International Journal of Engineering, Science and Mathematics
Vol. 6 Issue 8, December 2017 (Special Issue)
ISSN: 2320-0294 Impact Factor: 6.765
Journal Homepage: http://www.ijesm.co.in, Email: ijesmj@gmail.com Double-Blind Peer Reviewed Refereed Open Access International Journal - Included in the International Serial Directories Indexed & Listed at: Ulrich's Periodicals Directory ©, U.S.A., Open J-Gage as well as in Cabell's Directories of Publishing Opportunities, U.S.A

AN EXPERIMENTAL INVESTIGSTION OF PERFORMANCE, COMBUSTION AND EMISSION CHARACTERISTICS OF DIESEL ENGINE FUELED WITH BIO DIESEL AND ITS BLENDS

Shaik Chand Mabhu Subhani[1]
S.Koteswara Rao [2]
P.Durga Neeharika [3]
Dr. K. Srinivasa rao [4]
N.Vijay kumar [5]

Keywords:
Tyre oil,
Cotton seed oil,
Engine performance,
Combustion
Emission parameters.

Abstract

" Petroleum based fuels play a vital rule in rapid depletion of conventional energy sources along with incredible demand and also major contributes of air pollution which helps to address the energy, cost and global warming Bio diesel is define as the mono alkali Easters of long chain fatty acids derived from renewable lipid sources. It is made from vegetable oil, animal fats and other resources that can be used with little or no engine modification. The biodiesel is oxygenated, non toxic, sulphur free bio degradable and renewable fuel.
The cotton seed oil and Tyre oil was blended with diesel in some different composition varying from 0% to 20% in steps of 10%. Clean and renewable bio fuel have been treated as touted as the answer to issue of demisting fossil fuel. The performance, combustion and exhaust emission of a diesel engine were experimentally investigated using bio diesels fuel with promising economic perspective ,one obtain from cotton seed oil and other obtain from waste types such as tyre oil.

The various performance, combustion and emission parameters like brake mean effective pressure (BMEP), brake power (BP), brake specific fuel consumption(BSFC), mechanical efficiency (Mech. Eff.), brake thermal efficiency (BthEff),heat release rate, max combustion pressure, mass fraction of fuel burn, CO emissions, CO2 emissions, HC emissions, NOx emissions were evaluated at Torque in a Four stroke single cylinder diesel engine. These performance and emission parameters of diesel fuel were compared with that of C0T10D90, C0T20D80, C10T0D90, C10T10D80, C10T20D70, C20T0D80 and C20T10D70. The performance parameters of C20T10D70 blend were similar to those of diesel

Additives plays an important role in minimize the HC and NO_X which results in the sign of relief who are opting bio diesel as an alternative fuel"

Author correspondence:
Shaik chand mabhu Subhani,
Assistant Professor, Department of Mechanical Engineering
Narasaraopeta Institute of Technology, Narasarao pet, Guntur dt, AP

1. Introduction

Energy is very important for society as it is used to sustain and improve well-being. It exists in various forms, from many different sources. Historically, with economic development, energy needs grew, utilizing natural resources such as wood, hydro, fossil fuels, and nuclear energy in the preceding century. However, rising concerns on energy security, economic development, and climate change in the recent past have focused attention on using alternative sources of energy such as bio-fuels. Bio-fuels are the fuels produced from renewable resources, particularly plant derived materials. There are mainly two types of bio-fuels, first generation and second generation bio-fuels. The first generation bio-fuel is bio-diesel and bio-ethanol. Bio-diesel produced by transeseterifiction or reforming of vegetable oils and bio-ethanol produced by sugars/starch fermentation. On the other hand, second generation bio-fuel from lignin and cellulose such as wood straw etc. by hydrolysis to liquid fuel (not yet viable).

The difference between bio-diesel and petroleum diesel lies in the name itself. Petroleum diesel is created and is 100% petroleum based, considered as a fossil fuel. On the other hand bio-diesel is composed of biological mass. Bio-diesel is created from live feed stock such as vegetable oil, peanut oil, coconut oil, even algae oil. Bio-Diesel can be used as a direct fuel considered B100.

2. Research Method

In this chapter, methods adopted for the measurement of different properties of refined cotton seed and tyre biodiesels from seven different blends (C0T10D90, C0T20D80, C10T0D90, C20T0D80, C10T10D80, C10T20D70, and C20T10D70) has been discussed. These seven blends were fuelled in a compression ignition (C.I.) engine. The performance parameters such as BP, Brake Thermal Efficiency (BthEff), Brake Specific Fuel Consumption (BSFC), Brake mean effective pressure (BMEP) and Mechanical efficiency (MechEff) are measured. Emission parameters such as Carbon Monoxide (CO), Carbon Dioxide (CO2), Un-burnt Hydro carbon (UHC), Nitrogen Oxides (NOx) are also evaluated. These performance and emission parameters of refined cotton seed and tyre biodiesels are compared to those of pure diesel

Different types of blend

1. DIESEL : 100% PURE DIESEL
2. C0T10D90 : 0%CSO 10%TYREOIL 90% DIESEL
3. C0T20D80 : 0%CSO 20%TYREOIL 80% DIESEL
4. C10T0D80 : 10%CSO 0%TYREOIL 80% DIESEL
5. C20T0D80 : 20%CSO 0%TYREOIL 80% DIESEL
6. C10T10D80 : 10%CSO 10%TYREOIL 80% DIESEL
7. C10T20D70 : 10%CSO 20%TYREOIL 70% DIESEL
8. C20T10D70 : 20%CSO 10%TYREOIL 70% DIESEL

Determination of properties of the biodiesel

Estimation of the following properties of the produced biodiesel is discussed as below

- Kinematic viscosity
- Calorific value
- Flash point
- Fire point
- Density

The redwood viscometer:

The redwood viscometer is used for determination of viscosities of lubricating oils

S.No	Blend	Viscosity(Stokes)
1	DIESEL	2.65
2	C0T10D90	2.43
3	C0T20D80	2.32
4	C10T0D90	3.59
5	C10T10D80	3.42
6	C10T20D70	3.31

7	C20T0D80	4.53
8	C20T10D70	4.23
9	TYRE OIL	1.64
10	REFINED COTTON SEED OIL	6.92

Bomb calorimeter

The gross heat of combustion of fuel samples was determined with the help of Bomb Calorimeter

S.No	Blend	Calorific value(KJ/Kg)
1	DIESEL	46000
2	C0T10D90	45750
3	C0T20D80	45670
4	C10T0D90	45730
5	C10T10D80	45520
6	C10T20D70	45360
7	C20T0D80	45600
8	C20T10D70	45330
9	TYRE OIL	41320
10	CSO	40200

Pensky Martin (closed) apparatus:

The flash and fire point of the fuel samples were determined by using Pensky Martin (closed) apparatus

S.No	Blend	Flash Point(^{0}C)	Fire Point(^{0}C)
1	DIESEL	55	61
2	C0T10D90	54	59
3	C0T20D80	52	57
4	C10T0D90	54	60
5	C10T10D80	53	57
6	C10T20D70	51	55
7	C20T0D80	57	63
8	C20T10D70	56	62
9	TYRE OIL	46	49
10	REFINED COTTON SEED OIL	134	146

Density:

Density is defined as the mass per unit volume of a substance,

S.No	Blend	Densityat 45^{0}C (Kg/m^3)
1	DIESEL	640
2	C0T10D90	650
3	C0T20D80	660
4	C10T0D90	660
5	C10T10D80	670
6	C10T20D70	68
7	C20T0D80	660

8	C20T10D70	680
9	TYRE OIL	780
10	REFINED COTTON SEED OIL	780

Test rig specification:

Engine: Four stroke single cylinder water cooled diesel engine

Make : Kirloskar

Rated power : 3.7Kw (5 HP)

Bore dia : 80mm

Stroke length : 110mm

Connecting rod length : 234mm

Swept volume : 562cc

Compression ratio : 16.5: 1

Rated Speed : 1500 rpm

Dynamometer: Eddy current dynamometer

Make : POWER MAG

Rated torque : 2.4 kg –m

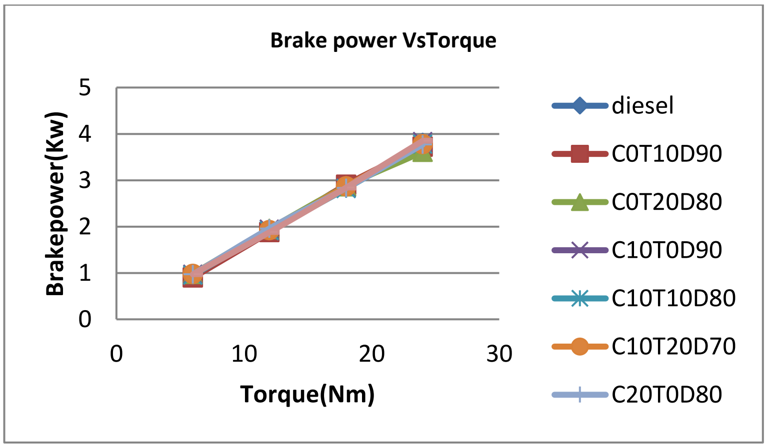
Arm length : 150mm

Fig:1 Experimental setup

3. EXPERIMENTAL SETUP AND METHADOLOGY

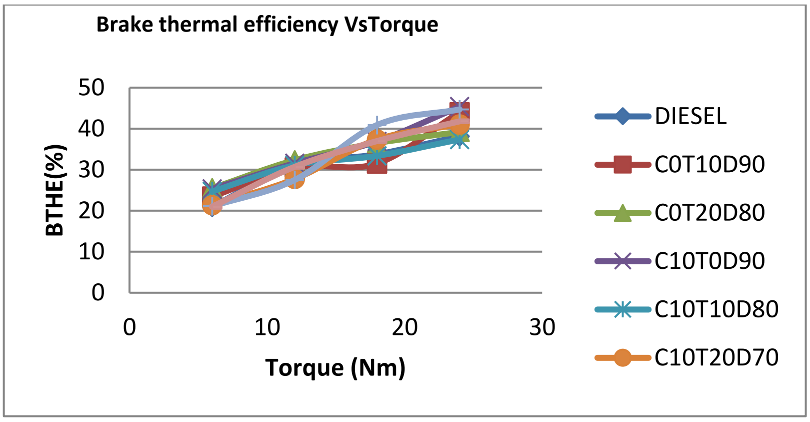
A. PERFORMANCE PARAMETERS

i. Brake power (kW) Vs Torque (Nm)



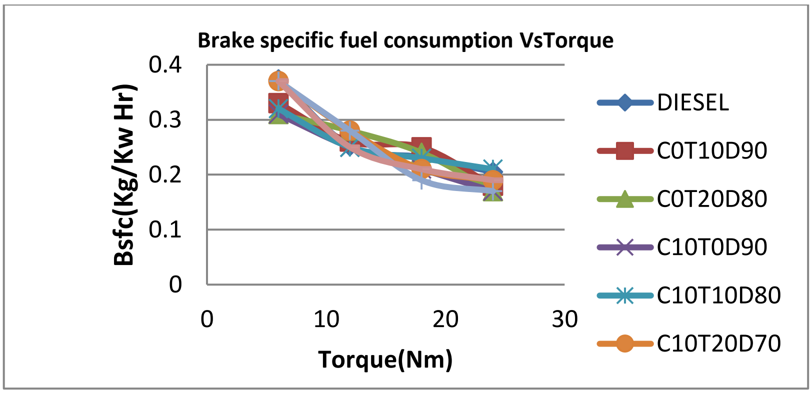
The brake power for DIESEL, C0T10D90, C0T20D80, C10T0D90, C10T10D80, C10T20D70, C20T0D80 and C20T10D70 at maximum torque of 24 Nm is 3.805kw, 3.72kw, 3.61kw, 3.83kw, 3.78kw, 3.78kw, 3.77kw and 3.85kw respectively. The brake power for C20T10D70 is 1.183% more than the diesel and for C0T20D80 is 5.125 % less than diesel. The highest is recorded with and C20T10D70 lowest with C0T20D80.

ii. Brake Thermal Efficiency (%) Vs Torque (Nm)



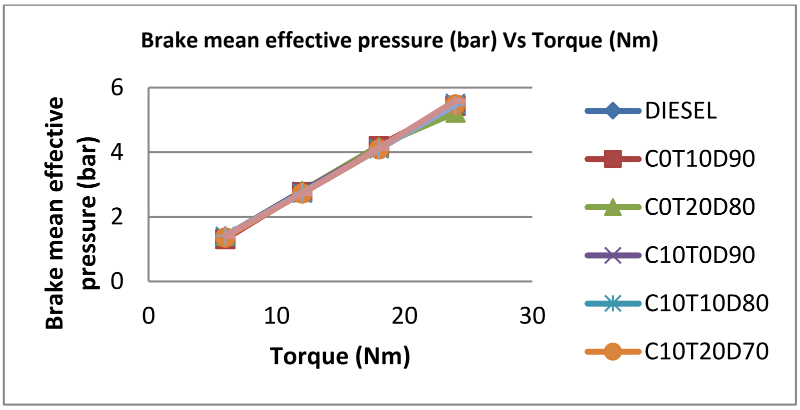
It has observed that as the applied torque is increases, the brake thermal efficiency of the fuel blends also increases. It due to increase in power developed and reduction in heat loss with increase in torque. The maximum brake thermal efficiency at full torque of 24Nm is 45.36% for C10T0D90. The brake thermal efficiencies for DIESEL, C0T10D90, C0T20D80, C10T0D90, C10T10D80, C10T20D70, C20T0D80 andC20T10D70 at maximum torque of 24 Nm are 30.135%, 44.02%, 39.19%, 45.36%, and 37.38%, 41.05%, 44.69% and 41.79% respectively. The brake thermal efficiency of C10T0D90 is 50.52% more than standard diesel.

iii. Brake Specific fuel consumption (Kg/Kw Hr) Vs Torque (Nm)



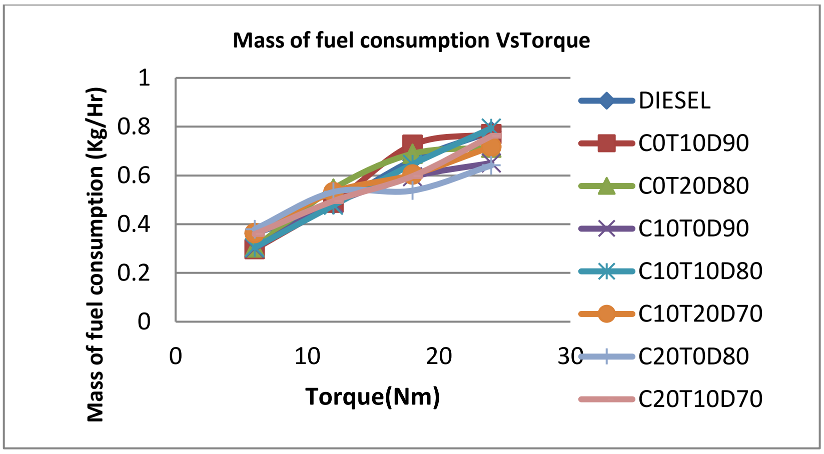
It shown that at higher torque of 24Nm , the brake specific fuel consumption for DIESEL, C0T10D90, C0T20D80, C10T0D90, C10T10D80, C10T20D70, C20T0D80 and C20T10D70 are 0.205 Kg/Kw Hr, 0.18 Kg/Kw Hr, 0.17 Kg/Kw Hr, 0.17 Kg/Kw Hr, 0.21 Kg/Kw Hr,0.19 Kg/Kw Hr, 0.17 Kg/Kw Hr and 0.19 Kg/Kw Hr. the brake specific fuel consumption for C0T20D80, C10T0D90 and C20T0D80 is 0.17 Kg/Kw.

iv. Brake mean effective pressure (bar) Vs Torque (Nm)



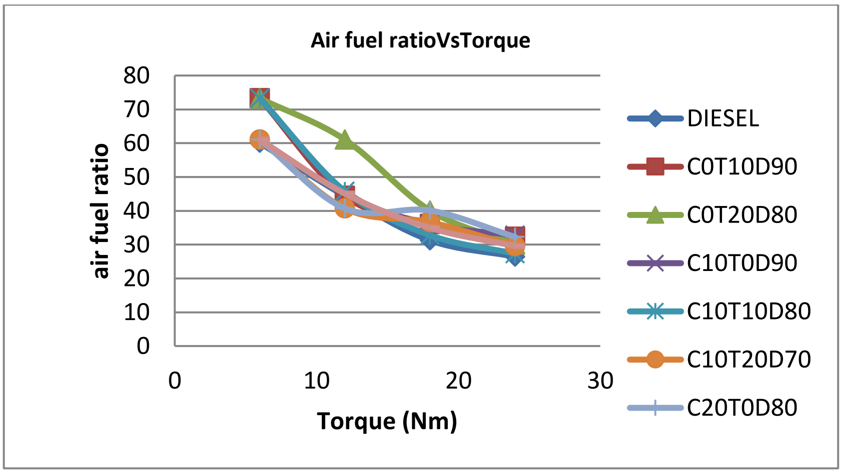
A little variation of mean effective pressure has been observed during the experiment for each blend. The regular shape of the curve indicates that the proper combustion has done in the combustion chamber of the fuel. The fig it shown that at higher torque of 24Nm , the brake mean effective for DIESEL, C0T10D90, C0T20D80, C10T0D90, C10T10D80, C10T20D70, C20T0D80 and C20T10D70 are 5.484 bar, 5.44 bar, 5.23 bar, 5.52 bar,5.49 bar, 5.48 bar, 5.46 bar and 5.60 bar.

v. Mass of fuel consumption (Kg/hr) Vs Torque (Nm)



The mass of fuel consumption of different blends of refined cotton seed and tyre biodiesel i.e. C0T10D90, C0T20D80, C10T0D90, C10T10D80, C10T20D70, C20T0D80 and C20T10D70 having mass of fuel consumption are 0.769 Kg/hr , 0.7137 Kg/hr,0.6511 Kg/hr, 0.7938 Kg/hr,0.7181 Kg/hr, 0.6409 Kg/hr and 0.7615 Kg/hr were compared with the diesel fuel having mass of fuel consumption of 0.78Kg/hr.

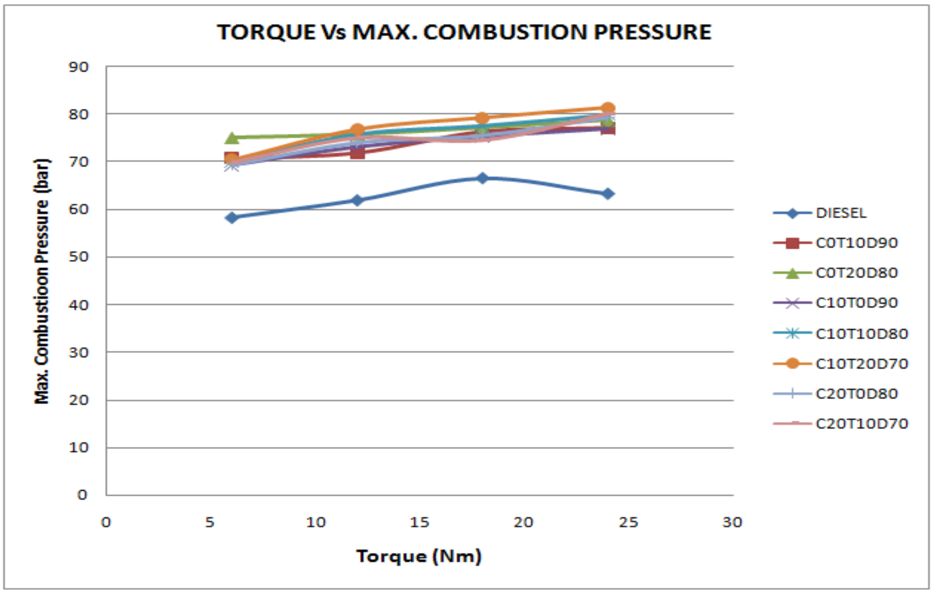
vi. Air fuel ratio Vs Torque (Nm)



It is observed that the air fuel ratio for DIESEL, C0T10D90, C0T20D80, C10T0D90, C10T10D80, C10T20D70, C20T0D80 and C20T10D70 at Torque of 24Nm are 26.444, 32.27, 30.05, 32.78, 27.31, 29.58, 32.27 and 29.58. From graph it is observed that the air fuel ratio increases as compared with diesel at full torque of 24 Nm at different blends of tyre oil and refined cotton seed oil. At maximum torque the air fuel ratio for the blend C10T10D80 is approximately near to diesel.

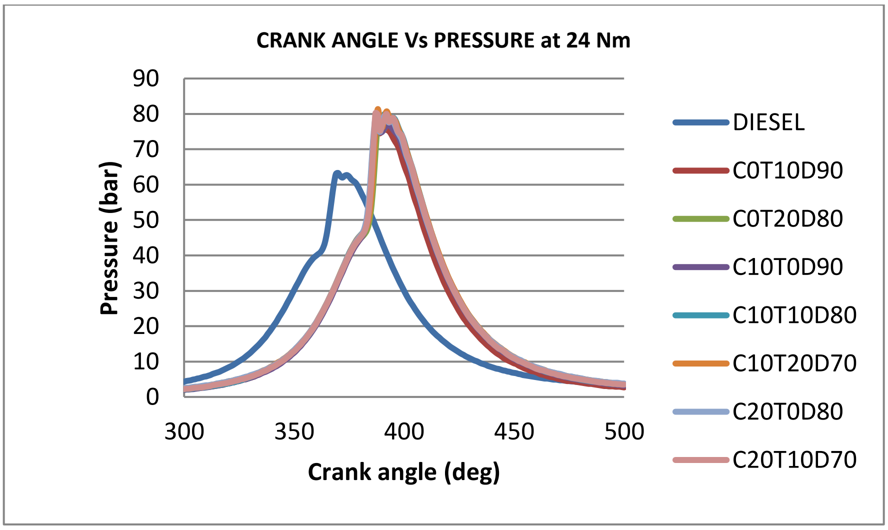
B. COMBUSTION CHARACTERISTICS

i. Maximum combustion pressure vs. Torque



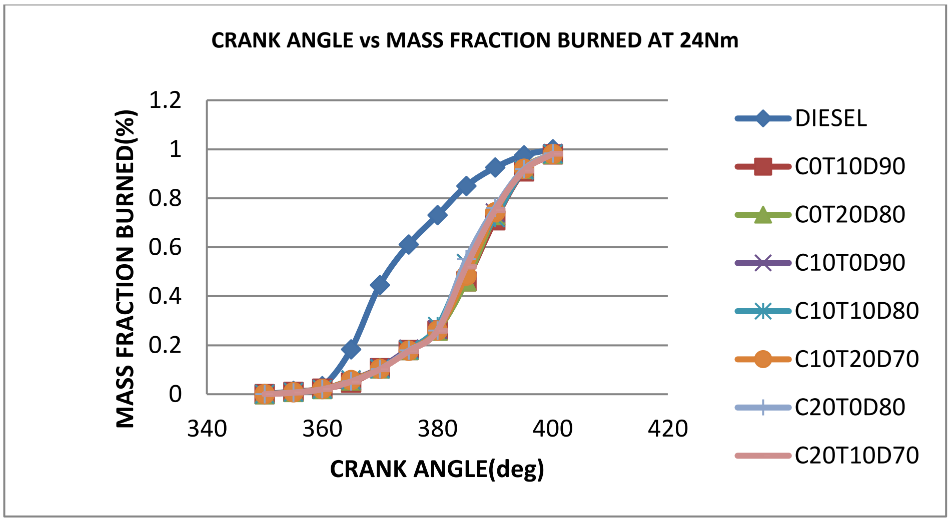
It has been observed that the blend C10T20D70 has gives higher combustion pressure due longer ignition delay of tyre oil and cotton seed oil. Longer ignition delay occurs due to fuel absorbs more heat from the cylinder immediately after injection. The peak pressure values for standard diesel, C0T10D90, C0T20D80, C10T0D90, C10T10D80, C10T20D70, C20T0D80 and C20T10D70 at Torque of 24Nm are 63.3 bar, 77.1 bar ,78.7 bar, 76.8 bar, 79.9 bar, 81.3 bar, 79.4 bar and 80.2 bar respectively.

ii. Pressure vs. Crank angle (deg)



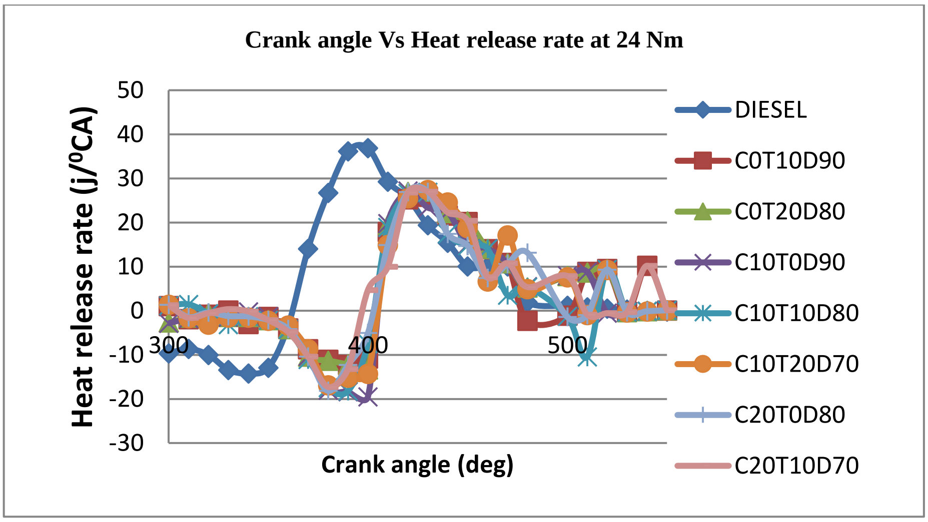
It had been concluded that the cylinder pressure decreases at the starting of the combustion and increases further. The pressure rise is due to combustion rate in initial stage, which is influenced by the fuel intake component in the uncontrolled heat release phase. The peak pressure recorded for standard diesel, C0T10D90, C0T20D80, C10T0D90, C10T10D80, C10T20D70, C20T0D80 and C20T10D70 at Torque of 24Nm are 63.3 bar, 77.1 bar,78.7 bar, 76.8 bar, 79.3 bar,81.3 bar, 79.4 bar and 80.2 bar respectively. Due to high viscosity and low volatility of bio diesel, the cylinder peak pressure is higher than the diesel.

iii. Mass fraction burnt (%) vs. Crank angle (deg)



At given torque the mass fraction burnt of blends is lower than that of standard diesel. Because of oxygen content of the fuel blends the combustion is sustained in diffusive combustion phase. At crank angle 350^0-$360^{0,}$ the mass fraction burnt for the fuel blend is same as diesel. But the crank angle $360^0 – 398^0$, the mass fraction burnt is away from diesel but at crank angle 398^0-400^0, the mass fraction slightly closer to each other." If you have an odd number of affiliations, the final affiliation will be centered on the page; all previous will be in two columns.

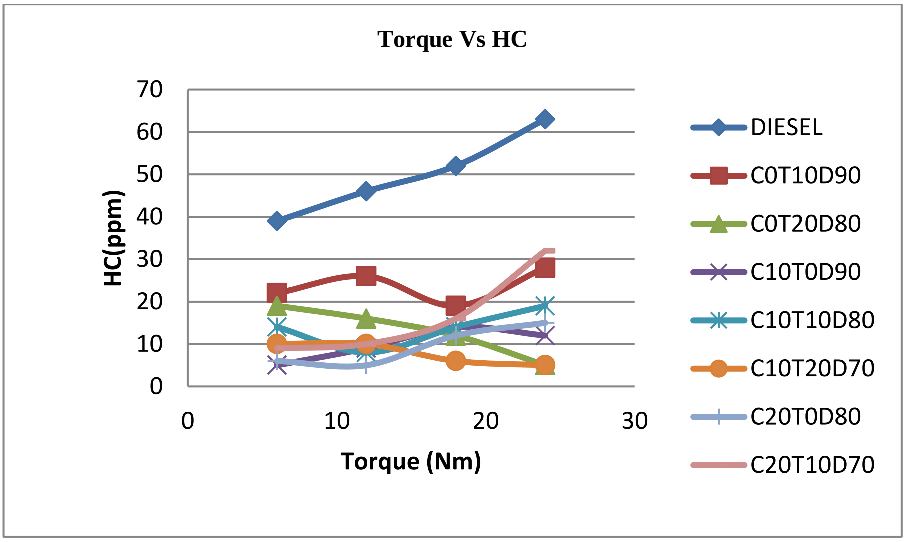
iv. Heat release rate (j/^{0}CA) vs. Crank angle (deg)



The maximum heat release rate for fuel blends C0T10D90, C0T20D80, C10T0D90, C10T10D80, C10T20D70, C20T0D80 and C20T10D70 and standard diesel at 24 Nm has been measures to be 25.83, 27.04, 27.15, 26.86, 27.4, 26.98, 27.04 and 36.86 J/°C. Based on the changes in crank angle variation of the cylinder, the heat release rate is analyzed. From the results, it has been confirmed that the heat release rate decrease at the start of combustion and increase further.

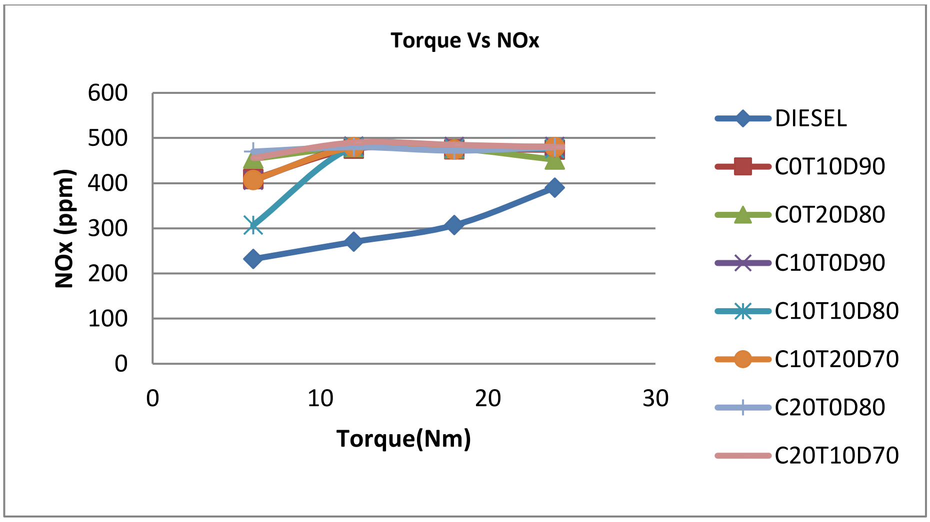
C. EMISSION ANALYSIS

i. HYDRO CARBON EMISSION (ppm) Vs TORQUE (Nm)



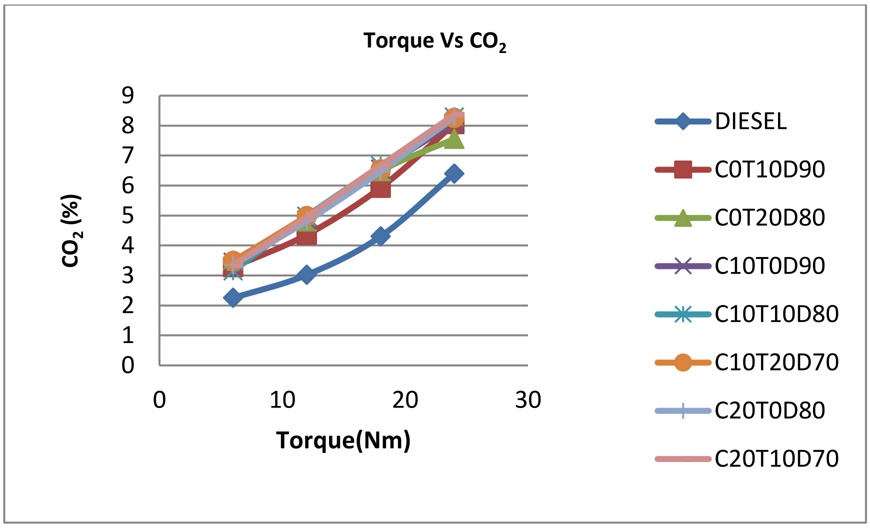
At higher load condition the hydrocarbon emission of various blends are higher except the blends C0T20D80 and C10T20D70. In vegetable oil fuels, the effect of fuel viscosity and the fuel spray quality has been expected to produce some increase in hydrocarbon content in emission. for blends C0T10D90, C10T0D90, C10T10D80, C20T0D80 and C20T10D70 increase in load increase the hydrocarbon emission and produce lesser hydrocarbon emission at 50% and above while comparing with standard diesel.

ii. NITROGEN OXIDE EMISSION (ppm) Vs TORQUE (Nm)



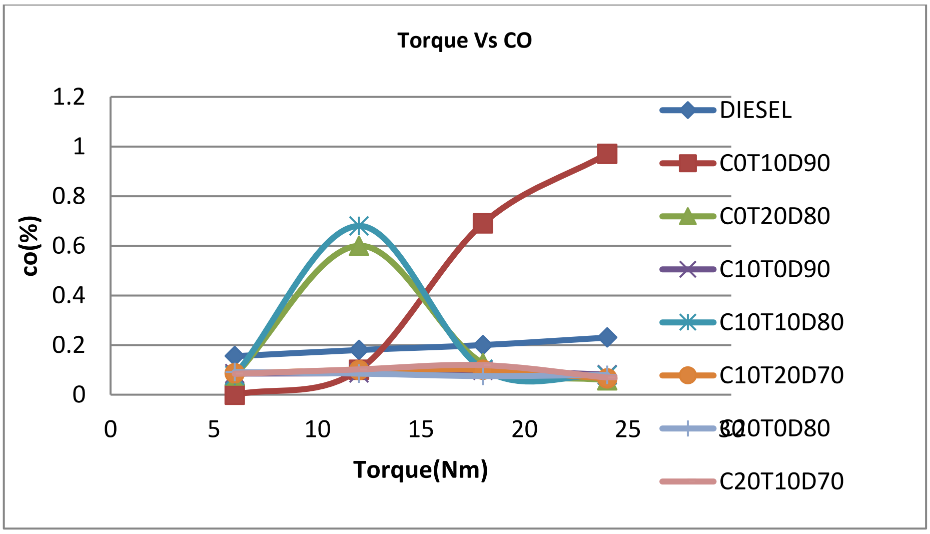
There was a gradual increase in NOx emission with increase in the blend concentration but lesser than that of diesel fuel. Due to higher heat release rates there is an increase in cylinder temperature resulting in increase in NOx emissions .The in-cylinder temperature has a strong effect on the formation of NOx. If the combustion temperature is higher, then higher NO_X is formed. This is most important characteristics of cotton seed oil, tyre oil and blends, as the NO_x emission is the most harmful gaseous emission from engine. But in case of 24Nm torque condition the nitrogen oxide emission from the C10T0D90 blend is higher than that of standard diesel and for C10T10D80 and C10T20D70. They are less when compared with other blends.

iii. CARBON DI OXIDE (%) Vs TORQUE (Nm)



The carbon dioxide emission changes with exhaust gas temperature. The increased emission of carbon dioxide in the atmosphere leads to several environmental problems like global warming and ozone layer depletion. The carbon dioxide emission from the combustion of bio fuel blends can be intake by the plants and so the carbon dioxide level is kept constant in the atmosphere. The results revels that the CO_2 emissions gradually increased with increasing Torque. Due to incomplete combustion and inadequate supply of oxygen carbon dioxide emission of the fuel blends C0T10D90 low at full load decreases.

iv. CARBON MONOXIDE (%) Vs TORQUE (Nm)



The carbon monoxide emission of the blend C10T10D80 is found to be higher for low and medium torque and closer to that of standard diesel at high Torque. For the blends of C10T20D70and C20T0D80 are having he carbon monoxide lower than that of the diesel Due to rising temperature in the combustion chamber, air fuel ratio, lack of oxygen at high speed, physical and chemical properties of fuel and smaller amount of time available for complete combustion, the proportion of carbon monoxide emission increases . The carbon monoxide emission increases for vegetable oil fuels due to the effect of fuel viscosity on the fuel spray quality.

4. Conclusion

The experimental results shown in this paper that engine performance and emissions of all blends where run on the diesel engine and compared with standard diesel fuel

- Properties of all blends are nearly equal to the diesel fuel.
- The brake power for C20T10D70 is 1.183% more than the diesel and for C0T20D80 is 5.125 % less than diesel. The highest is recorded with and C20T10D70 lowest with C0T20D80
- As the applied torque is increases, the brake thermal efficiency of the fuel blends also increases. The maximum brake thermal efficiency at full torque of 24Nm is 45.36% for C10T0D90
- The brake specific fuel consumption for C0T20D80, C10T0D90 and C20T0D80 is 0.17 Kg/Kw Hr and diesel has 0.205 Kg/Kw Hr the specific fuel consumption only increases for higher percentages of blends
- A little variation of mean effective pressure has been observed during the experiment for each blend
- The MFC of all biodiesel blends was found to be lower than diesel fuel. As the proportion of biodiesel blend increased, the MFC was observed to be increased. The MFC of C10T10D80 was higher than all other fuels
- The blend C10T20D70 has gives higher combustion pressure due longer ignition delay of tyre oil and cotton seed oil. C10T20D80 has 81.3 bar
- At crank angle 350^0-$360^{0,}$ the mass fraction burnt for the fuel blend is same as diesel. But the crank angle $360^0 – 398^0$, the mass fraction burnt is away from diesel but at crank angle 398^0-400^0, the mass fraction slightly closer to each other
- It has been confirmed that the heat release rate decrease at the start of combustion and increase further. While comparing the results obtained the heat release rate for C10T20D70 blends quite near to that of standard diesel
- At higher load condition the hydrocarbon emission of various blends are higher except the blends C0T20D80 and C10T20D70. In this work for blends C0T10D90, C10T0D90, C10T10D80, C20T0D80 and C20T10D70 increase in load increase the hydrocarbon emission and produce lesser hydrocarbon emission at 50% and above while comparing with standard diesel.
- It can be observed from the figure that there was a gradual increase in NOx emission with increase in the blend concentration but lesser than that of diesel fuel. Due to higher heat release rates there is an increase in cylinder temperature resulting in increase in NOx emissions
- Due to incomplete combustion and inadequate supply of oxygen carbon dioxide emission of the fuel blends C0T10D90 low at full load decreases.
- The carbon monoxide emission of the blend C10T10D80 is found to be higher for low and medium torque and closer to that of standard diesel at high Torque. For the blends of C10T20D70and C20T0D80 are having he carbon monoxide lower than that of the diesel.

Cotton seed oil and tyre oil promising as a best alternative fuel source of diesel engine because of its high heat content. It can be directly used as diesel fuel but having a major problem was cottonseed oil having high viscosity. From this investigation, test results showed that 20% cottonseed oil 10% tyre oil and 70% diesel (C20T10D70) and for suitable it to be used as diesel fuel without any modification of engine.

5. *References*

[1] J.B.Heywood. Internal Combustion Engines Fundamentals. McGraw-Hill Co, New York, 1988.

[2] Bhojraj N. Kale1, Dr.S.V.Prayagi " Performance analysis of cottonseed oil methyl ester for compression ignition engines" international journal of emerging technology and advanced engineering website: www.ijetae.com (issn 2250-2459, volume 2, issue 8, august 2012)

[3] Jinang M.Patel, Krunal J.Patel,Vatsal V.Patel and Kalpesh V.Vaghela " performance studies of tire pyrolysis oil blends with diesel fuel" international journal of engineering and advanced technology (ijeat) issn: 2249 – 8958, volume-3, issue-2, December 2013

[4] Ashish Jawalkar, Kalyan Mahantesh, M Jagadish "performance and emission characteristics of mahua and linseed biodiesel operated at varying injection pressures on CI engine" international journal of modern engineering research (ijmer), 2, page 1142-1149, 2012.

[5] Sk.Mohammad Younus, V.Ranjith Kumar, DR.Y.V.Hanumantha Rao" Performance and emissions characteristics of diesel engine fueled with tyre pyrolysis oil & diesel blends with additives" international journal of engineering science invention issn (online): 2319 – 6734, issn (print): 2319 – 6726 www.ijesi.org volume 2 issue 5 ‖ may. 2013 ‖ pp.32-37

[6] Alp Tekin Ergenc¸, Levent Y¨Uksek, Orkun ¨Ozener " Performance, emission, and heat release analyses of a direct injection diesel engine running on diesel and soybean ester blends" turkish j eng env sci (2013) 37: 23 – 32

[7] K.Naveen,T.Parameshwaran Pillai, Azhagiri Pon" Experimental investigation of variable Compression ratio diesel engine using ziziphus jujuba oil" international journal of innovative research in science, engineering and technology volume 3, special issue 3, march 2014, issn (online) : 2319 – 8753 issn (print) : 2347 – 6710

[8] Miqdam Tariq Chaichan, Prof. Dr. Sabah Tarik Ahmed " Evaluation of performance and emissions characteristics for compression ignition engine operated with disposal yellow grease" the international journal of engineering and science (ijes) ||volume|| 2 ||issue|| 2 ||pages|| 111-122 ||2013|| issn: 2319 – 1813 isbn: 2319 – 1805

[9] Dr. Hiregoudar Yerrennagoudaru, Manjunatha K. Chandragowda " Performance and emission characteristics of twin cylinder CI engine using cottonseed oil blended with methanol" iosr journal of mechanical and civil engineering (iosr-jmce) e-issn: 2278-1684,p-issn: 2320- 334X, volume 12, issue 1 ver. I (jan- feb. 2015), pp 47-53

[10] M.Harinatha reddy, DR P.Nageswara Reddy, DR.K.Vijayakumar Reddy " Experimental investigation of compressed ignition engine using cotton seed oil methyl ester as alternative fuel" research invent: international journal of engineering and science isbn: 2319-6483, issn: 2278- 4721, vol. 2, issue 1 (january 2013), pp 06-10 .

[11]M. Ozcanli, H. Serin, O. Y. Saribiyik, K. Aydin, And S. Serin " Performance and emission studies of castor bean (ricinus communis) oil biodiesel and its blends with diesel fuel" energy sources, 34, page 1808–1814, 2012

[12] W.M Adaileh, K.S. Alqdah "performance of diesel engine fuelled by a biodiesel extracted from waste cooking oil" energy procedia ,18, page 1317-1334, 2012.

[13] Y.C. Sharma a, B. Singh a, S.N. Upadhyay "Advancements in development and characterization of biodiesel: A review" Elsevier, Fuel 87 (2008) 2355–2373

[14] Ashish Jawalkar1, Kalyan Mahantesh1, M Jagadish "Performance and emission characteristics of mahua and linseed biodiesel operated at varying injection pressures on ci engine" international journal of modern engineering research (ijmer), 2, page 1142-1149, 2012

[15] R. K. Yadav And S. L. Sinha" performance of diesel engine using blends of Conventional diesel and jatropha bio-diesel as alternative fuel for clean environment" international journal for research in emerging science and technology, volume-2, issue-2, february-2015, volume-2, issue-2, february-2015

[16] jinang m.patel, krunal j.patel,vatsal v.patel, kalpesh v.vaghela" Performance studies of tire pyrolysis oil blends with diesel fuel" international journal of engineering and advanced technology (ijeat) issn: 2249 – 8958, volume-3, issue-2, December 2013

[17] Palash M. Mendhe, Mirzamunawwar Baig And Chetan D. Madane " Cottonseed oil used as an alternative fuel for the performance characteristics of CI engine by blending with diesel" international journal for research in emerging science and technology, volume-2, special issue-1, march-2015

[18] Vaneet Bhardwaj, Varun Singla, Pradeep Gaikwad and Gomish Sharma " Study of Performance Characteristics of Compression Ignition Engine Fuelled with Blends of Biodiesel from Used Cottonseed Oil" International Review of Applied Engineering Research. ISSN 2248- 9967 Volume 4, Number 3 (2014), pp. 289-296