Nishant Tyagi, Ambuj Sharma / International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622 www.ijera.com
Vol. 2, Issue 4, July-August 2012, pp.1673-1679

Experimental Investigation Of Neem Methyl Esters As Biodiesel on C.I Engine

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ABSTRACT:-

Diesel is a fossil fuel that is getting depleted at a fast rate. So an alternative fuel is necessary and a need of the hour. Neem oil, which is cultivated in India at large scales, has a high potential to become an alternative fuel to replace diesel fuel. Direct use of Neem oil cannot be done, as its viscosity is more than the diesel fuel, and hence affects the combustion characteristics. The Neem oil is esterified to reduce the viscosity and it is blended with diesel on volume basis in different proportions. Typical blend proportions used are: 10:90, 20:80, 30:70. The blends are used to run a single cylinder CI engine and the performance and emission characteristics were studied and compared at different load conditions. Results showed that for the B20 blend results in better performance and lower emissions. The reason for B20 to give better performance is due to extra amount of oxygen that is present in the blend and for B30 to decrease in performance is due to increased viscosity of the fuel. And hence possibilities of homogeneous mixing decrease and combustion efficiency falls down. The engine emission such as carbon monoxide, hydrocarbons, oxides of nitrogen and smoke emission were comparable to diesel operation.

Keywords: Bio-diesel, Neem oil, NO_x reduction, Alternative fuel.

INTRODUCTION

The world energy demand has been increased drastically in few decades. Firstly, the price of conventional fossil fuel is rising rapidly and has added burden on the pocket of common man and economy of the nations who imports it. Secondly, combustion of fossil fuels is the main reason behind the increasing the carbon dioxide (CO_2) level, which result in increase of global warming. The depletion of conventional sources are also becomes the main concern for research world-wide into alternative energy sources for internal combustion engines. Bio-fuels have the potential to become alternative "greener" energy substitute for fossil fuels. It is available in plenty in the world and also the renewable source of energy. It is not a new idea to use bio diesel in engine it was first used by Rudolph diesel at Paris Exposition of 1900.vegetable oils cannot be used directly in diesel engine because of their high viscosity. The high viscosity may cause blockage in the fuel lines, filters, high nozzle valve opening pressures and poor atomization. Surely vegetable oils cannot be used safely in DI diesel engines. The problem of high viscosity of vegetable oil can be overcome by heating, blending and esterifying them. Also vegetable oils have longer duration for combustion and the pressure rise is also moderate, which is not given by conventional fossil fuels.

The use of vegetable oils, such as Neem, palm, olive oil, coconut husk, rice husk, and soybean, as alternative fuels for diesel is being promoted in many countries. Depending upon the climate and soil conditions, different countries are looking for different types of vegetable oils as substitutes for diesel fuels. For example, soya bean oil in the US, rapeseed and sunflower oils in Europe, palm oil in South-East Asia (mainly Malaysia and Indonesia) and coconut oil in the Philippines are being considered. Besides, some species of plants yielding non-edible oils, e.g. Neem, Jatropha, karanja and pongamia may play a significant role in providing resources. All these plants can be grown on a large scale on agricultural/waste/marginal lands, so that there is an abundance to produce biodiesel on farm scale.

2. TRANSESTERIFICATION:

In transesterfication methyl esters are formed by mixing methanol and sodium hydroxide on mass basis 15% and 5% respectively. Actually the transesterfication is an equilibrium reaction in which the methanol is dried at the end of reaction and glycerol is by-product of this transesterfication process. In transesterfication process vegetable oils were chemically reacted with an alcohol in presence of a catalyst to produce methyl esters.

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CH-COOR1
CH2-OH        R1COOR
 |                                  |
+
 CH-COOR2     +     3ROH     Catalyst
CH-OH    +  R2COOR
 |                                  |
+
 CH-COOR3
CH2-OH        R3COOR
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TRIGLYCERIDE +METHANOL CATALYST GLYCEROL + BIODIESEL

R1, R2, R3 are long chain hydrocarbon.

The mixture was aroused continuously and then allowed to settle under gravity separating funnel. Two different layers were formed under gravity settling for 24 hr. The above layer was of ester and below was of glycerol. The below was separated out. The separated ester was mixed with some warm water (around 10% volume of ester) remove the catalyst present in ester and allowed to settle down under gravity for another 24 hr. The catalyst got dissolved in water, which was separated and removed the moisture. The methyl ester was then blended with mineral diesel in various concentrations for preparing biodiesel blends to be used in CI engine for performing engine test.

EXPERIMENTAL SETUP:

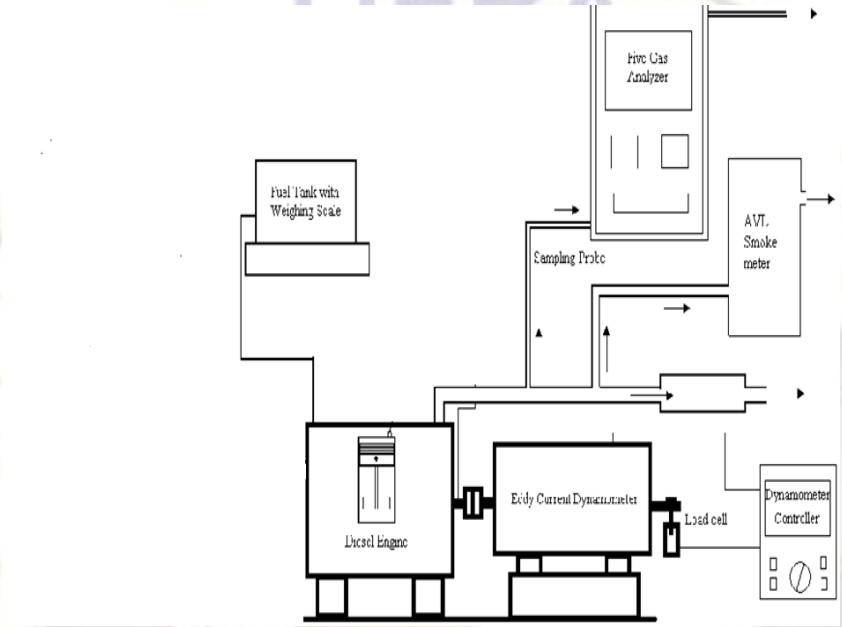

Fig.1. Experimental Setup

Properties of Neem oil before and after blending:
Before blend:

Properties	Diesel	Neem
Specific gravity	.83	.968
Viscosity(30 c) Sq. mm /sec	4.7	24.67
Calorific value (MJ/kg)	42	39
Carbon (%)	86	78.92
Hydrogen (%)	14	13.41

After blend (10% by volume with diesel)

Properties	Diesel	Neem
Specific gravity	.83	.84
Viscosity(30 c) Sq. mm /sec	4.7	5.65
Calorific value (MJ/kg)	42	41

Engine Specification:

Engine parameter	Specifications
Engine type	Kirloskar, Four stroke, Air cooled
No. of cylinder	Single cylinder
Bore	87.5 mm
Stroke	110 mm
Compression ratio	17.5:1
Rated speed	1500 rpm
Rated power	4.4 Kw
Dynamometer	Eddy current
Nozzle opening pressure	195, 205 bar.
Cubic capacity	661 cc

Study was carried out to investigate the effect of change of injection pressures on emission properties of Neem methyl ester in a stationary single cylinder diesel engine and to compare it with diesel fuel. Technical specifications of the engines are given above. The engine was coupled to Eddy current dynamometer. HORIBA-MEXA-324 FB was used for the measurement of CO and HC emissions The engine was operated on diesel first and then on methyl esters of Neem and their blends. The different fuel blend and mineral diesel were subjected to injection pressure change and their emission characteristics were tested on the engine. The performance data were then analyzed from the graphs regarding thermal efficiency, break specific fuel consumption, carbon monoxide, and hydro-carbon and NOX emissions for all blends of fuels

RESULT AND DISCUSSIONS:-

Specific Fuel Consumption:-Specific fuel consumption at different loads with all percentage of blending was found slightly decreased because of extra oxygen present in the blend is taking part in combustion process. Due to which extra amount of fuel is burning inside cylinder which improves the efficiency which results decreased specific fuel consumption. Estrification also helps to lower the temperature reaction and viscosity of fuel which results the better combustion. As increase the brake power, specific fuel consumption is decreasing for all the blends because of brake power is increasing due to better combustion which may be attributed to extra oxygen present in the blend and specific fuel consumption is quantity of fuel burned inside the cylinder for unit brake power. As we increase the percentage of biodiesel, viscosity starts playing the important role in combustion. Because of higher viscosity, fuel will not be able to atomize well inside the combustion chamber and results in poor combustion efficiency. Due to this, in B-30 blend specific fuel consumption just start increasing because of viscosity comes into the picture at this moment. In B-10 and B-20, viscosity is not predominant. It is found that B-20 is having lower specific fuel.

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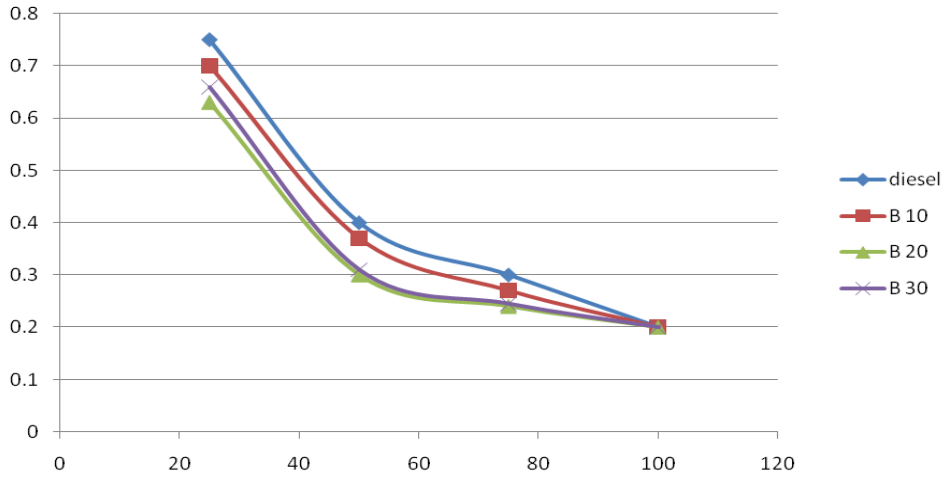
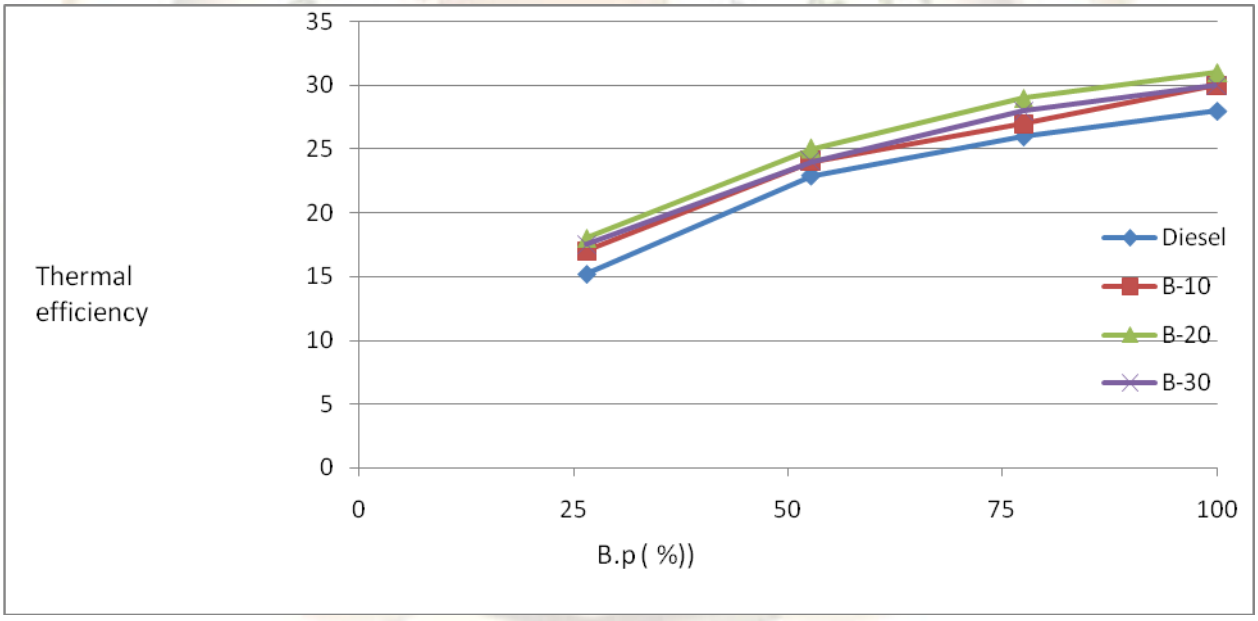
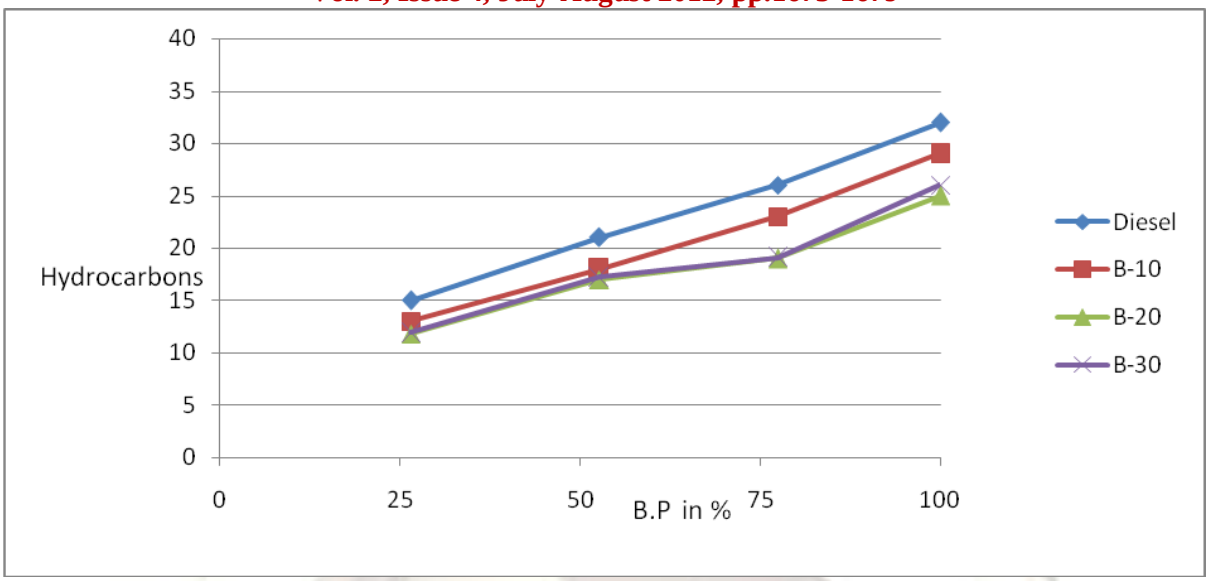


Brake Thermal Efficiency:-

An increase in break thermal efficiency may be attributed to the complete combustion of fuel because of oxygen present in blends perhaps also helped in complete combustion of fuel. It was observed that brake thermal efficiency of B10 is very close to brake thermal efficiency of diesel. Brake Thermal efficiency of B20 is better than B10 due to the more oxygen content. It is found that slight drop in efficiency of B30 because of improper combustion which may be attributed to higher viscosity than B10 and B20. Because of higher viscosity which may lead to poor mixture formation.

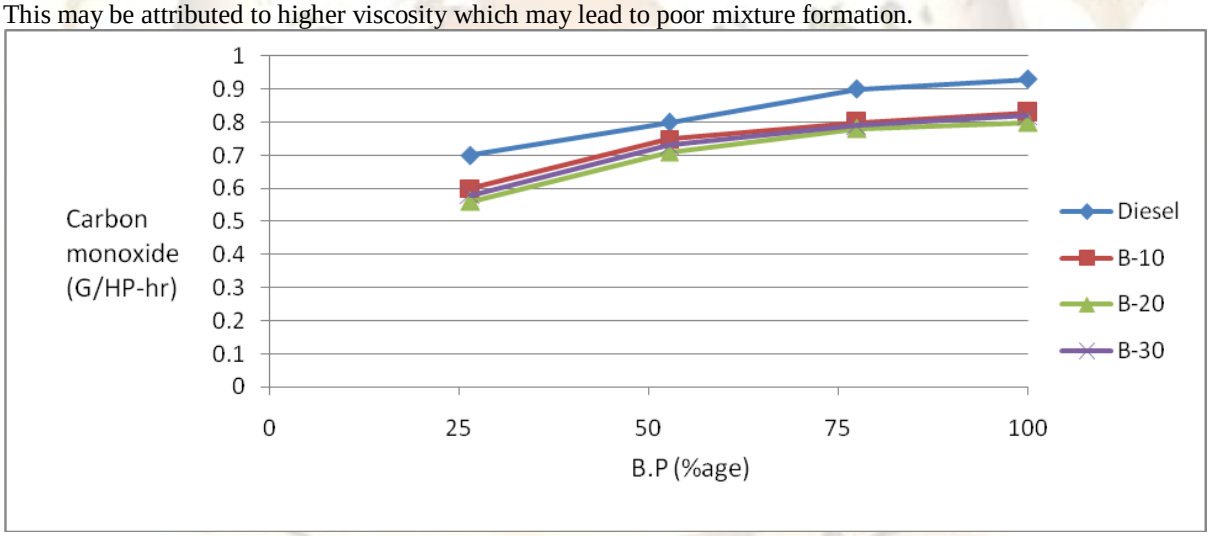


Hydrocarbon:-
Hydrocarbons were calculated by emission test for various blends of biodiesel and diesel. Quantity of hydrocarbon shows that the how the engine is performing throughout the operating range. If hydrocarbon quantity is more than engine is not performing well at this moment which means that incomplete combustion is happening inside the cylinder. Biodiesel gives fewer hydrocarbons compared to pure diesel. For B10 and B20 percentage of hydrocarbons decreases because of better combustion which may be attributed to extra oxygen present in the blend, but for B30 the percentage of hydrocarbons increases slightly due to insufficient combustion because of higher viscosity which may lead to poor mixture formation due to poor atomization.



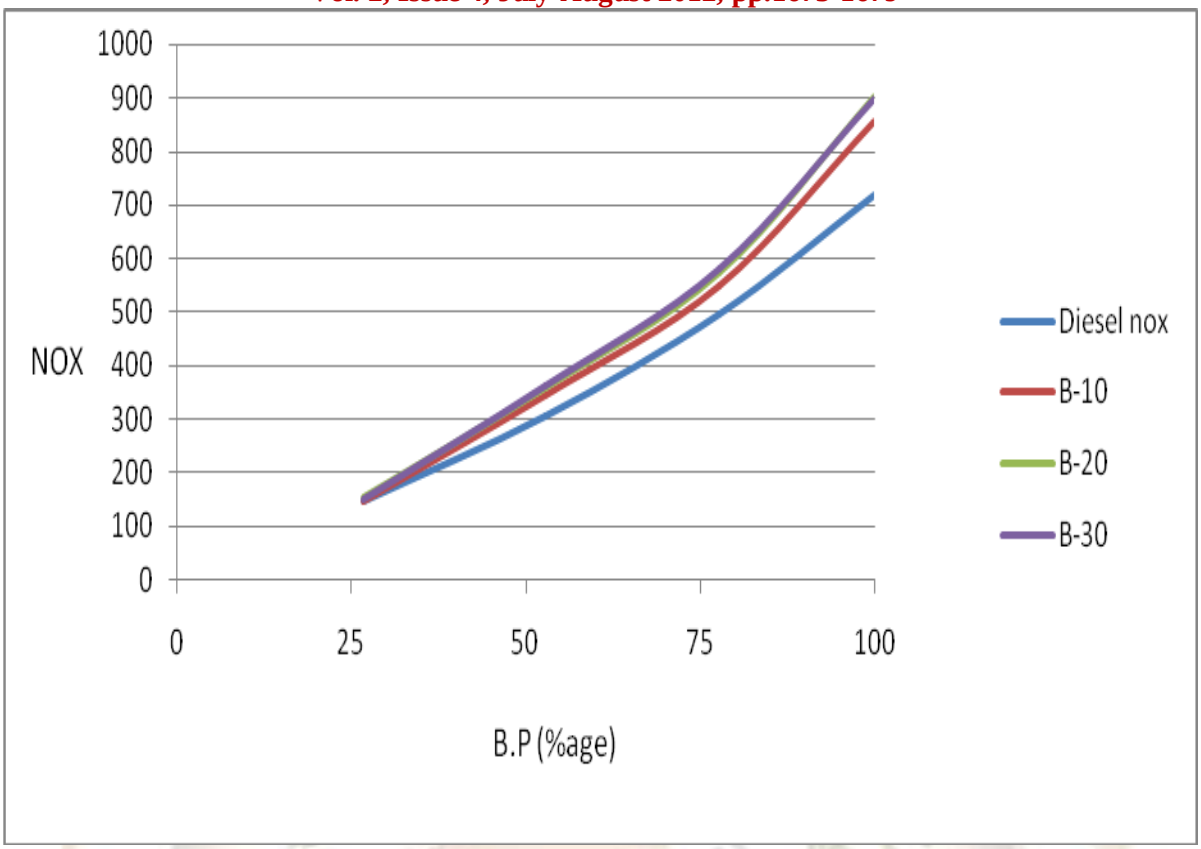
Carbon monoxide:-

Carbon monoxide was calculated by emission test for various blends of biodiesel and diesel. It also shows that the performance of engine. If the engine performs well than defiantly co emission will be less. In the presence of less oxygen, co will generate in the cylinder. Biodiesel produce less carbon monoxide than compare to pure diesel because of better combustion because extra oxygen present in the blend. When percentage of blend of biodiesel increases, carbon monoxide decreases because of extra oxygen present in the blend which may lead to better combustion. But we found slight increase in carbon monoxide in B30 because of insufficient combustion. This may be attributed to higher viscosity which may lead to poor mixture formation.



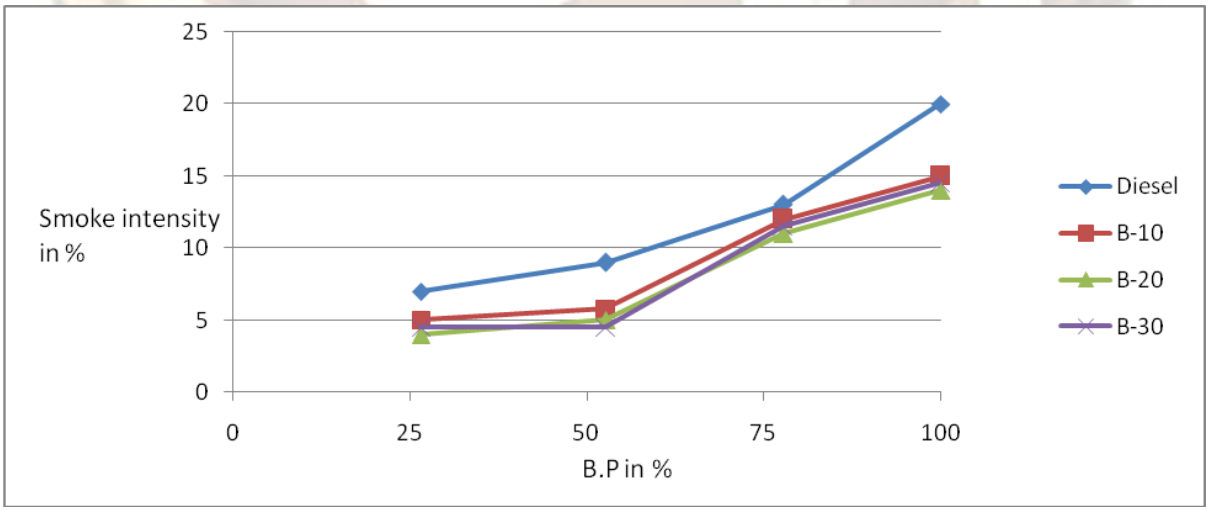
NOx:-

NOx was calculated by emission test for various blends of biodiesel and diesel. At higher temperature nitrogen will combined with oxygen and produce the oxides of nitrogen. Biodiesel gives more oxides of nitrogen as compared to pure diesel because of extra oxygen present in the blend which may lead to better combustion results higher temperature which is responsible for generating the oxides of nitrogen. One more reason for generating the oxides of nitrogen is after burning because in C.I. Engine combustion will continue till to the end of the expansion process. Those particles of fuel which are taking part in the combustion process at the end of the expansion process is not producing any work. This can generate higher temperature in exhaust where there is chance for generating the oxides of nitrogen. When percentage of blend of biodiesel increases, nox increases because oxygen present in the blend perhaps also helped in complete combustion of fuel. But it is found that slight decrease in Nox in B30 because of incomplete combustion. This may be attributed to higher viscosity which may lead to poor mixture formation.



Smoke intensity:-

Smoke intensity was calculated by opacity test for various blends of biodiesel and diesel. Biodiesel gives less smoke density compared to pure diesel. When percentage of blend of biodiesel increases, smoke intensity decreases because oxygen present in the blend perhaps also helped in complete combustion of fuel. But we found that slight increase in smoke intensity in B30 because of incomplete combustion. This may be attributed to higher viscosity which may lead to poor mixture formation.



CONCLUSION:-

1. Methyl esters of neem can give better performance when blended with diesel and blend B20 shows better performance characteristics as compared with diesel and better emission characteristic as compared to other blend.

2. The cost can be reduced drastically of bio fuel by producing them on large scale.
3. Since the properties of bio-diesel and diesel are very close to each other it gives better results.

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