International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 6 June 2022, pp: 1927-1936 www.ijaem.net ISSN: 2395-5252

Performance analysis and emission control of an IC Engine through blending of sunflower and soyabean oil

Md. Mustaqueem, Dr. Savita Vyas
Rajiv Gandhi Proudyogiki Vishwavidyalaya, Bhopal, M.P.
Rajiv Gandhi Proudyogiki Vishwavidyalaya, Bhopal, M.P.

Submitted: 15-06-2022 Revised: 20-06-2022 Accepted: 25-06-2022

ABSTRACT: IC engines have a main application in the transportation and power generations. Diesel engine is very efficient but the main concern is on emission of pollutant gaseous which consist of carbon mono oxide. Carbon di oxide, nitrogen oxides etc. There are several techniques to reduce pollutant gas emission from a diesel engine. One of the beat technique to reduce pollutants is the application of bio fuels with some modifications in the diesel engine. In this study, the performance and emissions characteristics of single cylinder, four stroke diesel engine operating on diesel and soybean blends as well as sunflower blends have been investigated experimently. The rate of pollutants are checked in express pollution checking center, and generates the pollutant data. HSU percentage are generated by the combustion of bio diesel which was blended with soyabean and sunflower oil separately. Various other concentration like CO_2, CO and NOx is calculated through flue gas analyser.

I. INTRODUCTION

Biodiesel consists of mono alkyl esters produced from vegetable oils, animal or old cooking fats. Coconut biodiesel is fuel alternative produced from soybean oil. Biodiesel contains no petroleum diesel, but it can be blended with petroleum diesel.

Biodiesel is a clean burning, Eco-Friendly natural fuel obtained from tree born oils by a chemical transformation process called Transesterification carried out in a Chemical Processing Plant. Transesterfication is an age old chemical process and is a time tested method of Transforming Vegetable oils or fats into Biodiesel (Alkyl Esters of Fatty Acids) and Glycerin plus some soaps etc.

The chemistry lies in transforming the fatty acid chains into Alkyl Esters of respective fatty acids present in different feed oils used and isolation of glycerol present in the Triglyceride molecule in the oils and fats. Industrial production of Biodiesel consists of the following three distinct processing phases and three basic Equipment lineups.

Organic Chemistry

The major components of vegetable oils are triglycerides. Triglycerides are esters of glycerol with long-chain acids (fatty acids). The composition of vegetable oils varies with the plant source. The fatty acid profile describes the specific nature of fatty acids occurring in fats and oils. The chemical and physical properties of fats and oils and the esters derived from them vary with the fatty acid profile. **Transesterification** is the process where an alcohol and an ester react to form a different alcohol and a different ester. For biodiesel, an ethyl ester reacts with methanol to form a methyl ester and ethanol. These ethyl esters react with methanol to form biodiesel and glycerol. As mentioned above, the purpose of transesterification is to reduce the viscosity of the oil so that it has properties closer to that of regular diesel used in CI engines. Methanol is the preferred alcohol for obtaining biodiesel because it has the 14 lowest cost and it is readily available. However, for the reaction to occur in a reasonable time, a catalyst must be added to the mixture of the vegetable oil and methanol to accelerate the speed of a reaction. Below is a figure showing the endothermic (requiring heat) chemical reaction behind the transesterification process.

Transesterification Reaction

Represents a mixture of various fatty acid chains and therefore must be defined based on the oils in use. The subscript 3 indicates the

International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 6 June 2022, pp: 1927-1936 www.ijaem.net ISSN: 2395-5252

number of moles needed to satisfy the formation of the methyl esters. This model only states the molar ratios of starting materials and products however; the molar ratios may need to be varied to obtain a more complete reaction. Typically, 6 moles of alcohol are used for every mole of triglyceride so that the reaction proceeds in the "forward‟ direction. Not all reactions complete quickly and for some it takes considerable time before the starting materials and reaction products are present in constant amounts, indicating equilibrium has been reached. A reaction can also occur in the reverse direction (from right to left), so to force the equilibrium in the direction of the desired products, one or more parameters of the 15 reaction may need to be changed. These include the molar ratio, temperature, pressure and use of a catalyst.

Sources of Bio-diesel
All Tree Bearing Oil (TBO) seeds - edible and non-edible

Edible: Soya-bean, Sun-flower, Mustard Oil etc.

Non-edible: Jatropha Curcas, Pongemia Pinnata, Neem etc.
Edible seeds can't be used for bio-diesel production in our country, as its indigenous production does not meet our current demand

II. LITERATURE SURVEY

In this article, we will use aluminum oxide (Al_2O_3) in conjunction with B20 to achieve specific fuel properties from previous journal research, improve the performance characteristics of the diesel engine, and achieve better engine emissions control without any engine modification.[1]

Performance and emission analysis of a diesel engine was conducted on a diesel engine, operated under different operating conditions, using varied Parinari polyandra biodiesel blends. Exhaust emissions, like total hydrocarbons, carbon dioxide, carbon monoxide, sulphur dioxide, and nitrogen oxides were measured. The biodiesel properties were found to be similar to fossil diesel. B10 was found to be the optimal blend in improving the engine performance in terms of speed, power and thermal efficiency. B30 demonstrated stable performance characteristics without any modification of the diesel engine.[2]

This study is focused on the biodiesel CFP-related mechanisms and highlights the factors that initialize and pace the crystallization process. This review indicates that the CFP of biodiesel fuel can be improved by utilizing different techniques. Winterisation of some biodiesel has been shown to improve CFP significantly. Additives such as polymethyl acrylate improved CFP by 3-9 ° C. However, it is recommended that improvement methods in terms of fuel properties and efficiency should be carefully studied and tested before being implemented in industrial applications as this might impact biodiesel yield, cetane number, etc.[3]

In this paper, the performance of the engine has been assessed for emulsified fuel and biodiesel derived from yellow oleander seed oil in a single cylinder diesel engine, and the performance is compared with that of the diesel fuel. It is observed that Brake Specific Fuel Consumption (BSFC) for the biofuels is higher than that of the diesel. But there is no distinction between the fuels for power and torque.[4]

The experimental research are conducted according to the ESC (European Stationary Cycle - Directive 1999/96/EC) 13-mode. Using biodiesel fuel average thermal efficiency is kept at the level of the application of conventional diesel fuel, average emission of CO is reduced by 13.6%, average emission of NOx is increased by 27.6%, average emission of HC is increased by 59.4%, and average particles emission is reduced by 43.2%.[5]

This experimental was applied on a diesel engine at different engine loads from zero to full load. Thermal efficiencies for waste cooking-oil biodiesel blends were lower than diesel oil. Specific fuel consumptions of biodiesel blends were higher than diesel fuel. Higher exhaust gas temperatures were recorded for biodiesel blends compared to diesel oil. CO2 emissions for waste cooking-oil biodiesel blends were higher than diesel oil. CO and HC emissions for biodiesel blends were lower than diesel fuel. NOx emissions for biodiesel blends were higher than diesel fuel.[6]

Characteristics of biodiesel from Palm Kernel Oil Methyl Ester (PKOME), Jatropha Curcas Methyl Ester (JCME) & Coconut Oil Methyl Ester (COME) and their blends have been determined to run in a compression ignition direct injection (CIDI) internal combustion engine. The vegetable oils of Ghanaian origin (PKOME, COME and JCME) were converted to biodiesel by transesterification. Optimum amount of catalysts including 1% H2SO4, 1% NaOH and methanol: oil ratio between 6:1 and 8:1 produced the best yields of the biodiesels. The biodiesels were run in a VW

International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 6 June 2022, pp: 1927-1936 www.ijaem.net ISSN: 2395-5252

diesel engine in an experiment. PKOME and COME were blended in proportions of 100%, 75%, 50% and 25% to determine the best blend for optimum physiochemical properties and engine performance. [7]

This study brings out an experiment of two biodiesels from pongamia pinnata oil and mustard oil and they are blended with diesel at various mixing ratios. The effects of dual biodiesel works in engine and exhaust emissions were examined in a single cylinder, direct injection, air cooled and high speed diesel engine at various engine loads with constant engine speed of 3000 rpm. The influences of blends on CO, CO2, HC, NOx and smoke opacity were investigated by emission tests. The brake thermal efficiency of blend A was found higher than diesel. The emissions of smoke, hydro carbon and nitrogen oxides of dual biodiesel blends were higher than that of diesel. But the exhaust gas temperature for dual biodiesel blends was lower than diesel. [8]

As the fossil fuels are depleting and green house gases are increasing usage of biodiesel came into existence. Biodiesel is a renewable, clean-burning diesel which can be produced from vegetable oils. This project deals with study of emission and performance characteristics on diesel engine with blends of Neem oil as biodiesel. Biodiesel is prepared from Neem oil by transesterification process followed by adding 1% v/v H2SO4. The tests were performed with B10, B20, B30 blends on a single cylinder, 4-stroke, diesel engine. The result shows lower emissions and higher performance for B10 than the other blends and diesel. The brake thermal efficiency is higher than the diesel and CO, HC and NO_X emissions were 23%, 8.5%, and 22% lesser than that of diesel. [9]

The performance and emission of a single cylinder four stroke variable compression multi fuel engines when fueled with 20%, 25% and 30% of Karanja blended with diesel are investigated and compared with standard diesel. Experiment has been conducted at compression ratios of 15:1, 16:1, 17:1, and 18:1. The impact of compression ratio on fuel consumption, brake thermal efficiency and exhaust gas emissions has been investigated and presented. Experimental analysis on the performance of biodiesel over diesel was evaluated by response surface methodology to find out the optimized working condition. The overall optimum is found to be 25% biodiesel–diesel blended with a compression ratio of 18. [10]

This paper presents the performance of biodiesel blends in a single-cylinder water-cooled diesel engine. All experiments were carried out at constant speed 1500 rpm and the biodiesel blends were varied from B10 to B100. The engine was equipped with variable compressions ratio (VCR) mechanism. For 100% Jatropha biodiesel, the maximum fuel consumption was 15% higher than that of diesel fuel. The brake thermal efficiency for biodiesel and its blends was found to be slightly higher than that of diesel at various load conditions. The increase in specific fuel consumption ranged from 2.75% to 15% for B10 to B100 fuels. The exhaust gas temperature increased with increased biodiesel blend. The highest exhaust gas temperature observed was 430∘C with biodiesel for load conditions 1.5 kW, 2.5 kW, and 3.5kW, where as for diesel the maximum exhaust gas temperature was 440∘C.TheCO2 emission from the biodiesel fuelled engine was higher by 25% than diesel fuel at full load. The CO emissions were lower with Jatropha by 15%, 13%, and 13% at 1.5 kW, 2.5 kW, and 3.5kW load conditions, respectively. The NO� emissions were higher by 16%, 19%, and 20% at 1.5kW, 2.5kW, and 3.5kW than that of the diesel, respectively. [11]

A study revealed [12] that Methyl ester of coconut oil can substitute diesel fuel partially for existing conventional diesel engine without any major modifications in engine components. Engine performance with blended fuel up to 40% methyl ester of coconut oil don't differ to great extent from that of diesel fuelled engine performance. Fuel consumption rate, break specific fuel consumption and break specific energy consumption are low in case of methyl ester of coconut oil blending compare to neat diesel. Long term performance and endurance test to evaluate the durability of the engine with prolonged operation with this blending was not done .

The German study involved a Deutz 4 cylinder marine diesel engine (direct injection) found on fishing boats in Europe and the Tennessee study evaluated a 110 HP Volvo marine diesel engine, also used in work boats and fishing boats. Volvo also makes smaller single and double cylinder diesel engines for recreational sailboats.[13]

III. METHODOLOGY

Experimental Setup

A hundred Liters/Day capacity Bio-Diesel generating setup was installed in RGPV Energy Park to produce Bio-Diesel from various oil seeds.A single cylinder 4-stroke diesel Engine was purchased & Installed in Thermal Engineering Lab of Mechanical Engineering Department, to conduct experimental work for testing Bio- Diesel.

In this chapter a detail description of procedure of making biodiesel in energy park of RGPV is mentioned, along with the complete technical specifications and of CI engine test kit used for performance testing is also written here. Procedure followed for conducting experimentations is also recorded in this chapter.

Procedure Preparation of Biodiesel

(i) Biodiesel preparation from palm & soya bean oil:

Since, waste vegetable cooking oil is a more economical source of the fuel than other sources, it is considered as a source of the biodiesel in this study.

a. Palm oil
b. Soya bean oil

In this research, biodiesel will be produced by a transesterification process catalyzed by KOH (as Alkali catalyst) and methanol (as alcohol) at R.G.P.V Energy lab.

(ii) Blend preparation at different proportion:

Samples of palm oil biodiesel and mineral diesel preparation using an electrical magnetic stirrer. Briefly, palm oil biodiesel addition to petroleum diesel at a low stirring rate. The mixture stir continuously for 20 min and left for 30 min at room temperature to reach equilibrium before subjected to any tests. In addition to Palm oil biodiesel (B100) and mineral diesel (D) five biodiesel diesel blends were prepared through blending palm oil biodiesel at 10%, 20%, 30%, 40%, and 50% by volume with mineral diesel.

Samples of palm oil biodiesel and mineral diesel preparation using an electrical magnetic stirrer. Briefly, palm oil biodiesel addition to petroleum diesel at a low stirring rate. The mixture stir continuously for 20 min and left for 30 min at room temperature to reach equilibrium before subjected to any tests. In addition to Palm oil biodiesel (B100) and mineral diesel (D) five biodiesel diesel blends were prepared through blending palm oil biodiesel at 10%, 20%, 30%, 40%, and 50% by volume with mineral diesel.

Fuel property measurements

The properties of the biodiesel and diesel fuel analysis in accordance with the ASTM D6751 standards in a testing laboratory.

a. Cloud and Pour point
b. Viscosity
c. Density
d. Heating value of Blended fuel
e. Cetane number

Biodiesel Sample

The production of biodiesel, or alkyl esters, is well known. There are three basic routes to ester production from oils and fats:

1. Base catalyzed transesterification of the oil with alcohol.
2. Direct acid catalyzed esterification of the oil with methanol.
3. Conversion of the oil to fatty acids, and then to alkyl esters with acid Catalysis.

Making biodiesel from the waste cooking oil & grease which contain higher value of FFA.

Transesterification

Trans-esterification also called alcoholysis is the displacement of alcohol from an ester by another alcohol in a process similar to hydrolysis. This process has been widely used to reduce the viscosity of triglycerides. The transesterification reaction is represented by the general equation, which is the key reaction for bio-diesel production.

RCOOR' + R" RCOOR" + R'OH

Biodiesel Preparation

The filtered oil was heated up to a temperature of 50°C in water bath to melt coagulated oil. It is important not to overheat the

International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 6 June 2022, pp: 1927-1936 www.ijaem.net ISSN: 2395-5252

oil above 65°C, because at that temperature alcohol would boil away easily. The heated oil of 100 ml was measured and transfered into a conical flask containing catalyst-alcohol solution. The reaction was considered to start at this moment, since heated oil assisted the reaction to occur. The reaction mixture was then shaken by using shaker at a fixed speed for 2h

Separation of biodiesel from by-products

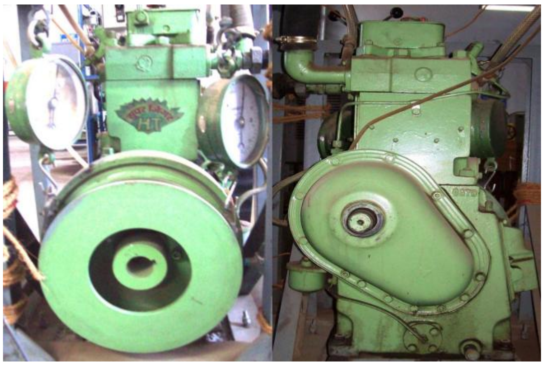
The product of the reaction was exposed to open air to evaporate excess methanol for 30 min. The product was then allowed to settle down overnight. Two distinct liquid phases: crude ester phase at the top and glycerol phase at the bottom were produced in a successful transesterification reaction.

Purification of biodiesel by washing

The biodiesel (top ester phase) separated at the bottom 250ml conical flask glycerol phase by transferring. Then biodiesel purified by washing with distilled water to remove all the residual by-products like excess alcohol, excess catalysts, soap and glycerin. Approximately 30% of distilled water added at the volume of the biodiesel volume. The flask was shaken gently for 1 min and placed on the table to allow separation of biodiesel and water layers. After separation, the biodiesel was transferred to a clean conical flask. The washing process was repeated for several times until the washed water became clear. The clean biodiesel was dried in an incubator for 48 h, followed by using sodium sulphate. The final product was analyzed to determine its ester content (that is purity of product) and also other equipments were used to determine related properties.

Single cylinder 4 Stroke Diesel (CI) Engine Experimental Set-up

Single Cylinder 4 stroke (CI) Engine test kit was purchased and installed in the thermal Engineering Lab of University Institute of Technology, RGPV Bhopal. Details along with technical specifications of this kit being discussed as below



Experimental Setup of Diesel Engine

Technical Specification

A) DIESEL ENGINE

MAKE: - Kirloskar Oil Engine, Pune.
MODEL: - SV1
TYPE: - Vertical, Totally Enclosed, Compression Ignition Four Stroke Cycle, Water cooled engine.
NO. Of CYLINDER: - ONE
BORE: - 87.5 mm
STROKE: - 110 mm
CUBIC CAPACITY: - 662 CC
COMPRESSION RATIO: - 16.5**:** 1
RPM: - 1800
RATE OF OUTPUT: - 8 HP

Instrumentation

1. **Temperature Sensors**: Cr-Al Sensors are used to sense the temperature at various points.
2. **Speed Sensor**: Speed sensors used for the measure rpm of the engine along with external tachometer.
3. Calorimeter
4. Orificemeter
5. Burette and stop watch for measurement of fuel consumption.

Procedure

1) First start all the water pumps and check supply to the engine.
2) Check diesel in fuel tank.
3) Then fill water in manometer at certain level.
4) Check all the sensors for proper work.
5) Start the engine at no load condition then taking readings in different load condition.
6) All temperature will be measured by digital display on to the engine.
7) These processes continue done for different fuel like-diesel/biodiesel at different ratio.

Test Parameters

These are to be entered every time engine testing has to be done. First load is selected and set then its results like temperature, fuel consumption ration, RPM etc for corresponding load to be entered Manually/Automatically.

Parameter Description

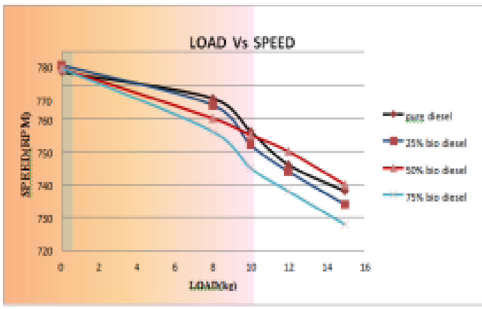
- Fuel Consumption Rate
- Air Intake Velocity
- Load
- Mean Efficiency Pressure
- Actual Speed
- Temperature Of water Inlet to Calorimeter
- Temperature Of water Outlet From Calorimeter
- Gas Inlet Temperature to Calorimeter
- Gas Outlet Temperature from Calorimeter

Engine Performance:

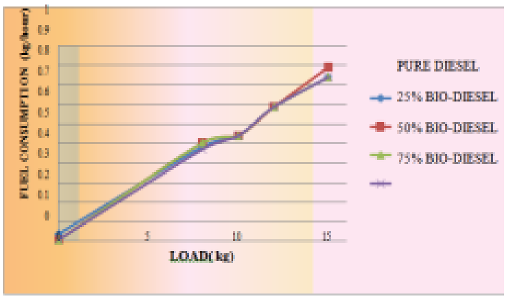
1- Power and Mechanical Efficiency
2- Mean Effective pressure and Torque
3- Specific Output
4- Volumetric Efficiency
5- Fuel- Air ratio
6- Specific fuel consumption
7- Thermal Efficiency and Heat Balance

IV. RESULT

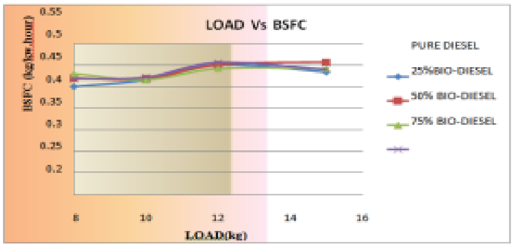
Repeated experimental work was done by using this single cylinder 4-stroke diesel engine and data were recorded at different loads for neat diesel, and by mixing different ratio of diesel and biodiesel, using lean blends all data was collected and represent in the graphs which are shown below.



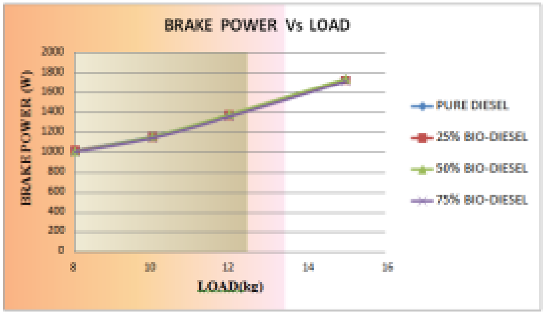
Variation of speed with load for pure diesel and diesel blends with biodiesel (Soyabean and Sunflower).



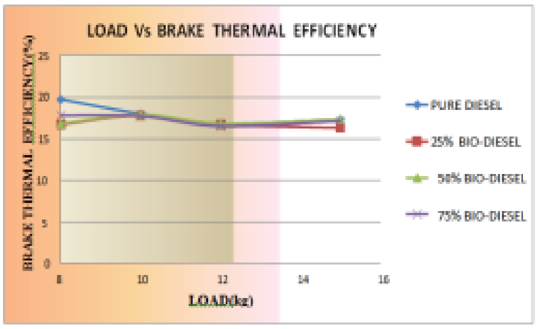
Variation of fuel consumption with load for pure diesel and soyabean diesel blends with biodiesel



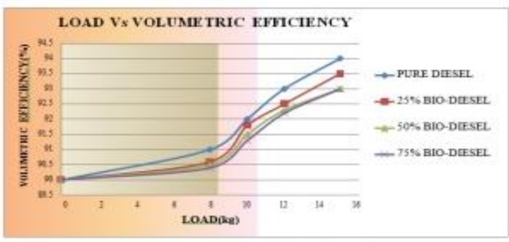
Variation of BSFC, with load for pure diesel and soyabean diesel blends with biodiesel



Variation of Brake power with load for pure diesel and soyabean diesel blends with biodiesel

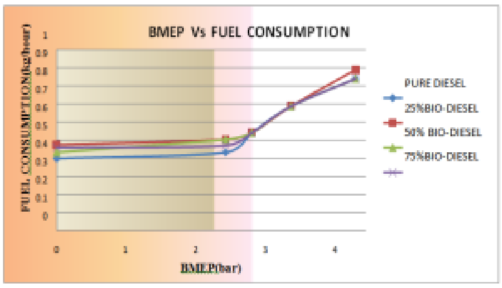


Variation of brake thermal efficiency with load for pure diesel and soyabean diesel blends with biodiesel

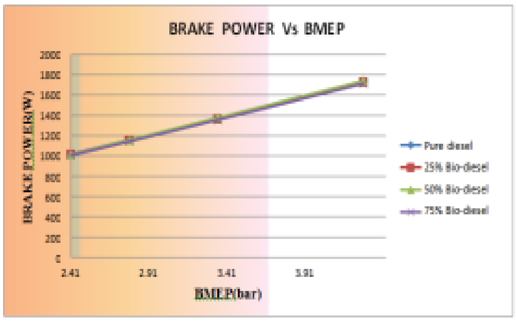


Variation of volumetric efficiency with load for pure diesel and soyabean diesel blends with biodiesel

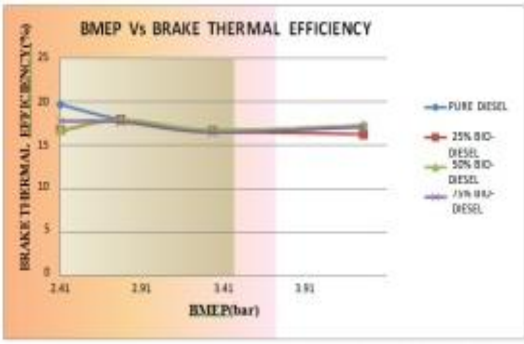
International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 6 June 2022, pp: 1927-1936 www.ijaem.net ISSN: 2395-5252



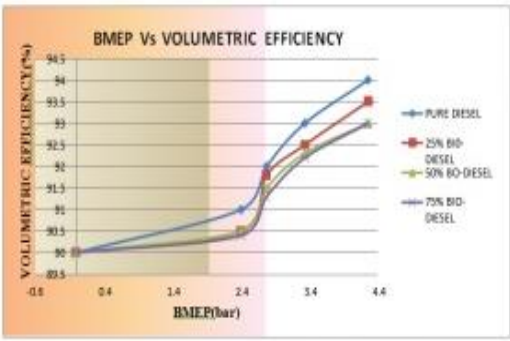
Variation of fuel consumption with BMEP for pure diesel and soyabean diesel blends with biodiesel



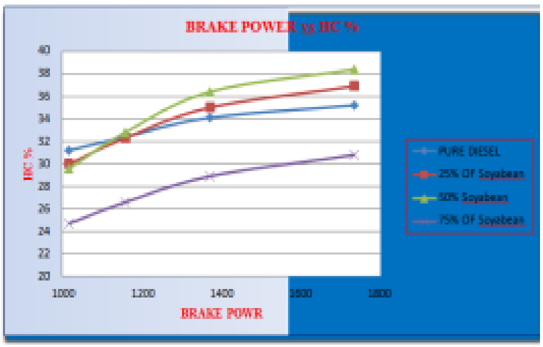
Variation of Brake power with BMEP for pure diesel and soyabean diesel blends with biodiesel



Variation of brake thermal efficiency with BMEP for pure diesel and soyabean diesel blend with biodiesel

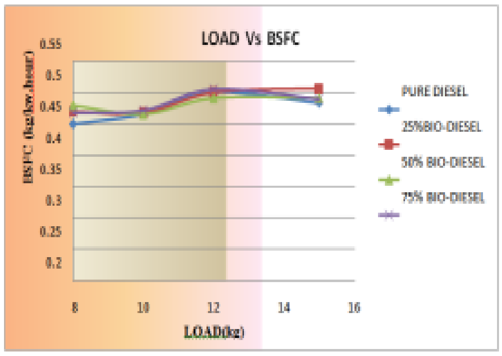


Variation of volumetric efficiency with BMEP for pure diesel and soyabean diesel blends with biodiesel

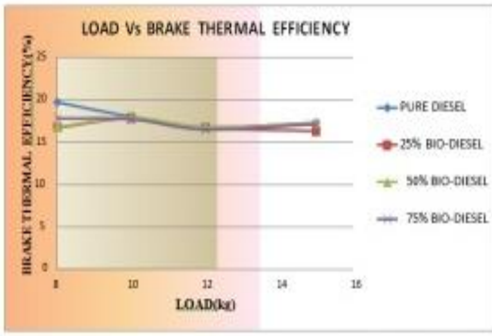


Brake power Vs (HC %) in case of soyabean biodiesel blends

GRAPHS OF SUNFLOWER BIODIESEL

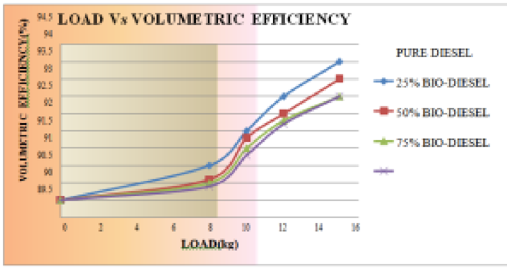


Variation of BSFC, with load for pure diesel and sunflower diesel blends with biodiesel

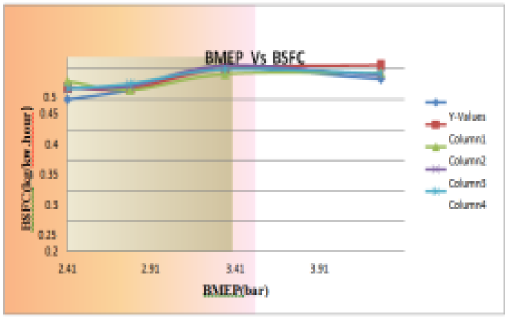


Variation of brake thermal efficiency with load for pure diesel and sunflower diesel blends with biodiesel

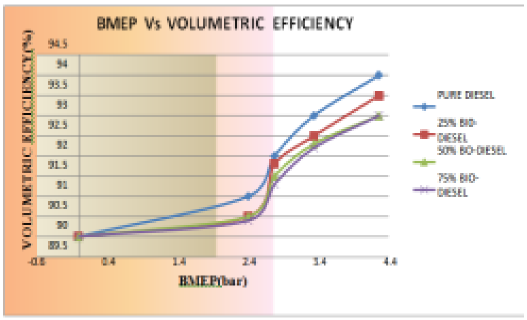
International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 6 June 2022, pp: 1927-1936 www.ijaem.net ISSN: 2395-5252



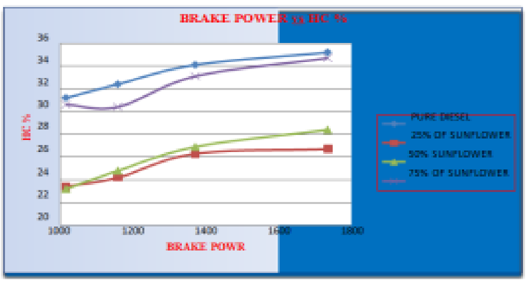
Variation of volumetric efficiency with load for pure diesel and sunflower diesel blends with biodiesel



Variation of BSFC with BMEP for pure diesel and sunflower diesel blends with biodiesel



Variation of volumetric efficiency with BMEP for pure diesel and sunflower diesel blends with biodiesel



Brake power Vs (HC %) in case of sunflower biodiesel blends

Analysis Of Emission Characteristics
Single Cylinder Four Stroke Diesel Engine
Sunflower used as Bio-Diesel
Ist Proportion – 75% Diesel & 25% Biodiesel

S.No.	Load	Fuel	Mixture	Time
1	0 kg	15ml	5ml	60 sec.

On burning this above proportion, the emitted pollutants will be measured in Express Pollution Checking Center. Following data was provided as a resultant:

S.No.	Km^{-1}	HSU%
1	0.62	23.4
2	0.64	24.2
3	0.71	26.3
4	0.72	26.7
5	1.83	54.6
Mean	1.63	50.4

IInd Proportion – 50% Diesel and 50% Biodiesel

S.No.	Load	Fuel	Mixture	Time
1	0 kg	10ml	10ml	60 sec.

On burning this above proportion, the emitted pollutants will be measured in Express Pollution Checking Center. Following data was provided as a resultant:

S.No.	Km^{-1}	HSU%
1	0.90	32.3
2	0.66	24.8
3	0.73	26.9
4	0.77	28.4
Mean	0.76	28.1

IIIrd Proportion – 25% Diesel and 75% Biodiesel

S.No.	Load	Fuel	Mixture	Time
1	0 kg	5ml	15ml	60 sec.

On burning this above proportion, the emitted pollutants will be measured in Express Pollution Checking Center. Following data was provided as a resultant:

S.No.	Km^{-1}	HSU%
1	1.82	50.4
2	0.73	26.7
3	0.64	23.9

International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 6 June 2022, pp: 1927-1936 www.ijaem.net ISSN: 2395-5252

4	0.74	28.3
5	0.64	32.3
Mean	0.85	29.3

Soyabean used as Bio-Diesel

I[st] Proportion – 75% Diesel & 25% Biodiesel

S.No.	Load	Fuel	Mixture	Time
1	0 kg	15ml	5ml	60 sec.

On burning this above proportion, the emitted pollutants will be measured in Express Pollution Checking Center. Following data was provided as a resultant:

S.No.	Km^{-1}	HSU%
1	2.64	67.8
2	0.83	30.0
3	0.90	32.3
4	1.00	35.0
5	1.07	36.9
Mean	0.95	33.5

II[nd] Proportion – 50% Diesel and 50% Biodiesel

S.No.	Load	Fuel	Mixture	Time
1	0 kg	10ml	10ml	60 sec.

On burning this above proportion, the emitted pollutants will be measured in Express Pollution Checking Center. Following data was provided as a resultant:

S.No.	Km^{-1}	HSU%
1	1.80	54.0
2	1.65	50.9
3	1.69	51.7
4	1.63	50.05
Mean	1.69	51.7

IIIrd Proportion – 25% Diesel and 75% Biodiesel

S.No.	Load	Fuel	Mixture	Time
1	0 kg	5ml	15ml	60 sec.

On burning this above proportion, the emitted pollutants will be measured in Express Pollution Checking Center. Following data was provided as a resultant:

S.No.	Km^{-1}	HSU%
1	1.67	51.3
2	0.66	24.7
3	0.72	26.6
4	0.79	28.9
5	0.85	30.8
Mean	0.75	27.7

From the above data, it was confirmed that the pollutant gaseous emission was well under the criteria of Bharat Standard IV.

From the above table it was also confirmed that the HSU percentage of Soyabean blended diesel of proportion 25% Diesel and 75% Biodiesel is 27.7 which is very less as compared with other. So from pollution point of view it was a favourable biodiesel mixture which will protect our environment.

V. CONCLUSION

In the present work it was observed that the emissions for all the three blends were lower than that for pure diesel. However the literature provides information that bio diesel combustion results in higher NOx emissions. The present model calculates the NO formation based on temperature, practically biodiesel combustion results in higher NO emissions due to effects like higher bulk modulus, higher fuel consumptions due to higher densities.

From the result it was also confirmed that the HSU percentage of Soyabean blended diesel of proportion 25% Diesel and 75% Biodiesel is 27.7 which is very less as compared with other. So from pollution point of view it was a favourable biodiesel mixture which will protect our environment.

REFERENCES

[1]. Performance and emission analysis of di diesel engine fuelled by biodiesel with al_2o_3 nano additives. Volume 47, Part 1, 2021
[2]. Exhaust emissions and engine performance analysis of a marine diesel engine fuelledwith Parinari polyandra biodiesel–diesel blends; Nov. 2020
[3]. A Mini Review on the Cold Flow Properties of Biodiesel and its Blends; Dec. 2020
[4]. Performance of Diesel Engine Using Biodiesel and Hybrid Biofuel. The IUP

Journal of Mechanical Engineering, Vol. XII, No. 3, August 2019, pp. 71-78
[5]. A DIESEL ENGINE PERFORMANCE MEASUREMENT WITH DIESEL FUEL AND BIODIESEL 2019.
[6]. STUDY OF THE PERFORMANCE AND EMISSION CHARACTERISTICS OF DI DIESEL ENGINE FUELLED WITH BIODIESEL-DIESEL BLENDS 2019.
[7]. Performance Evaluation of Biodiesel-Biodiesel Blends in a Dedicated CIDI Engine 2018.
[8]. Ministry of Petroleum and Natural gas Gazette Dated Sept 12th 2003, part 1.page230.
[9]. Mathur and Sharma, A Course in Internal Combustion Engines. 2005 page 517.
[10]. K. Srithar, K. Arun Balasubramanian; Experimental investigations on mixing of two biodiesels blended with diesel as alternative fuel for diesel engines ; Engineering Sciences (2017) 29, 50–56.
[11]. Jayashri N. Nair, Ajay Kumar Kaviti; Analysis of performance and emission on compression ignition engine fuelled with blends of Neem biodiesel; Egyptian Journal of Petroleum (2017) 26, 927–931.
[12]. K. Sivaramakrishnan; Investigation on performance and emission characteristics of a variable compression multi fuel engine fuelled with Karanja biodiesel–diesel blend; Egyptian Journal of Petroleum xxx (2017)
[13]. Amar Pandhare and Atul Padalkar; Investigations on Performance and Emission Characteristics of Diesel Engine with Biodiesel (Jatropha Oil) and Its Blends; Journal of Renewable Energy Volume 2013, Article ID 163829, 11 pages
[14]. Comparison of pure plant oil and bio diesel as fuel" by Prof. E. Schrimpff,Fachhochschule Weihenstephan, University of Applied Sciences, "the largest 'green' university of applied sciences in Germany" 2005.
[15]. Marine Biodiesel in Recreational Boats, Randall von Wedel, Ph.Dcyto Culture International Inc, Point Richmond, CA Second Edition April 22, 1999.