International Journal of Technical Innovation in Modern Engineering & Science (IJTIMES)
Impact Factor: 5.22 (SJIF-2017), e-ISSN: 2455-2585
Volume 4, Issue 08, August-2018

INFLUENCE OF DUAL BIO-FUEL ON SINGLE CYLINDER VARIABLE FUEL INJECTION PRESSURE DIESEL ENGINE

D. Bhaskara[1], Prof. Dr.M.L.S. Deva Kumar[2], Dr. A. Nagaraju[3]

[1]*PG Research Scholar, AICE, Mechanical Engineering Department, JNTUA College of engineering, Ananthapuramu, A.P.*
[2]*Professor of Mechanical Engineering Department, JNTUA College of engineering, Anantapuramu, A.P.*
[3]*Lecturer of Mechanical Engineering Department, JNTUA College of engineering, Anantapuramu,A.P.*

Abstract: ***Fossil fuel sources in the world are falling at a high level due to the immense growth of the population and the use of technology. According to studies, there is a gap between supply and demand. It will gradually increase in the coming days. It is necessary to fill up the gap between demand and supply. Developing countries like India, invests heavily on imports of petroleum fuels. In such countries most of automotive and transport vehicles are run on diesel. Diesel vehicles discharges considerable amount of pollutants like UHC, CO, NOx, lead, soot, which are very harmful for society and environment. However, to overcome this menace, the bio-fuels are being used in IC engines as alternate fuels. To attain the complete combustion of the charge in the cylinder the fuel injection parameters play a large role. The major parameters are no. of fuel nozzle holes, fuel droplet size and fuel injection pressure. These parameters can influence the performance of engine as well as emission characteristics of an I.C. engine. In this present work, experimental study was carried out using a blends of dual bio-fuels and diesel in a single cylinder, 4-stroke water cooled light duty injection CI engine at various injection pressures 180,200 and 240 bars. Here the tests were carried out for pure diesel and blends of 30% turpentine and turmeric oils by volume in diesel engine at constant speed with variable loads. The performance results at 180 to 200 bars of blend very closer to pure diesel results. The emissions UHC and CO are very less at 200 bars than pure diesel. The NOx emissions are lesser at 240 bars compare to pure diesel. The overall performance is good at 180 and 200 bars. But the emissions are decreased when increasing injections pressure.***

Keywords – Turpentine oil, Turmeric oil, BSFC – Brake specific fuel consumption CO – Carbon monoxide, Diesel Engines, Engine Performance, Fuel injection pressure, NOX emissions, UHC- Unburned hydro carbons.

1. INTRODUCTION

An Engine can be defined as the motor which is used to change one form of energy(heat) into work called heat engine. In this heat is low grade energy and work is high grade energy. Heat engines are classified as Internal combustion engines and External combustion engines. The Internal combustion engines having more efficiency than the external combustion engines and emits lesser pollutants in this diesel used as a fuel. The main idea of alternative fuels is good stock in the transport sector, since they only help in environmental quality but have different positive social effects. Since the last century many scientists have proposed biofuels as a good alternative to fossil fuels. In this experimental research we are going to introduce turpentine and turmeric oil as an alternative fuel. In present experimental investigation we are purchased Turpentine and Turmeric oils at FALCON Ltd in Bangalore. The Turpentine and Turmeric oils are very cheap and easy available alternative fuel in the world. Now a day's major pollutants from automobiles are Nitrogen oxides (NOx), unburned hydrocarbons (UHC), Carbon monoxide (CO), sulphur compounds and lead compounds and particulates. Compared to smaller engines, emissive pollutants are larger for large engines, and the pollution depends on the gas population.The main intention of this design is decreasing the exhaust emissions and improve the efficiency of the engine. Fuel injection pressure is in the opposite direction of the fuel droplet. The amount of fuel drops increases with less injection pressure, and then the ignition delay during combustion is longer. This injection leads to increased stress. Engine efficiency decreases since the combustion process has reached a very poor condition. When injection pressure improved the fuel particle size decreased. The air and fuel mixture formation become better from that complete combustion was done in the cylinder during the period of ignition. When injection pressure is high the ignition delay period is lesser. The homogeneous mixture is leads to increase in combustion efficiency.

2. FUEL PROPERTIES AND ENGINE SPECIFICATIONS

S.NO	PROPERTIES	UNITS	DIESEL	TURPENTINE OIL	TURMERIC OIL	B30
1	Density	kg/m^3	820	860	895	874.2
2	Viscosity @40^oC	m^2/s	3.2	2.5	5.2	3.5
3	Calorific Value	kJ/kg	44000	44500	41430	41200
4	Flash Point	^oC	60	46	185	46
5	Fire Point	^oC	72	62	235	48
6	Cetane Number		48	27	55	51

Table 2.1: Properties Of Diesel Turpentine And Turmeric Oils

PARAMETERS	SPECIFICATIONS
ENGINE	KIRLOSKAR
ENGINE TYPE	FOUR STROKE SINGLE CYLINDER WATER COOLED ENGINE
SPEED	1500rpm
Compression ratio	16.5:1
BORE	80mm
STROKE	110mm
RATED POWER	5HP
POWER OUTPUT	3.7kW

Table 2.2: Engine Specifications

III. VARIATION OF INJECTION PRESSURES

The desired amount of fuel should be estimated by fuel injection pressure, depending upon engine applied load and rated speed, and inject the fuel at desired rate in an absolute time. The shape and size of fuel particle obtained depends on the pressure of fuel injection of the engine. In this research study the fuel injection pressure changed from 180 to 240 bars. Generally, diesel engine has 180bar fuel injection pressure for high loads and speed. In this the fuel injection pressure is changing by tightening or loosening with help of screw provided on the top of the fuel injector. For measurement of injection pressure on fuel injector system by using fuel injector pressure tester.

Figure3.1 :Fuel injector of diesel engine

IV. EXPERIMENTAL PROCEDURE

Figure 4.1Experimental Setup

1. Enter the water to flow into the engine and calorimeter.
2. Put the weight if any on the dynamometer.
3. Open the 3-way cock so that fuel can flow in to the engine.
4. The engine starts by cranking.
5. Wait to attain the uniform state.
6. Load the engine by switching on the loading switches.
7. Wait 5min for engine to attain uniform rated speed.
8. Note down roto-meter reading
9. Take time for 10cc fuel consumption.
10. Note down the following readings for variable fuel injection pressure of engine.
11. Manometer readings, in cm of water.
12. Take the Temperatures at different locations.
13. Readings of Voltmeter and Ammeter.
14. Note pollution values from the pollution setup i.e., multi gas analyzer system
15. Repeat the same procedure for different loads at distinct fuel injection pressures i.e., 180,200 and 240 bars respectively and note down the above readings.
16. After the completion of experiment, remove the load and then switch off the engine.

V. RESULTS

A. Hydrocarbon Emissions (HC):

As the injection pressure increases the UHC emissions are reduces because, higher injection pressures will cause to proper spray at the starting of injection. This will improve the performance by using B30 turpentine and turmeric oils which is having viscosity a little above diesel. Probably it happened because of the improvement in the fuel spray, which can result a lesser delay period. The improved spray also gives a good combustion and thermal efficiency. The unburned HC Emissions are high at 180 bars and it is lower at 240bar. The reason behind this is at 240bar proper diffusion, combustion of the biodiesel takes place which results low emissions. At 180 and 240 bars there is very short time for the diffusion of the fuel to takes place which gives higher emissions. The quantity of biodiesel increases in the blend the UHCs are decreases due to presence of high oxygen content in the biodiesel and it leads to complete combustion in the cylinder.

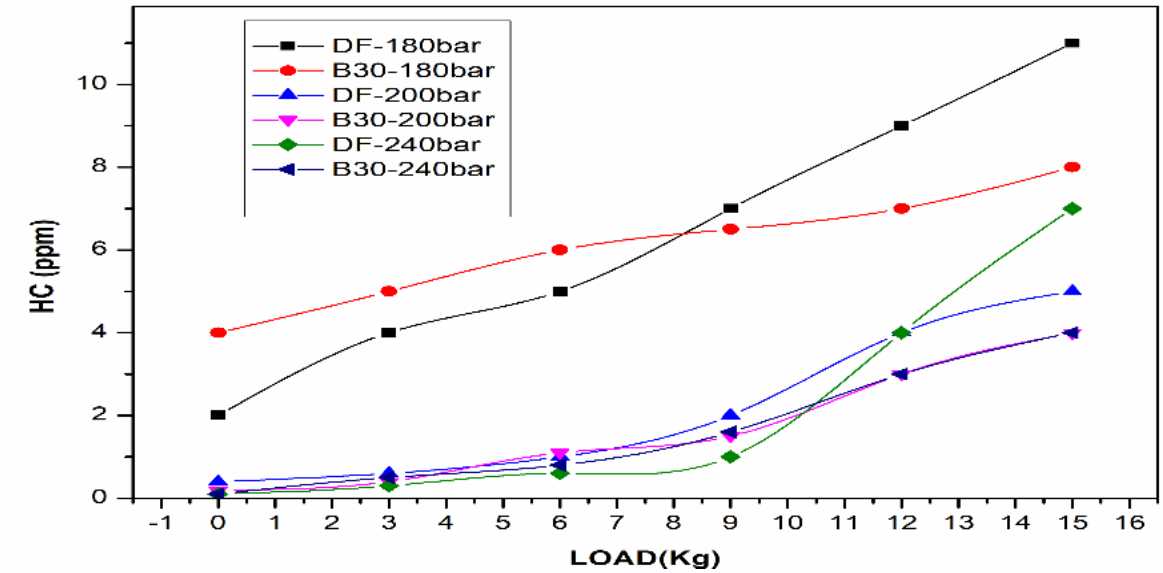

Figure 5.1 HC VS LOAD

B. Carbon Monoxide (CO) Emissions:

At full load, for the injector opening pressure of B30 turpentine and turmeric oils, due to higher injection pressure, atomization and mixing process are improved. Due to a little above viscosity of turpentine and turmeric than diesel high injection pressures are required for improving atomization and better mixing of air and fuel resulting low CO emissions. This CO emission is decreased when increasing loads at all pressures. The CO emissions with B30 blends of turmeric and turpentine oils are lower if compared to 100% of diesel. The blends of turpentine and turmeric oils produce a greater combustion efficiency leading to lower amounts of CO. The CO emissions are very less at 180 bars for B30 Blend compared to diesel at all pressures and higher for diesel at 180 bars.

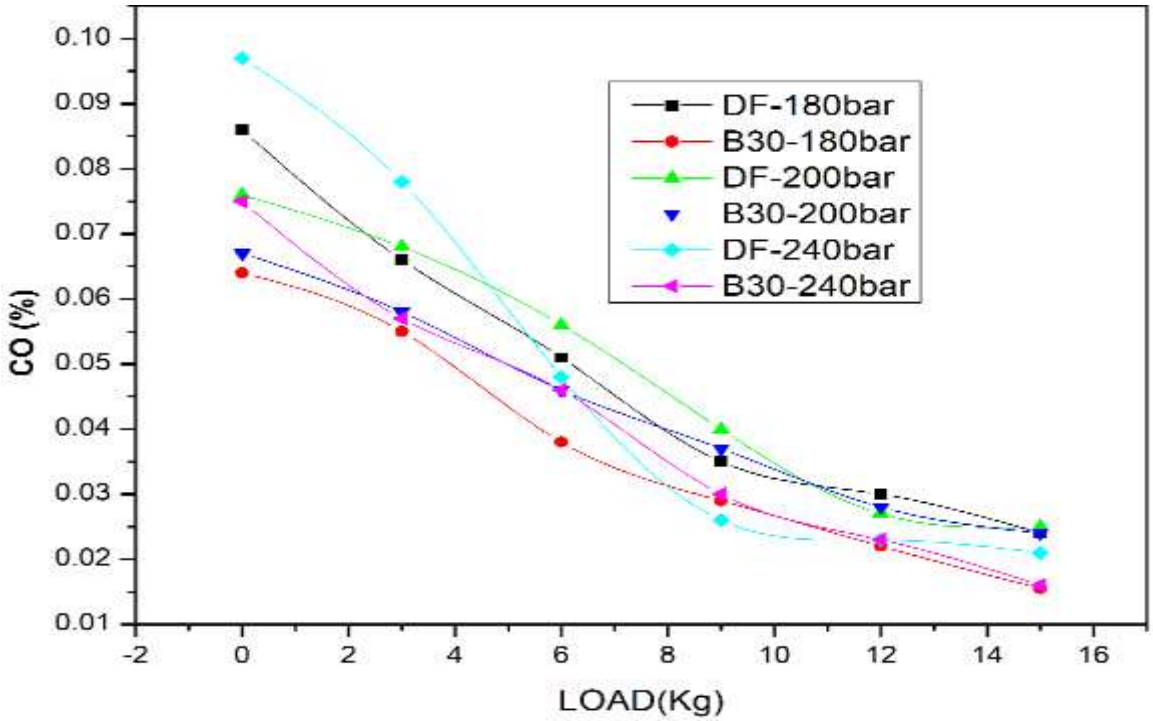

Figure 5.2 CO VS LOAD

C. Oxides of Nitrogen (NO_X):

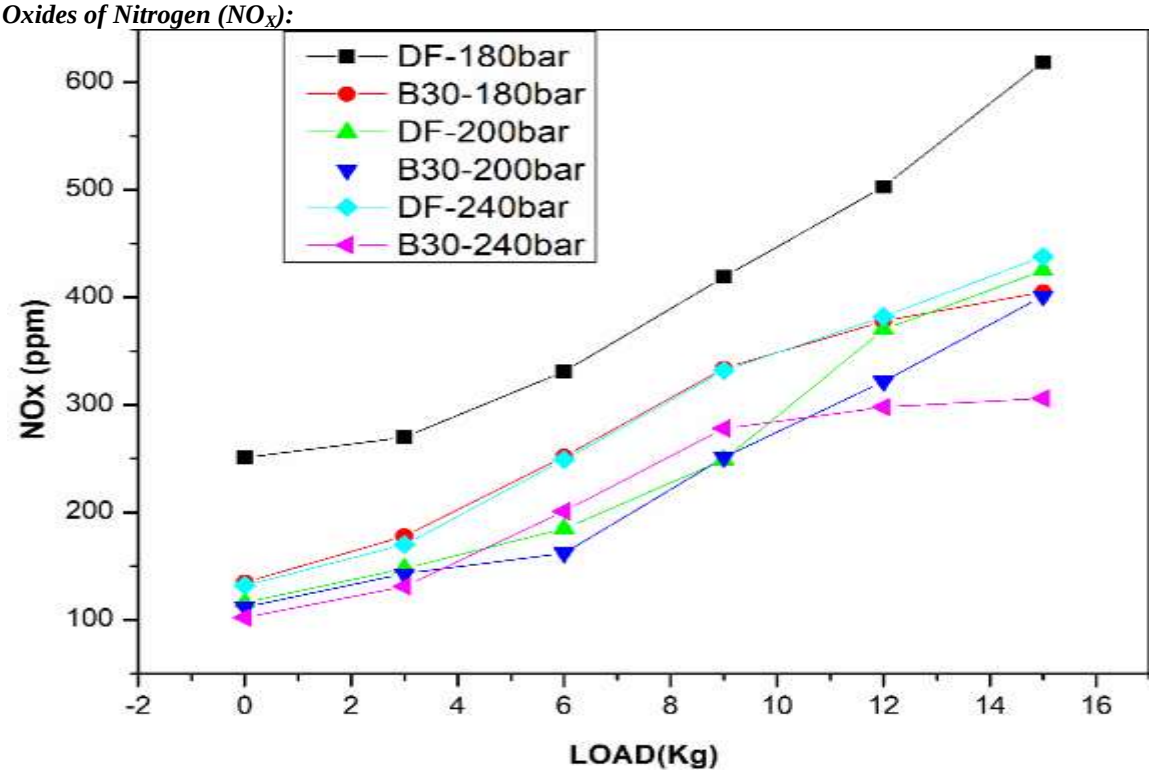

Figure 5.3 NOx VS LOAD

Above fig shows the variation in NO_x emissions with load for diesel and biodiesel blends. NO_x emissions increases with increase in combustion and exhaust temperature, therefore NO_x emissions are directly proportional to the power output of the engine. The following test results shows that NO_x emissions increase linearly with increase of load because of higher exhaust temperature and cylinder pressure. Because of having high oxygen content, Biodiesel produces more emissions which results in complete combustion causing higher exhaust temperature. From the above graph B30 at 240bar shows NO_x emissions are very low compared to other fuel injection pressures.

D. Brake Thermal Efficiency (BTE):

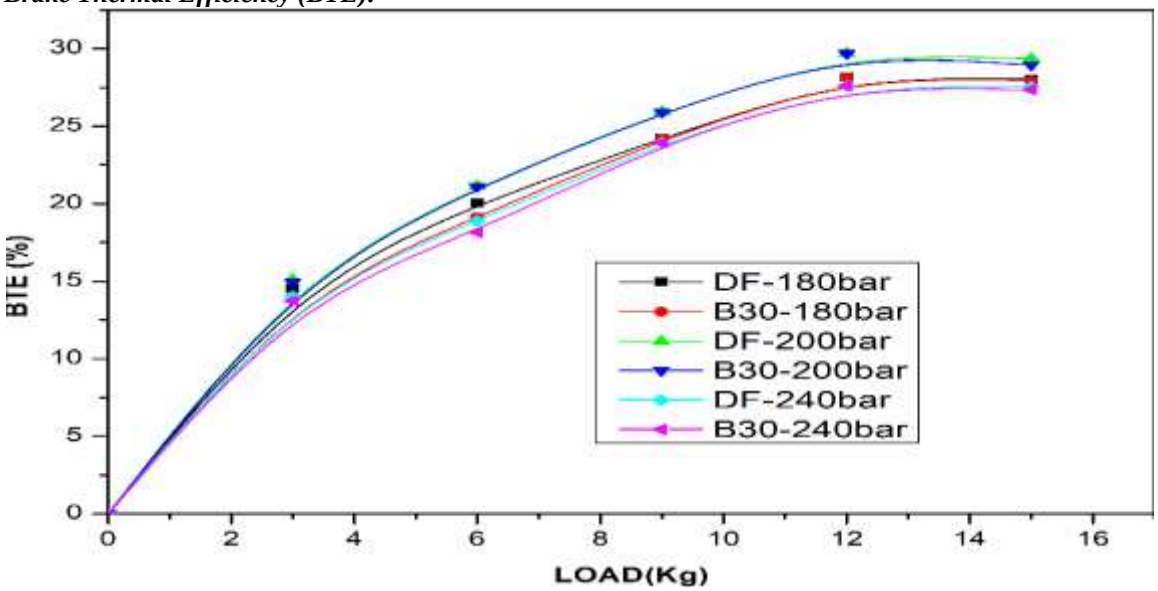

Figure 5.4 BTE VS LOAD

BTE is defined as the ratio of brake power to product of fuel consumption and calorific value. Above Fig shows the variation in Brake thermal efficiency (BTE) with respect to variable fuel injection pressures such as 180bar,200bar and 240bar in case of diesel, and blend of B30. It is clearly seen that BTE increases up to the load 12 kg (BP is 2.35 kW) and then decreases at full load due to incomplete combustion. The present test results it is observed that diesel has highest BTE of 29.75% at FIP 200bar (BP is 2.31kW) and 29.35% at FIP 200bar (BP is 2.88 kW) because of highest heat content, cetane value and lower viscosity. For blend B30 BTE is maximum 29.80% at 2.35kW and 200bar then at full load due to incomplete combustion the BTE slightly decreases to the 29.35% at 2.88 kW and 200bar because of highest heat content, cetane value and lower viscosity.

E. Brake Specific Fuel Consumption (BSFC):

The specific fuel consumption is changed with load at different pressures for diesel and B30 Turpentine and Turmeric oils were presented in fig5.5. The BSFC is decreases with increasing loads for all pressures. This result may due to poor mixture formation Turpentine and Turmeric oils and effect of higher viscosity. The specific fuel consumption of B30 blend is lesser than that of diesel for 3rd and 4th loads at 240 bar compared to other injection pressure for both sources. This result caused when increasing the injection pressure, the fuel droplets size decreases and then the fuel droplets momentum increases. And they have collided on the engine cylinder wall then produce same power, the fuel consumption also increased. From all pressure the diesel has lower BSFC value at 200 bars at full load condition.

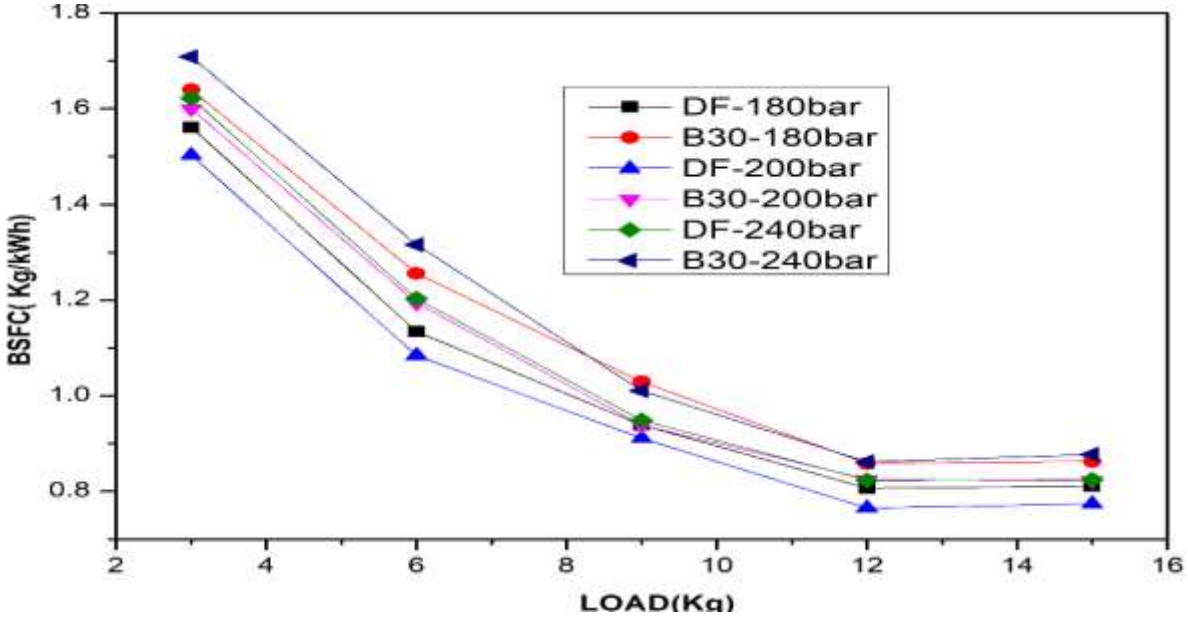

Figure 5.5 BSFC VS LOAD

VII. CONCLUSION

The engine was made to run on diesel fuel mode, and blends of turpentine and turmeric oil and diesel mode. The experiments were conducted at three different fuel injection pressures of 180, 200 and 240 bar. The performance and emissions of the engine at full load were investigated. The following results were obtained.
Engine was able to run on 180, 200 and 240 bar fuel injection pressures on diesel fuel mode and blends of turmeric and turpentine oils and diesel.

A. The HC emission of B30 is less at all loads compared to diesel.
B. The CO emissions are low for B30 at 240 bars than diesel.
C. Break Thermal efficiency nearly equal to the diesel for 60% load at B30 and 200 bar.
D. Break specific fuel consumption lower at B30 and 200 bar compare with diesel fuel for 240 bar .
E. The NOx emissions are lesser at 240 bars compare to pure diesel.
Based on the experimental investigation it can be concluded that B30 blends of turpentine and turmeric oils can be adopted as an alternative fuel for CI engines.

REFERENCES

1. Sachin I. Meshram, Prof. M. S. Deshmukh, "Evaluation of Performance and Emission Characteristics of Turmeric Leaves-based Fuel on 4-stroke SI Engine", Third International Conference on Emerging Trends in Engineering and Technology.
2. Swarup Kumar Nayak, Bhabani Prasanna Pattanaik, Experimental Investigation on Performance and Emission Characteristics of a Diesel Engine Fuelled with Mahua Biodiesel Using Additive, 4th International Conference on Advances in Energy Research 2013, ICAER 2013.
3. Waghmode D.R. , Gawande J.s "Performance and Emission Analysis of a Diesel Engine Fuelled With Waste Turmeric oil."
4. R.KARTHIKEYAN" Turpentine Blend Composition With Diesel Oil"
5. DR.N.V. MAHALAKSHMI" Turpentine Blend Composition With Diesel Oil"
6. M.L.S.Deva Kumar "Effect Of Injection Pressure On The Performance And Emission Characteristics Of Di Diesel Engine Running On Nelli Oil And Diesel Fuel Blend".
7. Altin R, Cetinkaya S and Yucesu H S (2001), "The Potential of Using Vegetable Oil Fuels as Fuel for Diesel Engines",Energy Conversion and Management Vol. 42, pp. 529-538.
8. Narendra Kumar Yadav , Rajesh Gupta, Pankaj Dubey " Emission Reduction by using Linseed & Turpentine Oil Blend as Alternative Fuel in Diesel Engine."
9. R. Karthikeyan, N.V. and Mahalakshmi(2007), Performance and emission characteristics of a turpentine-diesel dual fuel engine. Energy 32(2007) 1202-1209.
10. O.Arpa, R.Yumrutas, and M.H. Alma(2010). Effects of turpentine and gasoline-like fuel obtained from waste lubrication oil on engine performance and exhaust emission.Energy 35(2010) 3603E3613.