscosity of ASO

At 40 Degree Celsius

kinematic viscosity (centistroke)	Dynamic viscosity (centipoises)
16.4	15.74

## 4.4 FLASH AND FIRE POINT TEST

The flash point of a fuel is the lowest temperature at which the fuel can be heated so that the vapour gives off flashes momentarily when an open flame is passed over it. Flash point for furnace oil is 66 °C. The flash and fire point test is conducted to albiziasamanoil .



Figure3 – Flash and Fire point apparatus

Table4.3-Flash and Fire point of ASO

PROPERTY	TEMPERATURE (CELSIUS)
FLASH POINT	135
FIRE POINT	147

## V. EXPERIMENTAL RESULTS

### 5.1 PREPARATION OF BLENDS OF ASO WITH DIESEL

The ASO blended with diesel by volume as N5 (5% ASO & 95% diesel fuel) is prepared as first 95% (475ml) of diesel fuel was taken in reactor vessel then 5 % ( 25ml) ASO heated at 70 degree celsius was introduced in the same vessel. The mixture is then stirred for 15min. Other blends was prepared as same method N10(10% ASO& 90% diesel fuel) is prepared as first 90% (450ml) of diesel fuel was taken in reactor vessel then 10 % ( 50ml) ASO heated at 70 degree celsius was introduced in the same vessel.

### 5.2 VCR ENGINE

The setup consists of single cylinder, four stroke, VCR (Variable Compression Ratio) Research engine connected to eddy current dynamometer. It is provided with necessary instruments for combustion pressure, crank-angle, airflow,

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fuel flow, temperatures and load measurements. These signals are interfaced to computer through high speed data acquisition device. The set up has standalone panel box

Engine performance study includes brake power, indicated power, frictional power, BMEP, IMEP, brake thermal efficiency, indicated thermal efficiency, Mechanical efficiency, volumetric efficiency, specific fuel consumption, Air fuel ratio, heat balance and combustion analysis.



Figure 4 – VCR test engine

## 5.2.1 Software

EngineSoft is Labview based software package for engine performance monitoring system EngineSoft can serve most of the engine testing application needs including monitoring, reporting, data entry, data logging. The software evaluates power, efficiencies, fuel consumption and heat release. Various graphs are obtained at different operating condition. While on line testing of the engine in RUN mode necessary signals are scanned, stored and presented in graph. Stored data file is accessed to view the data graphical and tabular formats. The data in excel format can be used for further analysis.

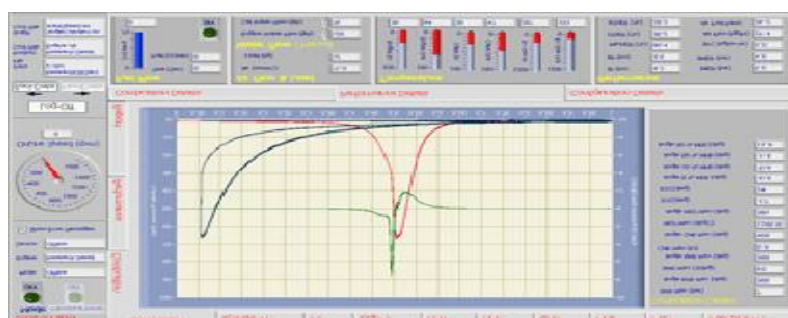


Figure 5 – Enginesoft software

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**Table 2: Specifications of test engine**

<b>Engine type Make</b>	<b>Kirloskar</b>
Bore	87.5mm
Stroke length	110mm
No. of cylinders	01
No. of strokes	04
Type of cooling	Water cooled
Rated power	3.5 Kw at 1500 RPM
Engine capacity	661cc
Variable CR range	12 to 18
Fuel used	Diesel, CNG-Diesel and Diesel in dual fuel mode

Figure 6 – Specification of test engine

## VI. RESULTS AND DISSCUSSIONS

### 6.1 ENGINEPERFORMANCE ANALYSIS

#### 6.1.1 BRAKE POWER

Brake or shaft horsepower is less than indicated power. In gasoline engine Performance, The power produced by an engine is expressed in horsepower. When the power developed is measured by means of a dynamometer or similar braking device, it is called brake horsepower.

$$BP = \frac{2 \times \pi \times N \times W \times R_e}{60 \times 1000} = \text{in KW}$$

N = Speed of the engine 1500 rpm.

W = Applied net weight in KG s.

R<sub>e</sub>= EffectiveRadius of the brake drum in(0.165) meter.

#### 6.1.2 INDICATED POWER

It is defined as thepower developed by combustion of fuel in the cylinder of engine is called (ip). It is always more than brake power.

$$IP = BP + FP = \text{in Kw}$$

#### 6.1.3 SPECIFIC FUEL CONSUMPTION

Brake specific fuel consumption (BSFC) is a measure of the fuel efficiency of an engine that burns fuel and produces rotational, or shaft, power. It is typically used for comparing the efficiency of internal combustion engines with a shaft output

#### 6.1.4 BRAKE THERMAL EFFICIENCY

Brake Thermal Efficiency is defined as break power of a heat engine as a function of the thermal input from the fuel. It is used to evaluate how well an engine converts the heat from a fuel to mechanical energy.

The following Figures shows the Brake power, Indicated power and Friction power for ASO and DF.

N5

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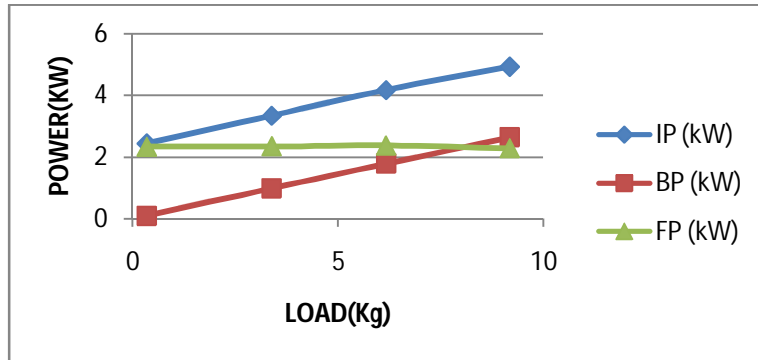


Figure 7 – N5(LOAD VS POWER)

The above graph shows the difference in brake power, indicated power, frictional power of 5% blend of albizia saman oil in ci engine(VCR engine).it shows that the powers are given in kilowatts and to corresponding loads in kilograms respectively.

## N10

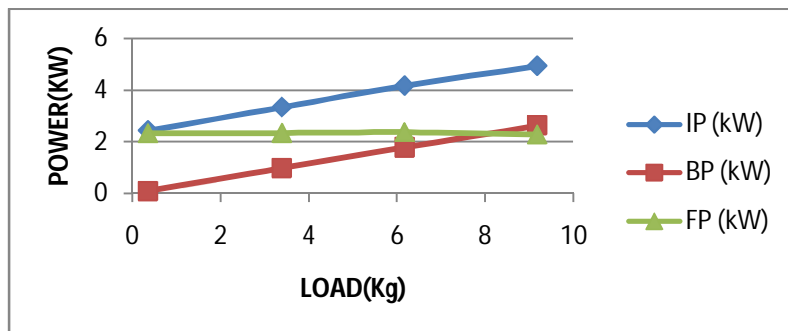


Figure 8 – N10((LOAD VS POWER)

The above graph shows the difference in brake power, indicated power, frictional power of 10% blend of albizia saman oil in ci engine(VCR engine).it shows that the powers are given in kilowatts and to corresponding loads in kilograms respectively.

## DIESEL

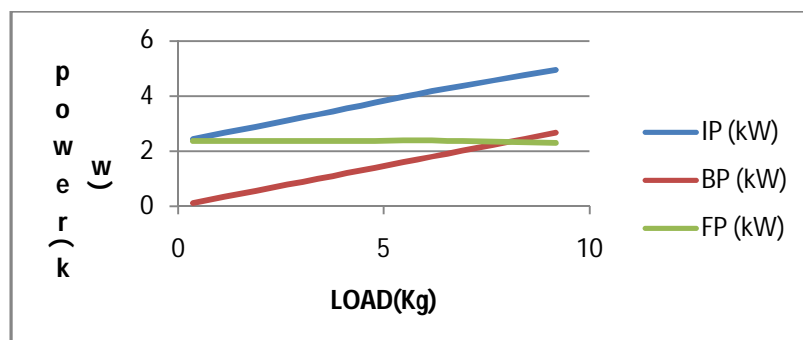


Figure – 9 Diesel((LOAD VS POWER)

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The above graph shows the difference in brake power, indicated power, frictional power of diesel with compression ratio 15 in ci engine (VCR engine).it shows that the powers are given in kilowatts and to corresponding loads in kilograms respectively.

LOAD VS BRAKE POWER

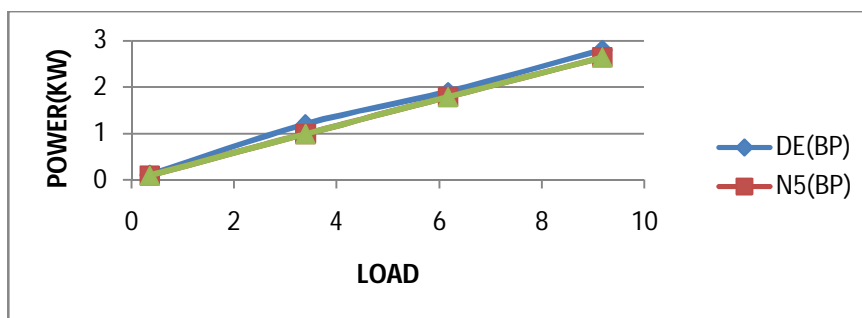


Figure 10 - LOAD VS BRAKE POWER

The above graph shows the difference in brake power of 5%, 10% blend of albizia saman oil to diesel with compression ratio 15 in ci engine (VCR engine).it shows that the powers are given in kilowatts and to corresponding loads in kilograms respectively.

COMPARISION OF THERMAL EFFICIENCIES  
N5

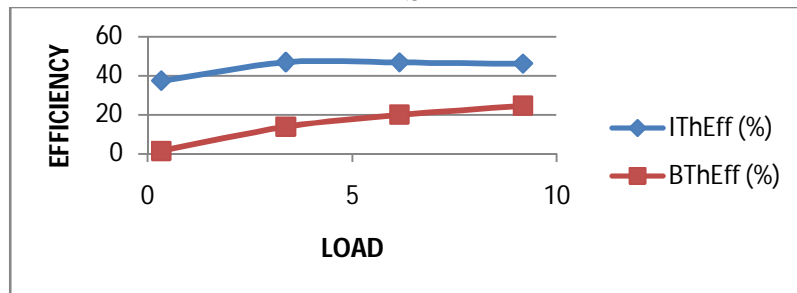


Figure 11 – N5 (LOAD VS THERMAL EFFICIENCIES)

The above graph shows the difference in brake thermal and indicated thermal efficiencies of 5% blend of albizia saman oil in ci engine (VCR engine).it shows that the efficiencies are given in percentages and to corresponding loads in kilograms respectively.

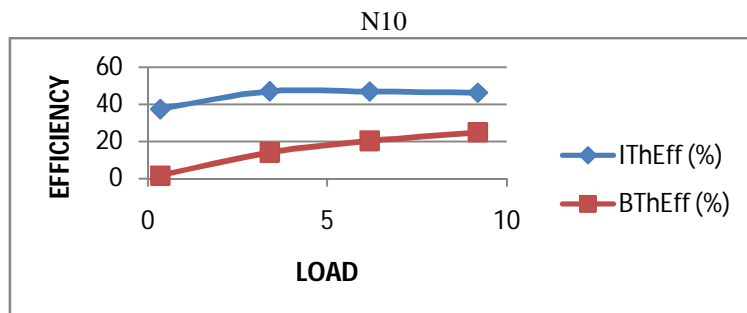


Figure 12 – N10 (LOAD VS THERMAL EFFICIENCIES)



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The above graph shows the difference in brake thermal and indicated thermal efficiencies of 10% blend of albizia saman oil in ci engine (VCR engine).it shows that the efficiencies are given in percentages and to corresponding loads in kilograms respectively.

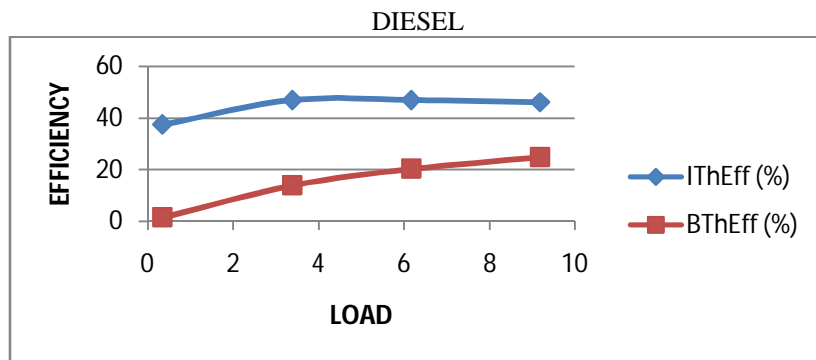


Figure 13 – Diesel (LOAD VS THERMAL EFFICIENCIES)

The above graph shows the difference in brake thermal and indicated thermal efficiencies of diesel with compression ratio 15 in ci engine (VCR engine).it shows that the efficiencies are given in percentages and to corresponding loads in kilograms respectively.

## LOAD VS BRAKE THERMAL EFFICIENCY

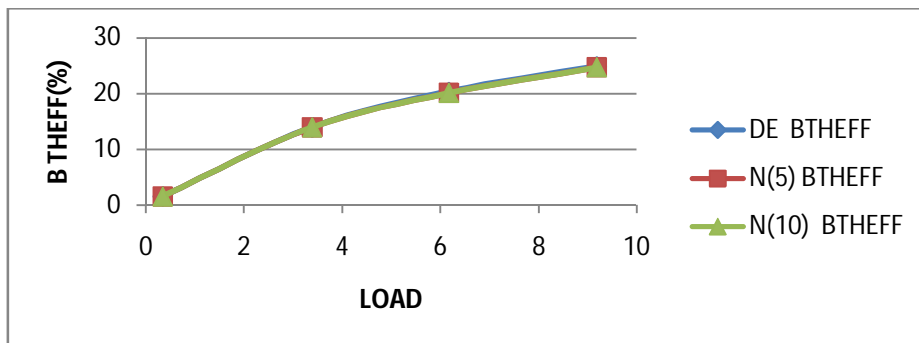


Figure14: LOAD VS BRAKE THERMAL EFFICIENCY

The above graph shows the difference in brake thermal efficiencies of 5%,10% blend of albizia saman oil to diesel with compression ratio 15 in ci engine (VCR engine).it shows that the efficiencies are given in percentages and to corresponding loads in kilograms respectively.

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### SPECIFIC FUEL CONSUMPTION

#### COMPARISON OF SFC

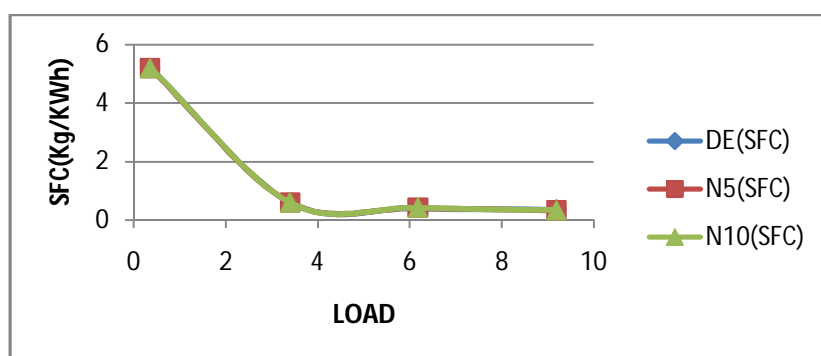


Figure – 15 Specific fuel consumption

The above graph shows the difference in specific fuel consumption of 5%, 10% blend of albizia saman oil to diesel with compression ratio 15 in CI engine (VCR engine). It shows that the SFC's are given in kilograms per kilowatt hour and to corresponding loads in kilograms respectively.

### V. CONCLUSIONS

ALBIZIA SAMAN oil was produced from its seeds. Fuel properties were measured for ASO. Performance tests were carried out on single cylinder VCR constant speed engine. The results of our experimental study were concluded as follows:

- The brake power of N5 and N10 blends are similar but it is slightly lesser than diesel.
- The brake thermal efficiencies of N5, N10 and diesel are more or less similar.
- Brake specific fuel consumption of blends were determined and is found to be same.

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