International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 01 | Jan 2021 www.irjet.net p-ISSN: 2395-0072

AN EXPERIMENTAL INVESTIGATION AND REDUCTION OF NOx AND HC EMISSION IN C.I DIESEL ENGINE FUELED WITH PROSOPIS JULIFLORA SEED OIL

S.PRATHEEPAN[1], S.VIGNESH[2], V.B.VIBIN[3]

[1,2,3]Student, Dept. Of Mechanical Engineering, Vels institute of science, technology & advance studies, Chennai-600 117.

---***---

Abstract - *The present fossil fuel crisis and increasing vehicle population made us to think of alternate fuels. The abundance of the fossil fuels is expected to be exhaust in another 20-30 years. The cost of the fossil fuels is day by day increasing and also the emission from these fuels increases the air pollution. With keeping in view of all the above said points, it is made us to think of alternate fuels for all Combustion Ignition Engines. Among alternate fuels, the Prosopis Juliflora seed oil (15%,25% and 35%) blended with diesel will promise for substituting the diesel as a bio diesel. With pure vegetable oils there is combustion problems, and which leads to more emissions in the exhaust. The present investigation evaluates Prosopis Juliflora seed oil blended with Diesel in a diesel Engine along with additives of Eucalyptus oil. A single cylinder Diesel Engine adapted to investigate the Brake thermal efficiency, Brake specific energy consumption, and emission characteristics. In this investigation, the diesel engine was tested using Diesel and Biodiesel. From these investigations the emissions like HC, CO and CO_2 was reduced and Biodiesel is substitute to diesel fuel. To overcome the above problems here use combustion additives as eucalyptus at the time of combustion. So here we use Prosopis Juliflora seed oil blended with Eucalyptus oil as alternative fuels in diesel Engine and perform various tests and evaluate its performance. The results were compared with regular diesel.*

Key Words: (Size 10 & Bold) Key word1, Key word2, Key word3, etc (Minimum 5 to 8 key words)…

1. INTRODUCTION

The petroleum fuel depletion moving fast day by day and consequently the price of petroleum fuel hikes have made a severe impact on the power and transport sectors, also on the national and international economy. The importance of biodiesel increases gradually due to the depletion of petroleum reserves and improve in environmental concerns. Prosopis juliflora seed oil is non-edible oil and it is available in huge surplus quantities in South Asia. The prosopis juliflora seed oil production in India is estimated to be 30,000 tons per annum. Vegetable oils are environmentally friendly and it might provide a feasible substitute for diesel since these are renewable in nature. Various non-edible oils, such as prosopis juliflora seed oil, jatropha, rubber seed, mahua, waste cooking and cotton seed oils, are investigated for their suitability to diesel engine fuels.

2. METHODOLOGY

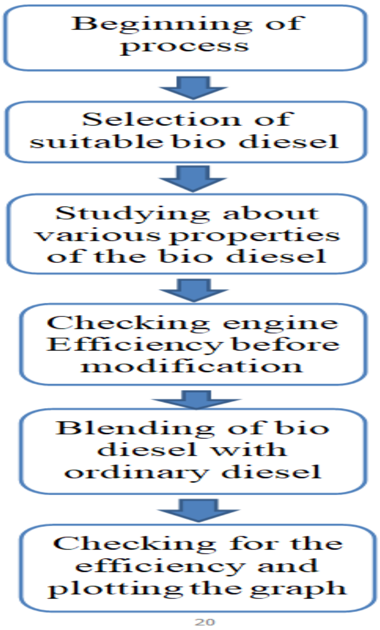

Fig 2.1 Methodology.

3. NECESSITY FOR IMPROVING ENGINE PERFORMANCE

Diesel is used in most industrial sectors overwhelmingly because it provides more power per unit of fuel and its lower volatility makes it safer to handle. One really exciting prospect of diesel over petrol is the possibility of eliminating petroleum consumption entirely. The vast majority of modern heavy road vehicles like trucks and buses, ships, long-distance trains, large-scale portable power generators, and most farm and mining vehicles have diesel engines. Diesel engines are the prime movers for heavy duty vehicles used in the transportation and agricultural sectors. Now a day diesel engine is mostly used of power generation in all over world so that the improving the performance of diesel engine is much important.

4. THEORETICAL STUDY OF EXPERIMENTAL SETUP

4.1 STROKE DIESEL ENGINE:

Diesel engines are manufactured in two-stroke and four-stroke versions. They were originally used as a more efficient replacement for stationary steam engines. Since the 1910s they have been used in submarines and ships. Use in locomotives, trucks, heavy equipment and electric generating plants followed later. In the 1930s, they slowly began to be used in a few automobiles. Since the 1970s, the use of diesel engines in larger on-road and off-road vehicles in the USA increased. As of 2007, about 50% of all new car sales in Europe are diesel. The diesel engine has the highest thermal efficiency of any regular internal or external combustion engine due to its very high compression Ratio.

4.2 CONSTANT PRESSURE CYCLE

The diesel internal combustion engine differs from the gasoline powered Otto cycle by using highly compressed hot air to ignite the fuel rather than using a spark plug (compression ignition rather than spark ignition). In the true diesel engine, only air is initially introduced into the combustion chamber. The air is then compressed with a compression ratio typically between 15:1 and 22:1 resulting in 40-bar (4.0 MPa; 580 psi) pressure compared to 8 to 14 bars (0.80 to 1.4 MPa) (about 200 psi) in the petrol engine. This high compression heats the air to 550 °C (1,022 °F). At about the top of the compression stroke, fuel is injected directly into the compressed air in the combustion chamber. This may be into a void in the top of the piston or a pre-chamber depending upon the design of the engine.

4.3 WILLAN'S LINE METHOD

In this method, gross fuel consumption vs. BP at a constant speed is plotted and the graph is extrapolated back to zero fuel consumption. The test is applicable only to compression ignition engines. IC Engine Testing.

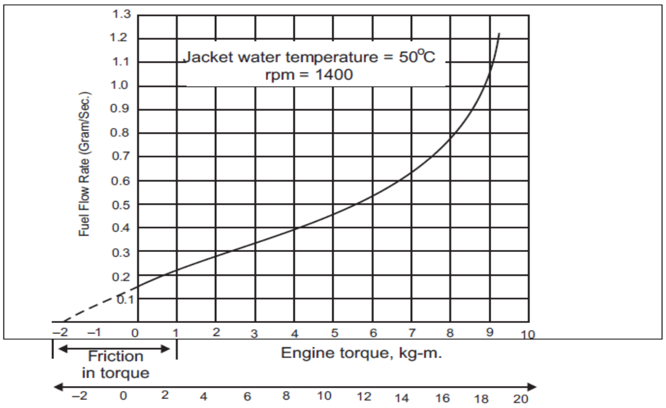

Fig 4.1 Willan's line method

4.4 AIR FUEL RATIO

Air fuel ratio is defined as the ratio of mass of air and mass of fuel present in combustion cycle. A 'Stoichiometric' AFR has the correct amount of air and fuel to produce a chemically complete combustion event. For gasoline engines, the stoichiometric, A/F ratio is 14.7:1, which means 14.7 parts of air to one part of fuel. The stoichiometric AFR depends on fuel type-- for alcohol it is 6.4:1 and 14.5:1 for diesel.

5. DESCRIPTION ABOUT COMPONENTS

5.1 DIESEL ENGINE

The diesel engine has the highest thermal efficiency of any regular internal or external combustion engine due to its very high compression ratio. Low-speed diesel engines (as used in ships and other applications where overall engine weight is relatively unimportant) can have a thermal efficiency that exceeds 50%.

5.2 U-TUBE MANOMETER

A manometer could also refer to a pressure measuring instrument, usually limited to measuring pressures near to atmospheric. The term manometer is often used to refer specifically to liquid column hydrostatic instruments. In this project ac motor is used.

5.3 DATA ACQUISITION SYSTEM

Data acquisition is the process of sampling signals that measure real world physical conditions and converting the resulting samples into digital numeric values that can be manipulated by a computer. Data acquisition systems (abbreviated with the acronym DAS or DAQ) typically convert analog waveforms into digital values for processing. The components of data acquisition systems include: Sensor that convert physical parameters to electrical signals.

5.4 LOAD SYSTEM

The purpose of a load bank is to accurately mimic the operational or "real" load that a power source will see in actual application. However, unlike the "real" load, which is likely to be dispersed, unpredictable and random in value, a load bank provides a contained, organized and fully controllable load.Consequently, a load bank can be further defined as a self-contained, unitized, systematic device that includes load elements with control and accessory devices required for operation.

5.5 GENERATOR

In electricity generation, an electric generator is a device that converts mechanical energy to electrical energy. A generator forces electric current to flow through an external circuit. The source of mechanical energy may be a reciprocating or turbine steam engine, water falling through a turbine or waterwheel, an internal combustion engine, a wind turbine, a hand crank, compressed air, or any other source of mechanical energy. Generators provide nearly all of the power for electric power grids.

5.6 FUEL TANK

A fuel tank (or diesel tank) is a safe container for flammable fluids. Though any storage tank for fuel may be so called, the term is typically applied to part of an engine system in which the fuel is stored and propelled (fuel pump) or released (pressurized gas) into an engine. Fuel tanks range in size and complexity from the small plastic tank of a butane lighter to the multi-chambered cryogenic Space Shuttle external tank.

5.7 PRESSURE GAUGE

Several groups in various sectors are conducting research on Juliflora curcas, a poisonous shrub-like tree that produces seeds considered by many to be a viable source of biodiesel feedstock oil. Much of this research focuses on improving the overall per acre oil yield of Juliflora through advancements in genetics, soil science, and horticultural practices.

5.8 MEASURING JAR

A measuring cup or measuring jug is a kitchen utensil used primarily to measure the volume of liquid or bulk solid cooking ingredients such as flour and sugar, especially for volumes from about 50 ml upwards. The cup will usually have a scale marked in cups and fractions of a cup, and often with fluid measure and weight of a selection of dry foodstuffs. Measuring cups are also used to measure washing powder, liquid detergents or bleach, with a measuring cup not also used for food.

5.9 VOLTAGE REGULATOR

Electronic voltage regulators are found in devices such as computer power supplies where they stabilize the DC voltages used by the processor and other elements. In automobile alternators and central power station generator plants, voltage regulators control the output of the plant. In an electric power distribution system, voltage regulators may be installed at a substation or along distribution lines so that all customers receive steady voltage independent of how much power is drawn from the line.

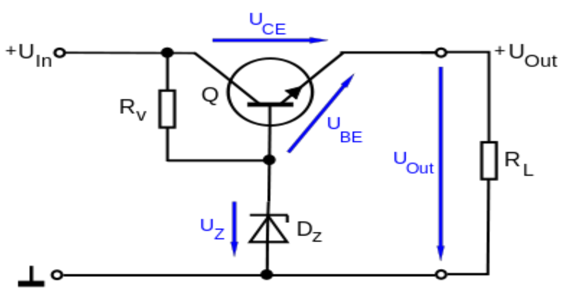

Fig 5.1 Voltage regulator

5.10 PROPERTIES OF BIODIESEL

Table 5.1 Properties of BioDiesel

PROPERTY	NEAT DIESEL	Eucalyptus	Prosopis Juliflora Seed Oil
Flash point °C	65	32	54
Fire point °C	78	42	65
Viscosity at 40 °C	2.86	4.85 cSt	3.07 cSt
Calorific value (MJ/Kg)	44.34	42.5	41.50

6.1 WORKING PROCEDURE

Study the engine specification and then run the engine with constant speed with neat diesel and calculating the time taken for 10cc fuel consumption and total fuel consumption, specific fuel consumption, brake power and exhaust gas temperature using this values we calculated the performance and combustion characteristics of the engine. After that selecting the suitable biodiesel according to availability and calculating the properties of biodiesel that is juliflora. Comparing the properties of neat diesel and biodiesel and then blending the biodiesel with neat diesel of about 5% and then repeating the same procedure with this some of characteristics is to be change, comparing that characteristics with neat diesel and then blending with 10% with neat diesel and repeating the same procedure and calculating the same characteristics, but for blends 5% and 10% are similar to the neat diesel. Here we have collected 5 kg of Juliflora seed and extracted 1.5 litre of Raw oil.

6.2 EUCALYPTUS OIL

Eucalyptus oil is the generic name for distilled oil from the leaf of Eucalyptus a genus of the plant family Myrtaceae native to Australia and cultivated worldwide. Eucalyptus oil has a history of wide application, as pharmaceutical, antiseptic, repellent, flavoring, fragrance and industrial uses. The leaves of selected Eucalyptus species are steam distilled to extract the eucalyptus oil. Eucalyptus oils in the trade are categorized into three broad types according to their composition and main end-use: medicinal, perfumery and industrial. The most prevalent is the standard cineole-based "oil of eucalyptus", a colorless mobile liquid (yellow with age) with a penetrating, camphoraceous, woody-sweet scent.

7. ENGINE PERFORMANCE RESULTS

Blend Details	Total fuel consumption (TFC) kg/h	Specific fuel consumption (SFC) kg/kwh	Brake power (BP)kw	Indicated Power (IP) kw	Mechanical efficiency (η_M)	Brake thermal efficiency (η_{BT})	Indicated thermal efficiency (ηIT)
ND	1.31	0.26	5.06	6.73	75.22	32.72	43.5
B15	1.22	0.24	5.1	6.02	84.69	35.45	41.86
B25	1.28	0.25	5.1	5.89	86.49	33.89	39.18
B35	1.18	0.23	5.07	0.8	86.36	36.47	42.23

Table 7.1

Blend Details	Brake power (BP)kw	Specific fuel consumption (SFC) kg/kwh
DIESEL	5.06	0.26
B15	5.1	0.24
B25	5.1	0.25
B35	5.07	0.23

Table 7.2

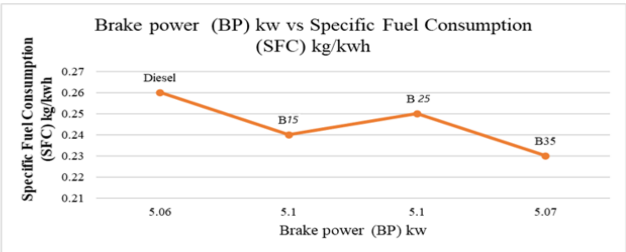

Fig 7.1 BP vs SFC

Blend Details	Brake power (BP)kw	Mechanical efficiency (η_M)
DIESEL	5.06	75.22
B15	5.1	84.69
B25	5.1	86.49
B35	5.07	86.36

TABLE 7.3

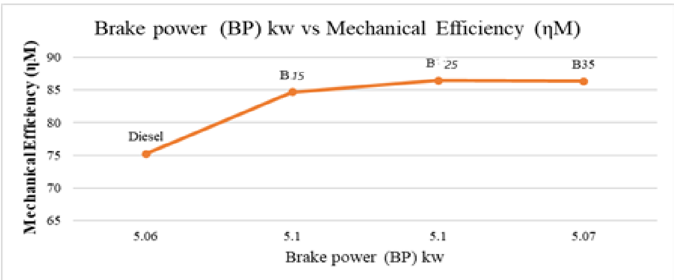

Fig 7.2 BP vs Mechanical Efficiency

Blend Details	Brake power (BP)kw	Indicated thermal efficiency (η_{IT})
DIESEL	5.06	43.5
B15	5.1	41.86
B25	5.1	39.18
B35	5.07	42.23

Table 7.4

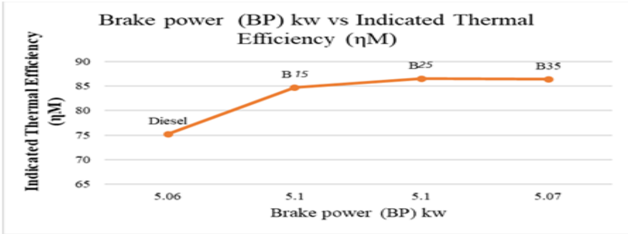

Fig 7.3 BP vs Indicated Thermal Efficiency

Blend Details	Brake power (BP)kw	Brake thermal efficiency (η_{BT})
DIESEL	5.06	32.72
B15	5.1	35.45
B25	5.1	33.89
B35	5.07	36.47

Table 7.5

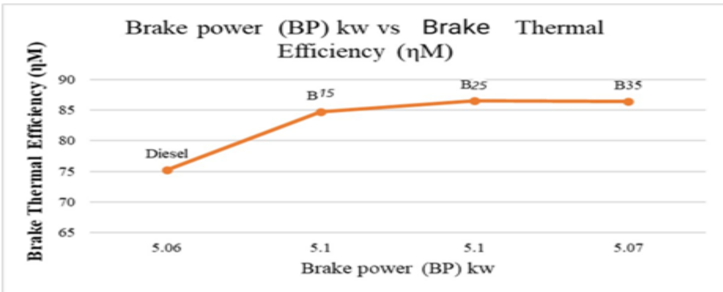

Fig 7.4 Bp vs Brake Thermal Efficiency

8. COMPARISION OF RESULTS

8.1 ENGINE EMISSIONS

Blend Details	CO %	HC PPM	NOX PPM	CO_2 %
DIESEL	0.239	45	2023	9.96
B15	0.075	15	2328	9.4
B25	0.078	19	2316	9.55
B35	0.088	26	2295	9.8

Table 8.1

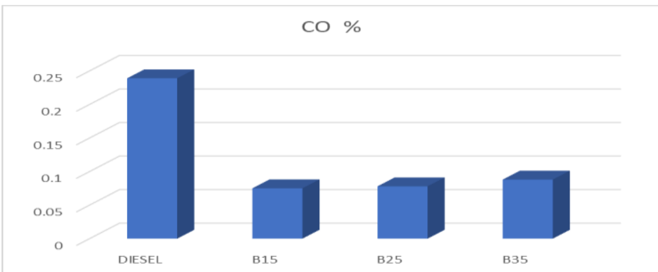

Fig 8.1 CO

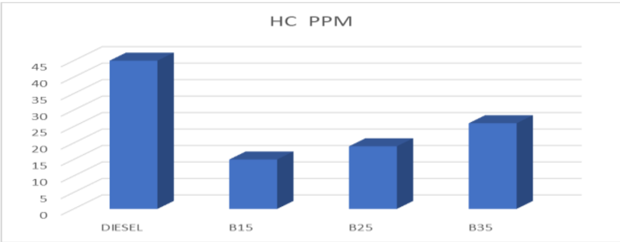

Fig 8.2 HC PPM

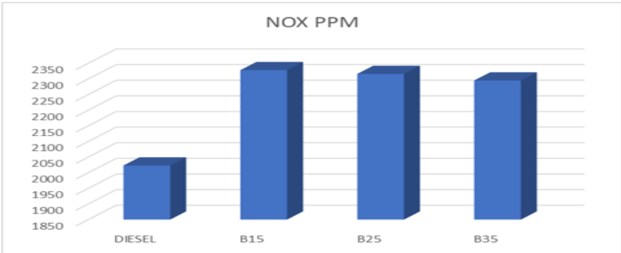

Fig 8.3 NOX PPM

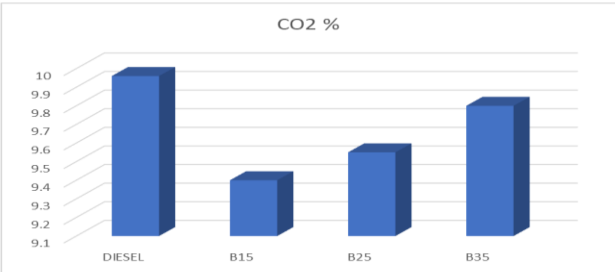

Fig 8.4 CO2%

8.2 Engine Combustion

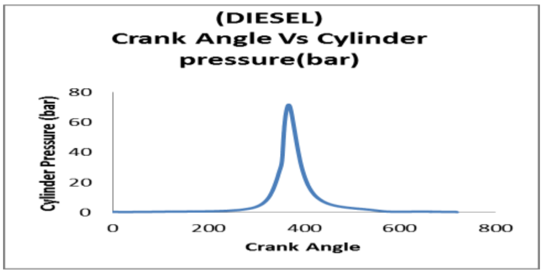

Fig 8.5 Crank Angle vs Cylinder Pressure

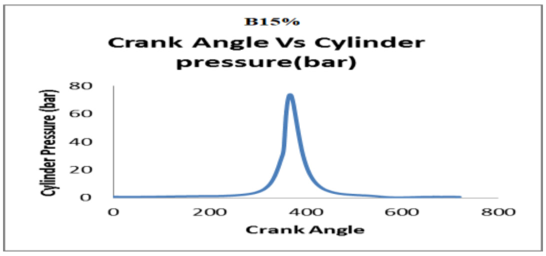

Fig 8.6 B15%

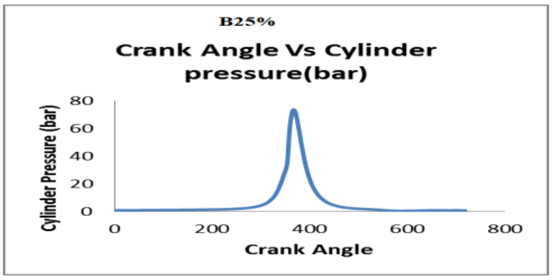

Fig 8.7 B25%

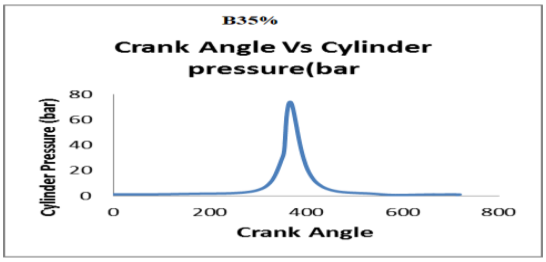

Fig 8.8 35%

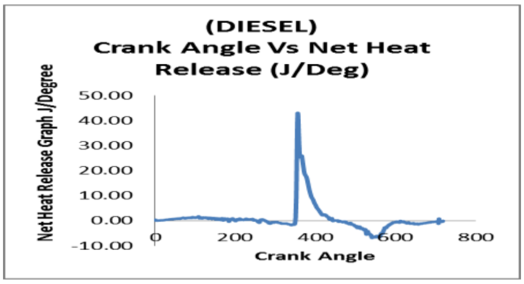

Fig 8.9 Crank angle vs heat release J/degree

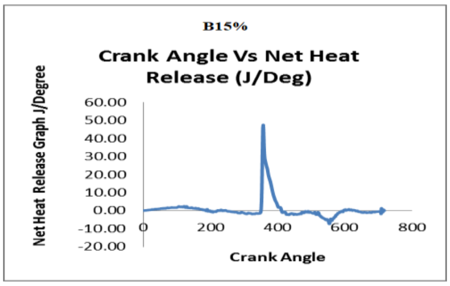

Fig 8.10 15%

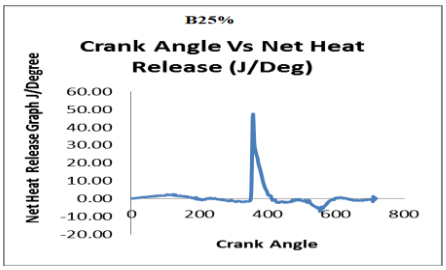

Fig 8.11 25%

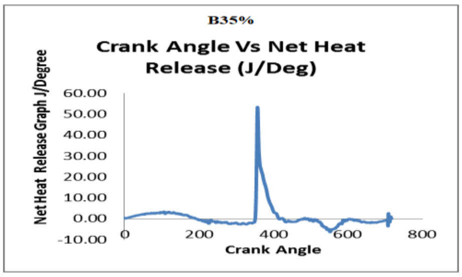

Fig 8.12 35%

9. CONCLUSIONS

The present experimental investigation has dealt with the production of biodiesel from eucalyptus, prosopis Juliflora seed oil measurement of properties and performance evaluation on blends of biodiesel at various loads. The fuel properties like density, flash point, viscosity and calorific value of all the blends are very similar to diesel and therefore diesel may be well replaced by biodiesel in near future. This makes the fuel to become the "On Farm Fuel" where farmer can grow his own resource, convert to biodiesel and use in agricultural sets itself without the need of any diesel for blending. The low efficiency may be due to low volatility, slightly higher viscosity and higher density of the biodiesel of prosopis Juliflora seed oil, which affects mixture formation of the fuel and thus leads to good combustion. The performance characteristics of single cylinder compression ignition engine fuelled with eucalyptus, prosopis Juliflora seed oil and its different blends have been studied and compared to the standard diesel fuel. The experiment was carried out with different parameters Vs various loading conditions. The investigation results pointed out that, the prosopis Juliflora seed oil can be directly used in a diesel engine as a result of its unique chemical possessions. Based on the experimental results the following conclusions were made. 25% of prosopis Juliflora seed oil showed significantly comparable thermal efficiency and consumption of specific fuel with diesel, which is noteworthy as a biodiesel while alcohol fuels suffer a setback of higher fuel consumption. According to the emission reports, the HC and CO and CO_2 emissions level have been considerably reduced for prosopis Juliflora seed oil compared with regular diesel at full loading conditions. On the other hand, prosopis Juliflora seed oil shows an advanced level of NOX emission compared with normal diesel. As a result, it was concluded that HC and CO and CO_2 emission reduction is possible when the outlay of advanced NOX attained from the prosopis Juliflora seed oil biofuel used in a constant speed single cylinder diesel engine without any alterations.

REFERENCES

[1] Ch.S. Naga Prasad, K. Vijaya Kumar Reddy, B.SP. Kumar, E. Ramjee, O.D. Hebbel and M.C. Nivendgi (2009) performance and emission characteristics of a diesel engine with castor oil, Indian journal of science and technology ISSN: 0974-6846 Vol.2 No.10 (2009).

[2] D. Vashist, and M. Ahmed (2012) comparative study of performance and Emission characteristics of a Diesel Engine Fuelled by Castor and jatropha Methyl Ester with the help of T Test, International Journal of Automotive Engineering Vol. 2, No. 2, April 2012.

[3] M.C. Navindgi , Maheswar Dutta and B. Sundheerprem Kumar (2012) performance evaluation , emission characteristics and economic analysis of four non –edible straight vegetables oils on a single cylinder C.I engine , ARPN journal of Engineering and Applied Sciences ISSN 1819-6608 Vol. 7, No. 2, February (2012).

[4] Deshpande D.P., Urunkar Y.D. and Thakare P.D. (2012) production of Biodiesel from Castor Oil using acid and Base catalysts, Research Journal of Chemical Sciences ISSN 2231-606X Vol. 2 (8), 51-56, August (2012).

[5] A.S. Ramadhas, C. Muraleedharan, S. Jeyaraj (2005) Performance and emission evaluation of a diesel Engine fuelled with methyl esters of rubber seed oil, Renewable Energy 30 (2005) (1789-1800).

[6] DevendraVashist and Dr. Mukhtar Ahmed (2011). A Comparative Study of Castor and Jatropha Oil Source and its methyl ester Test on the Diesel Engine, International Journal of Engineering Science and Technology, ISSN: 0975-5462 Vol. 3 No. 6 June 2011.