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Paper Authors

B.YESURAJU, DR.P.SREENIVASULU, R.V.MANIKANTA

SWARNANDHRA INSTITUTE OF ENGINEERING AND TECHNOLOGY, NARSAPUR.

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ENGINE PERFORMANCE AND EMISSION ANALYSIS OF CI ENGINE OPERATING ON BIODIESEL BLENDS WITH DIETHYL ETHER AS AN ADDITIVE

[1]B.YESURAJU, [2]DR.P.SREENIVASULU, [3]R.V.MANIKANTA
[1]STUDENT,DEPT. OF MECHANICAL ENGINEERING,SWARNANDHRA INSTITUTE OF ENGINEERING AND TECHNOLOGY, NARSAPUR.
[2]PROFESSOR, HEAD OF THE DEPARTMENT , DEPT OF MECHANICAL ENGINEERING, SWARNANDHRA INSTITUTE OF ENGINEERING AND TECHNOLOGY, NARSAPUR.
[3]ASSISTANT ROFESSOR, DEPT. OF MECHANICAL ENGINEERING, SWARNANDHRA INSTITUTE OF ENGINEERING AND TECHNOLOGY, NARSAPUR.
[1]rajunaidu305@gmail.com,[2]srinupothula@gmail.com, [2]rvenkatamanikanta@gmail.com

ABSTRACT Increasing demand of fuel day by day its consumption and hazards cause serious intensive attention is required for this problem. Also an Improvement of fuel properties are essential for suppression of pollutant and optimization of engine performance. One way is use of additives. The countries are confronted with serious problems like fossil fuel depletion and degradation of environment. Fossil fuels are in future will become reduced due to its excess quantity of extraction and high consumption. Therefore, biodiesel as considered like a promising option as they are clean renewable fuels and also the better substitute for diesel fuel in all compression ignition engine. In this research work, biodiesel was synthesized from palm seed oil via base catalyzed transesterification using catalyst NaOH. The synthesized fatty acid methyl ester after being washed was blended with diesel in the following percentage by volume of the biodiesel 0%, 20%, 40%, and 60% Out of which B20 blend found as best blend and B20 blend added with 5% DEE,10% DEE ,and 15% DEE additive. The prepared biodiesel blends are tested on a diesel engine. The properties of fuel are found such as viscosity, flash point, fire point and calorific value. Also, the investigation of engine performances on diesel like brake power, brake specific fuel consumption, brake thermal efficiency, indicated thermal efficiency and exhaust gas temperature of various blends of palm seed oil was carried out and their comparison made Finally, a discussion on emissions is also given in this paper.

CHAPTER-1 INTRODUCTION: DIESEL ENGINE

Developed in the 1890s by inventor Rudolph diesel, the diesel engine has become the engine of choice for power, reliability, and high fuel economy, worldwide. Early experiments vegetable oil fuels included the French government and Dr.Diesel himself, who envisioned that pure vegetable oils could power early diesel engines for agriculture in remote areas of the world, where petroleum was not available at the

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time. Modern biodiesel fuel, which is made by converting vegetable oils into compounds called fatty acid methyl esters, has its roots in research conducted in the 1930s in Belgium, but today's biodiesel industry was not established in Europe until the late 1980s. EARLY WORK: The early diesel engines had complex injection systems and were designed to run on many different fuels, from kerosene to coal dust. It was only a matter of time before someone recognized that, because of their high energy content, vegetable oils would make excellent fuel. The first public demonstration of vegetable oil based diesel fuel was at the 1990 world's fair, when the French government was interested in vegetable oils as a domestic fuel for their African colonies. Rudolph diesel later did extensive work on vegetable oil fuels and became a leading proponent of such a concept, believing that farmers could benefit from providing their own fuel. However, it would take almost a century before such an idea became a widespread reality. Shortly after Dr.Diesel death in 1913 petroleum become widely available in a variety of forms, including the class of fuels we know today as "diesel fuel". MODREN WORK: Due to the widespread availability and low cost of petroleum diesel fuel, vegetable oil-based fuels gained little attention, except in times of high oil prices and shortage. World War II and the oil crises of the 1970's saw brief interest in using vegetable oils to fuels diesel engines. Unfortunately, the newer diesel engine designs could not run on traditional vegetable oils, due to the much higher viscosity of vegetable oil compared to petroleum diesel fuel. A way was needed to lower the viscosity of vegetable oils to a point where they could be burned properly in the diesel engine. Many methods have been proposed to perform this task, including pyrolysis, blending with solvents, and even emulsifying the fuel with water or alcohols, none of which have provided a suitable solution. It was a Belgian inventor in 1937 who first proposed using transesterification to convert vegetable oils into fatty acid alky1 esters and use them as a diesel fuel replacement. The process of transesterification converts vegetable oil into three smaller molecules which are much less viscous and easy to burn in a diesel engine. The transesterification reaction is the basis for the production of modern biodiesel, which is the trade name for fatty acid methyl esters. In the early 1980s concerns over the environment, energy security, and agricultural overproduction once again brought the use of vegetable oils to the forefront, this ti-me with transesterification as the preferred method of producing such fuel replacements. Recently the Indian railway started that bio-diesel is used as a fuel inlocomotives.

1.2 SCOPE FOR PRODUCTION OF BIO DIESEL IN INDIA:

Energy scenario in India: The economic development of any country depends upon the source of energy. India being a developing country requires much higher level of energy to sustain its rate of progress. The dependency on energy resources of India is of similar pattern to other developing country. Coal and oil, the major fossil resources are on the driver seat. The rapid mechanization in agriculture sector and other unorganized small scale industrial sector needs more and more oil and electricity in future. As per the current estimates, oil reserves in India will exhaust in next few years. It is estimated that oil demand and supply almost quadruple during the last quarter century. At present, India is enabling to produce about one-third of the total petroleum fuels required. However, the remaining being imported which consume major share of foreign exchange earn by the country. The development and promotion of appropriate technology for utilizing non-traditional energy resources is coming up strategically as an emerging solution to the present energy and environmental crises. The planning commission of India has recommended two plant species i.e., Karanja and Jatropha for bio-diesel production and started working on bio-fuel project near about in 200 districts from 18 states in India.

1.3 INTERNAL COMBUSTION ENGINE & ALTERNATE FUELS:

In general, two broad types of IC engines are spark ignition (SI) engine and compression ignition (CI) engine which are popular in the society as petrol and diesel engine respectively. SI engine uses fuels with high auto ignition temperature like petrol, alcohol and gaseous fuels. The combustion in this engine is initiated at a single location by a spark and the developed flame then propagates in to the pre-mixed fuel air mixture in a progressive manner. Whereas, in CI engine, fuels with low selfignition temperature like diesel are used. In this engine, towards the end of compression process, fuel is injected to an environment of hot compressed air having a temperature higher than the self-ignition temperature of the fuel used which initiates combustion at several locations. The fuels of both SI and CI engines are commonly fossil based and have uncertain future because of their limited reserve and environmental impact. Hence to meet the international standard for both fuel consumption and exhaust emission, several proven options are being available starting from expensive engine hardware modification to cheaper alternative fuels. In Indian context, the use of existing IC engines with little or no modifications is a promising and viable solution which can only be possible through the route of alternative fuels. A number of nontraditional liquid and gaseous fuels are being tried in the existing internal combustion engines. The use of alternative fuels in both SI and CI engines are decided on the basis of their combustion characteristics. Some of the results obtained are of encouraging nature and need micro-level critical analysis for its sustainable application. Considering the need of the day, number of diesel engines used in agriculture and public transportation sector are far ahead of that of petrol engines. Therefore, it is more relevant to highlight the common features of diesel alternatives fuels.

1.4 OBJECTIVES OF PRESENT WORK:

In the present project work the following objectives are met. 1.Collection of calophylluminophyllum seeds from different sources and extracting oil. 2 Collecting requirements for the present work based on standard journals. 3.Converting raw oil into

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bio-diesel.Make ready the computerized MFVCR engine. 4.Conducting base line test using diesel. 5.Checking the properties of bio-diesel and compare with the base line values. 6.Checking the performance. Combustion and emission analysis of the calophylluminophyllum bio-diesel with additives CHAPTER 2 LITERATURE REVIEW A.S. Ramadhas*, S. Jayaraj C. Muraleedhara. (2008) Experimental investigations on diethyl ether as fuel additive in biodiesel engine in their Research work Methyl esters of biodiesel are produced from crude rubber seed oil. It improved the performance and emission characteristics of biodiesel engine, diethyl ether is chosen as additive.The addition of diethyl ether with biodiesel reduces the exhaust emissions as well. The experimental results support that use of DEE in blends with biodiesel improve the performance and emission characteristics.M.A Kalam , H.H. Masjuki (2008) Testing palm biodiesel and NPAA additives to control NOx and CO while improving efficiency in diesel engine, in their experimental results showed that B20x reduce NOx, CO and HC emissions and improving brake power.Obe Majeed Ali, RizalmanMamat, Nik R. Abdullah, and Abdul Adam Abdullah (2016) Investigation of blended palm biodiesel-diesel fuel properties with oxygenated additiveThe objective of this study was to characterize how the key fuel properties changed when diethyl ether was added to palm oil methyl esters-diesel blended fuel, the heating value of the blended fuel decreases slightly with increasing DEE portion in the blendsAmr Ibrahim (2016) Investigating the effect of using diethyl ether as a fuel additive on diesel engine performance and combustion, in his experimental analysis found that by increasing the additive quantity which can cause reduction of exhaust emissions and also engine stability up to some extent so when he is using additive more than 15% can cause the problem of instability.Harihvenu,venkataramananmadhavan(2016) influency of diethyl ether (DEE) addition in ethanol-biodiesel and methanol biodiesel diesel blends in diesel engine study is conducted to evaluate and compare the effects of diethyl ether in ethanol biodiesel blend and methanol biodiesel blend finally he concluded the ethanol biodiesl diesel EBD+DEE5%, methane biodiesl diesel MBD+5% which are usefull for reducing the emissions and improve the performanceThe objective of this study was to characterize how the key fuel properties changed when diethyl ether was added to palm oil methyl esters-diesel blended fuel, the heating value of the blended fuel decreases slightly with increasing DEE portion in the blendsPedro Benjumea, john agudelo,andresagudelo(2008),basic properties of palm biodiesel –diesel blends they found that all the properties respective fuels those are diesel and biodiesel blends are calculated with experimental setup.h.sureshbaburao, dr. t. venkateswararao, and dr. k. hemachandrareddy(2013) palm oil and calophylluminophyllum oil are potential feed stocks for future biodiesel in compression ignition engines about comparison of both oils those are palm oil biodiesel and Calophyllum and also adding

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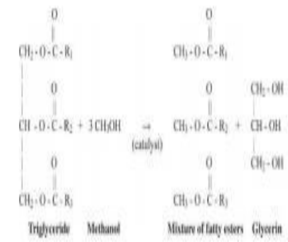
additives to the palm oil biodiesel for better performance as well as reduce engine emissions.

CHAPTER 3MATERIALS AND METHODOLOGY 3.1BIODIESEL PROCESSING ANDPRODUCTION

Biodiesel is an alternative diesel fuel that is produced from vegetable oils and animal fats. It consists of the monoalkyl esters formed by a catalyzed reaction of the triglycerides in the oil or fat with a simple monohydric alcohol. Biodiesel can be used alone, or blended with diesel in any proportions. Biodiesel can also be used as a low carbon alternative to heating oil.

3.2 INTRODUCTION

Biodiesel is an alternative fuel for diesel engines that is produced by chemically reacting a vegetable oil or animal fat with an alcohol such as methanol. The reaction requires a catalyst, usually a strong base, such as sodium hydroxide or potassium hydroxide, and produces new chemical compounds called methyl esters. It is these esters that have come to be known as biodiesel. Because its primary feedstock is a vegetable oil or animal fat, biodiesel is generally considered to be renewable. Since the carbon in the oil or fat originated mostly from carbon dioxide in the air, biodiesel is considered to contribute much less to global warming than fossil fuels. Diesel engines operated on biodiesel have lower emissions of carbon monoxide, unburned hydrocarbons, particulate matter, and air toxics than when operated on petroleum-based diesel fuel. 3.3PREPARATION Biodiesel is produced through a process known as transesterification, as shown in the equation below,



Where R1, R2, and R3 are long hydrocarbon chains, sometimes called fatty acid chains

Biodiesel is commonly produced by the transesterification of the vegetable oil or animal fat feedstock. There are several methods for carrying out this transesterification reaction including the common batch process, supercritical processes, ultrasonic methods, and even microwave methods. Chemically, transesterified biodiesel comprises a mix of mono-alkyl esters of long chain fatty acids. The most common form uses methanol(converted to sodium methoxide) to produce methyl esters (commonly referred to as Fatty Acid Methyl Ester - FAME) as it is the cheapest alcohol available, though ethanol can be used to produce an ethyl ester (commonly referred to as Fatty Acid Ethyl Ester - FAEE) biodiesel and higher alcohols such as isopropanol and butanol have also been used. Using alcohols of higher molecular weights improves the cold flow properties of the resulting ester, at the cost of a less efficient transesterification reaction. A lipid transesterification production process is used to convert the base oil to the desired esters. Any free fatty acids (FFAs) in the base oil are either converted to soap and removed

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from the process, or they are esterified (yielding more biodiesel) using an acidic catalyst. After this processing, unlike straight vegetable oil, biodiesel has combustion properties very similar to those of petroleum diesel, and can replace it in most current uses. A by-product of the transesterification process is the production of glycerol.Vegetable oils were proposed as diesel fuels but were found to be problematic due mostly to their greater viscosity. Problems were found with piston and injector deposits and crankcase oil dilution and resultant oil thickening. Conversion of the oils to their alkyl esters reduced the viscosity to near diesel fuel levels and produced a fuel with properties that were similar to petroleum based diesel fuel and which could be used in existing engines withoutmodifications

3.4PALMOIL:

Fig 1 Palm oil fruits

3.5CULTIVATION

Botanical name of oil palm is Elaeisguineensis. It is an ancient tropical plant from the West African tropical rainforest where it was grown wild and later it was developed into an agricultural crop. Oil palm produces two different types of oils: palm oil and palm kernel oil. Palm oil is used in wide variety of food products such as cooking oil, margarine and shortenings and palm kernel oil is used as a raw material in the production of non-food products like cosmetic, soaps, toiletries, detergents etc. is the most productive oil palm variety which can produce 10–35tonnes/hectare of fresh fruit bunch (FFB) palm oilannually The palm oil is a tropical perennial plant and it can grow well in lowland with humid places. The palm oil tree is unbranched and single-stemmed can grow up to 20–30m height. The flowers are produced in dense clusters which each individual flower is small with three sepals and three petals. The leaves are pinnate and can reach between 3 and 5m long.

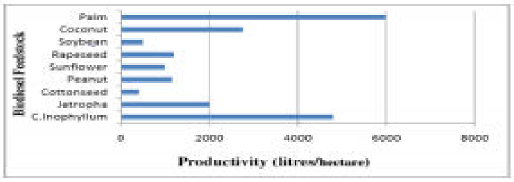

Fig 2 Productivity

3.6 BASE TRANSESTERIFICATIONPROCESS:

1. Take 100ml of palmoil
2. 1gm of NaOH is taken in a beaker and to this 30ml of methanol isadded.
3. Both oil and methanol are mixed well and stir for about1hr.

Fig 3 Base transesterification process

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4. The oil present at the bottom is removed and water wash to remove the soap present in the oil. The oil is washed until a clear solution water is observed and it is heated to remove the water present in the oil. 5. Then store the oil in safeplace. Prepare the respect blendsofB0,B20,B40,B60,B20+DEE5,B20+ DEE10,and B20+DEE15

CHAPTER 4 EXPERIMENTATION 4.1 INTRODUCTION

The details of the experimental set up are presented in this chapter. The experimental setup is fabricated to fulfill the objective of the present work. The various components of the experimental set up including modification are presented in this chapter.

Fig 4(4-Stroke Single cylinder water cooled Diesel Engine test Rig)

4.2ENGINESPECIFICATIONS:

The engine is four stroke single cylinder Diesel Engine

Make	- TOPLAND
Ignition System	- Compression Ignition
Arrangement of Cylinder	- Vertical
Cooling	- Water cooled
Bore	- 0.080 m
Stroke	- 0.11 m
Compression ratio	- 16.5:1
Speed	- 1500 rpm
Rated Power	- 5 HP
Lubricant	- SAE 20/SAE40

Fig 5 ENGINE SPECIFICATIONS

The Engine chosen to carry out experimentation is a single cylinder, four stroke, vertical, water cooled, direct injection type CI Engine. This engine can withstand higher pressures encountered and also is used extensively in agriculture and industrial sectors. Therefore this engine is selected for carrying experiments

4.3 TESTING AND PERFORMANCE OF ICENGINES INTRODUCTION:

With a growing demand for transportation IC engines have gained lot of importance in automobile industry. It is therefore necessary to produce efficient and economical engines. While developing an IC engine it is required to take in consideration all the parameters affecting the engines design and performance. There are enormous parameters so it becomes difficult to account them while designing an engine. So it becomes necessary to conduct tests on the engine and determine the measures to be taken to improve the engine performance.

5 PERFORMANCE PARAMETER MEASUREMENT AND TESTING:

The basic task in the design & development of engines is to reduce the cost & improve the efficiency and power. In order to machine the above task, the development engineer has to compare the engine developed with other engines in terms of its output and efficiency. Towards this end he has to test the engine and make measurements of relevant parameters that reflect the performance of the engine. In general, he has to conduct a wide variety of engine tests. The nature and the type of tests to be conducted depend upon a large number of factors.

5.1 PERFORMANCEPARAMETERS

¬ The important Measurements & tests are
¬ Power and MechanicalEfficiency
¬ Frictional power(FP)
¬ Indicated power(IP)

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¬ Brake power(BP)

¬ Fuelconsumption

¬ FuelAir-Ratio

¬SpecificOutput

¬ Specific FuelConsumption

5.2 EXPERIMENTAL PROCEDURE

¬ The fuel level in the tank ischecked.

¬ Lubricating oil level with the help of oil stick ischecked.

¬ The three way cock is Open so that the fuel flows to the engine as well to theburette.

¬ The cooling water valve is adjusted, so that the water flows continuously.

¬ The water level is checked and tank is filled water is not up to the level in the water rheostat. After carefully going through the preliminaries the decompression lever is pressed on so that there will not be any air trapping in between the cylinder head and piston.

¬ Then the engine is started by rotating the crank by means of hand crank lever by throwing of the decompression lever at sufficient speed.

¬ The engine is allowed and adjusted to pick up the speed and run at rated speed, smoothly for few seconds at rated speed using the tachometer.

¬ Record the time taken for 10cc fuel consumption at no load and the manometer reading on the panel board.

¬ Then the engine is applied to mechanical load by different loads.

¬ After setting the load on the engine at fixed point the time required for 10cc of fuel is measured and also the difference of manometer reading on the panel board.

¬ The pollution values are recorded from Automotive Emission Analyzer setup.

¬ Then the load on the engine is gradually increased and the necessary readings are tabulated.

¬ The same procedure repeated for the oil blends of B0, B20, B40, B20+DEE5, B20+DEE10, B20+DEE15 and B60 of palm biodiesel with chemical additive of diethyl ether, then slowly remove the load on the engine and stop the engine.

5.3 EXPERIMENTAL APPARATUS

Heat of combustion of liquids and solids can be determined by using a bomb calorimeter. For solid fuels, we are form the solid into powder form then the substance is pressed into a pellet, attached to a fuse wire and placed inside the bomb. The bomb is then charged with oxygen to a high pressure (20 - 30 atm) and immersed in water in the calorimeter bucket. The combustion is initiated by passing a current through the fuse wire. The heat of combustion is determined from the rise in the temperature of the calorimeter when the combustion reaction takes place.

5.4 PROCEDURE

For preparing following steps are involved

1. Prepare the sample. Weigh out approximately 0.5 to 0.95 g of the sample. Clean a sample holder and determine the mass of the pellet by weighing the sample holder with and without the pellet using a sensitive balance. Support the top of the bomb on the stand provided. Measure and Cut a 10 cm length of fuse wire (measure its length accurately) and connect the ends of the wire to the electrodes. Insert the sample

holder containing the sample and bend the fuse wire down to touch the sample. Fuse the wire to the pellet by connecting the wires to a lantern battery. Do not allow the wire to contact the sample holder. 1. Charge the oxygen bomb. The bomb can be dangerous if it is not assembled properly. Put the cover on the bomb and screw the cap down tightly by hand. Put the bomb in the bench socket. Attach the filling connection from the oxygen cylinder to the top of the bomb. Take care to align the connection properly before tightening the nut with the valve knob, needle valve, and relief valve closed, open the oxygen cylinder. Then, purge the bomb with oxygen to displace the air from the bomb as follows: 2.Calorimeter assembly. Take 2000 mL of distilled water in the 2-L volumetric flask provided. The water temperature should be slightly below room temperature. Place the bucket in position in the bottom of the jacket and set the bomb on the raised ring in the bucket. Attach the banana clips to the terminals on the bomb, making sure that the clips do not short to the bomb lid. Add the water carefully to the bucket to avoid splashing. Look for bubbles. If the bomb is leaking, you‟ll need to start over. Place the cover on the jacket with the thermometer at the front, attach the pulley belt, and start the motor.

3.ANALYSIS RUN.

Let the stirrer work for at least two minutes before starting temperature measurements. Note down the temperature and time at one minute intervals until a constant drift rate (temperature change with time) is observed for at least five minutes. Estimate temperatures to thousandths of a degree if possible. Tap the thermometer gently before each reading. While standing away from the calorimeter, press the ignition switch and record the time. Do not hold it down for more than 3 seconds. Stay away from the calorimeter for ~30 sec. A sharp temperature rise is expected within this time interval. If this does not happen, a poor connection is indicated. Continue recording the temperature every 15 sec for 4 – 5 minutes. The temperature will rise rapidly at first and then level off. When this happens begin recording the temperature at one minute intervals. Discontinue temperature measurements only after a slow and constant temperature change has been recorded for at least 5 minutes.

4. DISASSEMBLY OF THE CALORIMETER.

Turn off the stirrer motor, remove the pulley belt and thermometer, and lift off the cover of the jacket. Remove the clips from the terminals and lift the bomb out of the bucket. Open the valve knob on the bomb to SLOWLY release the gas pressure. Unscrew the cap, lift out the head and place it on the support stand. Look for evidence of incomplete combustion – if present, the run will have to be discarded.

5.**IMPORTANT FINAL STEPS.**

Collect all unburned pieces of fuse wire from the bomb electrodes. Straighten them and measure their combined length in centimeters. Subtract this length from 10 cm to determine the amount of wire actually burned.Wash all interior surfaces of the bomb with a jet of distilled water and collect the washings in a beaker. The bomb washings will contain any nitric acid

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produced in the bomb. Add a few drops of methyl orange indicator. If the indicator is pale yellow, no acid correction is necessary. Otherwise, titrate the bomb washings with a standard sodium carbonate solution. A 0.0709 N sodium carbonate solution can be prepared by dissolving 3.76 g of sodium carbonate and diluting to one liter with distilled water.

6.DETERMINATION OF VISCOSITY

The viscosity of the vegetable oil blends is determined by using Redwood Viscometer. The description of the apparatus is briefly given below.

Fig 6 Redwood Viscometer

Redwood Viscometer consists of a copper cup which is used to fill the liquid whose viscosity is to be determined. This cylinder cup is surrounded by a water jacket. The water in the jacket is heated to the desired temperature by using a heating coil. To maintain a uniform temperature throughout the volume of water a stirrer is provided. A ball valve is provided to control the flow of the liquid, through the small hole located at the bottom of the copper cup. A collecting flask and stop watch are required to find out the time for the volume of the liquid collected.

5.5PROCEDURE FOR DETERMINATION OF VISCOSITY

Apparatus was cleaned thoroughly. The ball valve was placed in position thus closing the orifice. The sample of Esterified mustard oil was poured into the cup up to the gauge point. The standard (50 ml) round bottom flask was kept under the orifice. The ball valve was lifted simultaneously starting the stop watch and allow the oil to pass through the orifice into the round bottom flask of 50 ml at room temperature of the stop watch for 50 ml of oil collection. Then the oil in the round bottom flask was poured into the oil cup of ball valve was lifted (by simultaneously starting the stop watch) to collect 50 ml of oil and then noted the time. The oC. The observations were tabulated. Then the heating of the oil was stopped and the oil was taken out from the cup. 5.6 DETERMINATION OF FLASH AND FIRE POINTS The flash and fire points of the vegetable oil blends are determined by using Pensky-Martin apparatus .The Pensky-Martin apparatus have of a cup which has a sharp pointer up to which the oil must be filled. The cup is filled with a tight fitting cover. The cover has a provision for inserting a thermometer and a stirrer in to the oil in the cup. The cover has a central hole which are enclosed by means of a sliding door. The cup is placed inside another copper vessel of cylinder shape. The angular space between the cup and cylindrical jacket is placed over a tripod stand. The outer cylindrical jacket can be warm up by means of electrical heating coil.

5.7 DENSITY MEASUREMENT

50ml of sample is measured by conical flask and weighed on digital weighing machine. The following formula is used to calculate density

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5.8 PROPERTIES FUEL:

FUEL	SPECIFIC GRAVITY	DENSITY Kg /m 3	CALORFIC VALUE KJ/Kg	VISCOSITY	FLASH POINT (°C)	FIRE POINT (°C)	CETANE NUMBER
DIESEL	0.83	830	43000	2.18	52	59	49
PALM BIODIESEL(B20)	0.859	859	41850	5.31	191	197	47
PALM BIODIESEL(B40)	0.864	864	40500	5.8	200	208	43
PALM BIODIESEL(B60)	0.870	870	39200	6	280	288	40
B20DEE5%	0.84	840	42749.52	2.96	83	87	54
B20DEE10%	0.844	844	40499.5	3.26	85	89	68
B20DEE15%	0.851	851	38249.57	3.60	88	91	75

Table 1PROPERTIES FUEL

GRAPHS: FOR B0, B20, B40&B60 (PREHEATED)

FOR BRAKETHERMAL EFFICIENCY

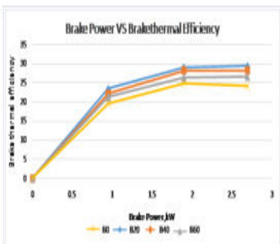

Fig 7 Brake power vs Brake thermal efficiency

variation of brake thermal efficiency with respect to brake power of various blends of palm biodiesel tested is presented in graph above. As palm biodiesel has very low self-ignition temperatures and wider flammability limits. However, lower brake thermal efficiency is obtained for higher percentages of palm biodiesel in the blend owing to the low calorific value. So the highest brake thermal efficiency have B20 then after B40.As on adding palm biodiesel as blend so it effect on performance on engine and for B60 (preheated)Blend also experimented on the diesel engine.

NOX EMISSIONS FOR FLUE GASES ANALYSIS

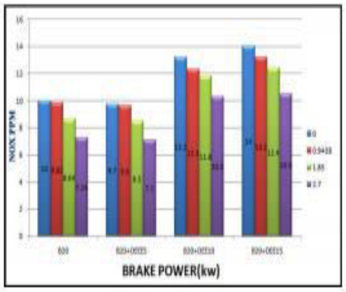

Fig 8 Variation of NOX with Brake power, kW

NOx are gradually decreasing by applying load on the engine additive effects effective combustion of the fuel.Higher temperature leads to creation of higher NOx emissions and also adding of diethyl ether based additive to the palm bio diesel oil.

CARBONDIOXIDE EMMISIONS

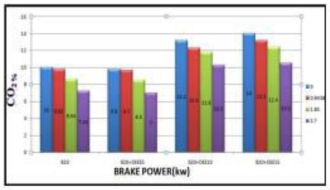

Fig 9 Variation CO2 with Brake power (kW)

compares the CO2 emission of blends of biodiesel–diethyl ether used in the diesel engine. The CO2 emission increases with increase in load, as expected. With increase in blend of palm biodiesel percentages in the blend, CO2 emission is also increased. More amount of CO2 in exhaust emission is an indication of the complete combustion of fuel. The combustion of fossil fuels produces carbon dioxide, which gets accumulated in the atmosphere and leads to many environmental problems. Though the combustion of biofuels produces carbon dioxide, oil- yielding crops are readily absorbing these and hence carbon dioxide

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levels are kept in balance As load increases co2 emissions increases because oxygenated additive i.e. diethyl ether is added to the palm biodiesel so it will give the excess amount of oxygen which is help to improve the better combustion characteristics

CARBON MONOXIDE EMMISIONS

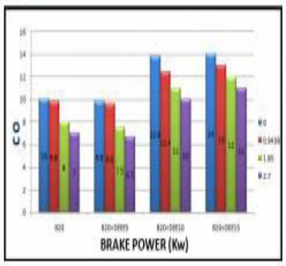

Fig 10Variation of CO with Brake Power, Kw

compares the carbon monoxide reduction for the adding of additive of Diethyl ether (DEE), because of adding of additive it supply the excess quantity of oxygen with the additive so it will help the complete combustion of the diethyl ether based palm biodiesel ,Poisonous carbon monoxide was reduced by adding the Diethyl ether as additive

HYDROCARBON EMMISIONS

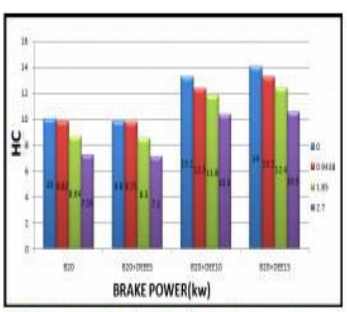

Fig 11 Variation of HC with Brake Power, Kw

compares the hydrocarbons by the addition of diethyl ether as additive it‟s a oxygenated base additive which will give the better combustion so the percentage of unburnt hydrocarbons were reduced by adding different loads so the additive (DEE) which help full for better combustion for the engine.

CHAPTER 6 RESULT DISCUSSION

Adding oxygenated additive (Diethyl ether) to bio diesel blend reduces the density and viscosity as well as increase the content of oxygenThe brake thermal efficiency of bio diesel blends are more when compared with diesel due to low viscosity and high volatilityIn this case I was observed that by adding of Additive (Diethyl ether) which is oxygenated it shows higher brake thermal efficiency compared to the diesel as well as palm biodiesel without additive.Adding of oxygenated additive (Diethyl ether) in bio diesel blend shows decreases the brake specific fuel consumption compared with diesel and biodiesel without additive.All exhaust emissions are CO, CO2, HC and NOx reduced greatly because addition of diethyl ether

CHAPTER 7 CONCLUSION

In this study, the performance and emission characteristics of a diesel engine operated on diesel fuel and palm biodiesel blends and additive such as B0, B20, B40, B60 B20DEE5%, B20DEE10% and B20DEE15% were experimentally investigated. The performance of the engine was evaluated in terms of brake specific fuel consumption, brake thermal efficiency and mechanical efficiency. The emission characteristics of the engine were studied in terms concentration of, CO, CO2, HC, and NOx. The results obtained for additive mixed in palm biodiesel oil and their blends with diesel were compared with the results of diesel. The following results are obtained.

¬ Thermal efficiency of the engine is high with palm biodiesel blends when compared with diesel. The presence of additive in the palm bio diesel increases the expansion work and reduces the compression work resulting increased net work done causing an increase in efficiency. ¬ It is observed that reduction of BSFC for engine by using additive biodiesel blends as compared to diesel fuel. ¬ NOX emissions are brought by 30-40% by using blends. ¬ Carbon dioxide emissions of palm biodiesel blends increases high compared to diesel. This is due to the fact that complete combustion of fuel in the combustion chamber. ¬ The concentration of hydro carbon emissions is less for palm biodiesel blends when compared to diesel. ¬ The CO emissions are low for palm bio diesel blends when compared with diesel. FUTURE SCOPE ¬ If we can add the ignition impower then we will get better efficiency and also reduces emissions ¬ The effect of the present additive can be tested in automotive engine and also with many alternative fuels in use

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