International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 12 | Dec 2019 www.irjet.net p-ISSN: 2395-0072

PERFORMANCE ANALYSIS OF C.I. ENGINE USING BIODIESEL FUEL BY MODIFYING INJECTION TIMING AND INJECTION PRESSURE

Ravi Shankar Kumar[1] Dharamveer Singh[2], Desh Bandhu Singh[3]

[1]*M.Tech Scholar, Department of Mechanical Engineering, R. D Engg. College Ghaziabad. U.P, India*
[2]*Research Scholar, Department of Mechanical Engineering, Delhi Technological University, India*
[3]*Professor, Department of Mechanical Engineering, Galgotia's College of Engg. and Technology, U.P., India*

Abstract - *This research presents the optimization of injection pressure and injection timing of the compression ignition engine with the use of biodiesel. The fossil fuel or conventional fuel blended with the biodiesel has been done by the fuel modification process. The Jatropha biodiesel blended with diesel for C.I. Engine. B100 (100% biodiesel) biodiesel are used to determine the engine performance on different load. The 2-stroke single cylinder C.I. Engine has been tested with B100 blended fuel. The engine runs on no-load condition for half an hour for the test to obtain the real operational condition of an engine then experiment done. Some blends having high exhaust gases emission such as SOx, NOx but also having high B.P. reading, on the other side some blends having fewer exhaust gases emission of SOx, NOx but also having less B.P. reading. I have made a conclusion that B20 blends are good in all prospect whether it is exhaust gases emission or engine power. I have used Jatropha seed because it will be easily cultivated with less amount of water or in a dry place. The Jatropha plant can evoke in infertile land so that we can cultivate the Jatropha in those types of areas. In the present situation, Jatropha oil are costly as compare to diesel but when the cultivation takes place on the commercial level. The cost will decrease and also do not forget that we have limited conventional fuel for the future generation.*

Key Words: **Blend[1], CI Engine[2], Emissions[3], B.P.[4], Performance[5]**

1. INTRODUCTION

The energy menace is a situation in which the country experience a break-down of energy supplies brought by quickly increasing energy cost that intimidate the economic and security of a country. The intimidates to economic security is represented by the possibility of retardation in economic growth, increasing inflation, increasing unemployment, and deficit in trillions of money in an investment. The intimidates to country security is represented by the incapability of United State Government to exercise various diplomatics options in particular regarding to nations with substantial crude oil reserves. For example, a few years ago disruption of Venezuelan oil supplies may boundary the US diplomatics options towards Iraq. We have seen the two energy menace of 1973 and 1979, then we feel some similar tenors between the two. Were appertinent with low crude oil stocks, Were appertinent in retarding US petroleum product, Started with political stampede in some of the crude oil producing nations, Were appertinent with high dependency on crude oil imports, Were appertinent with import concentration from a small number of suppliers, Were appertinent with low level of crude oil industry spending, Caused an economic downturn for countries, In Middle East countries limited the United Nation diplomatics, Dismemberment US and punish the west in response to support for Israel in the Yom Kippur war against Egypt led the price of crude to rise

As per the International Energy Agency project report minimum 50% enhancement in demand by 2030. The enhancement in consumption was 3% in 2011, but yearly enhancement of only 1.6% would lead to 51%. India and China are both rapidly enhancing their consumption of old. The supply is not enough to meet the demand and rapidly enhancement in global prices of crude oil is making an impact in the economy of many countries. Therefore it is essential to adjust to the retarding oil supply and turn to an alternative source of energy.

1.1 Dependency on Imported Petroleum Fuel

India is one of the largest crude oil and petroleum product consuming and importing countries. India's rank in oil consumption and import is 3rd and rapidly enhancement in oil consumption the rank go up as per US ministry of Petroleum Planning and Analysis Cell (PPAC) report. India imports nearly 70-72% of its petroleum demands. India had imported 213.83 million tonnes of crude oil 2016-17 for USD 70.236 billion. At present yearly consumption of diesel oil in India is 95 million tonnes constituting nearly 40% of the total petroleum product consumption. In 1990-91, the European Community introduced a 90% tax reduction for the use of biofuels, together with biodiesel. Presently mainly 34 countries worldwide produce biodiesel and India rank's 26th of these. India's crude oil imports go up by 23.4% in July this year on enhancement in demand for oil products, an experienced Petroleum Minister officially said. Crude oil imports in July were 8.532 million tonnes as opposed to 6.943 million tonnes in the same month previous last year.

1.2 World Oil Production

It is manifestly crucial to know the limitation of the world oil reserves. However, it is parallel crucial to know the rate at which oil can be produced. Each and every oil producing country of the world, scrimp for one, produced oil at almost the maximum rate in 2003, Figure 1 shows it. That mudslinging is Saudi Arabia. Venezuela and Iraq both had production obstructions in 2003 but world oil production remains nearly constant because of Saudi Arabia made up the difference.

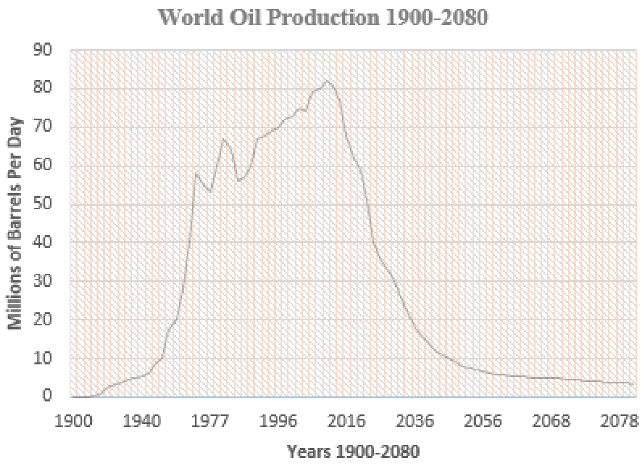

Fig -1: World Oil Production in Millions of Barrels Per Day

Saudi Arabia was able to significantly enhancing production on a short terms foundation in 2003, but perhaps not in 2006, according to Matthew Roy Simmons, the founder and chairman emeritus of "Simmons & Company International" in an oil field. Oil statistics data ordinarily comprise the ratio of R/P (Reserves to Production). It would appear that this is a scale of how long the oil will end. This is an illusory correlation because this assumes that production will remain constant until the last drop is extracted. Here are details of what virtually go on when an oil region is discovered. At first, production proceeds exponentially because of each new oil well adds its output. Lastly, production of the oil region reaches at maximum as every new oil well produces less oil and old oil well run dry. Then there was an exponentially decline as more old oil wells run dry. The productivity of a particular oil well depends on the rate at which oil flows horizontally to the wellhead, the pressure within the oil-bearing creation and viscosity of the oil. There are an optimum rate of production of any well. If oil is extracted too fast then some of the oil is left behind and the quantity ultimately produced is reduced.

1.3 Scope of Study

The further study required to understand the process of making biodiesel from two or more vegetable oils mixture,

[1] Energy and exergy analysis of biodiesels mixture may be conducted and a software programming for chemical composition, energy, and exergy analysis of fuel is to be developed.

[2] Oxidation and storage of the biodiesel fuel properties may be studies.

[3] Development and research have to be taken up for the development of non-edible oil-based lubricants and their commercialization.

[4] Whole life cycle and statistical analysis of individual potential biodiesel feedstock may be conducted.

[5] We required more intensive investigations on exploring different valuable by-products from glycerol and proper utilization of oil cake.

2. LITERATURE REVIEW

High percentage blends of biodiesel can have a problem due to cold temperature. B100 biodiesel produced from soyabean oil will become cloud at temperatures little above freezing and can prevent fuel filters if the temperature drops below 28 ^{0}F. In such conditions, biodiesel blends with diesel fuel are preferred. Since biodiesel is a strong solvent, it will lose trash in tanks and pipes, clogging filters initially. Remedy this problem is after first use change filters. Sometimes gaskets and rubber hoses on older vehicles with B100 don't hold up well. Pre-1991 vehicles should be monitored for hose reduction. If these happen, the seals and hoses should be replaced with Viton- installed parts.

By the use of biodiesel engine warranties are not affected, notwithstanding dealers are continuously confused on this point. The parts and assembly of the engines only cover manufacturers' warranty statements and problems caused by the fuels never cover, regardless of whether the fuel is biodiesel or petroleum-based diesel. The questions arise about compensation for damages caused by a distinct fuel should be addressed to the supplier of fuel.

2.1 What is Biodiesel?

The biodiesel is made from a number of feedstocks together with tallow, lard, vegetables oil and waste edible oils. "Biodiesel is defined as mono-alkyl esters of long chain fatty acids derived from vegetable oils or animal fats. To make biodiesel, feedstocks can be trans-esterification to made biodiesel by using alcohol. Which has been mixed with a catalyst like sodium hydroxide or potassium hydroxide. Most commonly used alcohol for a trans-esterification process is methanol. Methanol is less expensive and easily reacts so it used more than other alcohols.

$$\text{Triglyceride} + \text{Methanol} \xrightarrow[\text{Cat. NaOH}]{} \text{Glycerol} + \text{Esters}$$

(Trans-esterification Reaction)

Biodiesel derived from soybean is generally used in the US. While in Europe generally used feedstock for biodiesel production is rapeseed. Biodiesel is aromatics, biodegradable, nontoxic and essentially free from sulphur, in nature. It is mostly produced from the product that can be grown domestically and internationally, so it is also presumed as a renewable resource.

2.2 Physical & chemical properties of Biodiesel?

Since biodiesel and ethanol are made from biomass materials and its transportation is similar to biofuels. It's commonly used as blended fuel with petroleum fuels namely with gasoline and diesel fuel, but it can also be used alone. Biodiesel and ethanol are generally clean burning fuels, it produced very less air pollution emission.

1. Cetane number: It is defined as the comparative measure of a time interval between the start of injection and autoignition of the fuel. If higher the cetane number then minimum the delay interval and higher the combustibility. The fuel having low cetane number outcomes is difficult to start, also have exhaust smoke and noise. By using a test engine, the cetane number is generally measured and provide knowledge about the diesel fuel ignition quality. Commonly, the cetane number's range between 47 to 50 for diesel fuel, although 40 to 45 for vegetable oils.
2. Melt or pour point: It indicates the temperature at the oil which is in the solid state begin to melt or pour.
3. Cloud point: The temperature at which fuel oil being start solidify is called as the cloud point of that fuel.
4. Carbon residue: This shows the tendency of the fuel to form carbon deposits in an engine. A crucial indicator of the quality of biodiesel is the carbon residue, which coincides to the content of glycerides, liberated fatty acids, polymers, soaps, and remaining catalyst.
5. Density: The weight per unit volume is known as density. The oil having denser contain high energy. By obtained sample values, its seem that biodiesel is normally denser than diesel fuel, varies between 874 kg/m^3 to 881 kg/m^3 compared with diesel which has 848 kg/m^3 density. So, the final product density depends generally on the feedstock used.
6. Kinematic viscosity: Viscosity describes the flow properties and the tendency of a fluid to go under deformation when stress appear. Viscosity makes an impression on fuel atomization and injector lubrication. Fuel having less viscosity, cannot provide enough lubrication for the precision fit of fuel injection pumps, so it's resulting in enhancement in wear or tear and leakage.
7. Calorific value: Heating Value or heat of combustion is the amount of heating energy liberated by the combustion of fuel's unit value.
8. Flash point: The minimum temperature at which the fuel will get fire on an application of a firing source is known as the flash point temperature of diesel fuel. Fresh and clean biodiesel have 140^0C flash point, whatever well higher the flash point of petroleum-based diesel fuel $\pm 80^0C$.
9. Iodine value: It is a listing of the number of double bonds in biodiesel oil, so a parameter that liberates the degree of unsaturation of biodiesel. It is worth of the mass of iodine, dignified in grams, sucked up by 100 grams of specified oil.
10. Acid value: The total acid number is an indication of the presence of free fatty acids formed due to oil degradation and combustion.
11. Stability- oxidative, storage and thermal: Due to the existence of the chemical fabrication of methyl ester and fatty acids in biodiesel, its ages period more hurry as compared to petroleum diesel fuel. Generally, there are fourteen types of fatty acid methyl ester present in the biodiesel. The particular ratio of presence of these esters in the fuel oil makes an impression on the final properties of biodiesel. Lower oxidation stagnation can cause fuel thickening, the formation of adhesive and sediments which in turn can cause separate clogging and injector fouling. Biodiesel or biodiesel blends can't be kept in a storage tank or vehicle tank greater than six months. Depending on the storage temperature and some other circumstance suggest the use of convenient antioxidants.
12. Ash percentage: For the heating value, the ash content is crucial, as ash content enhanced with the retard in heating value. Biodiesel exhausts less ash content as compared to other coals, and sulphur content is too less as compared to other fossil fuels.
13. Sulphur percentage: The percentage by weight, of sulphur in the sulphur containing fuel is limited by law to a very low percentage for diesel fuel used in on-road application vehicles. We use animal fat and vegetable oil-based biodiesel having less than 15 PPM sulphur.

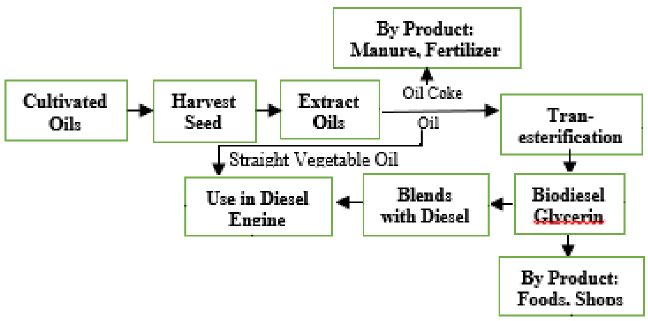

Fig- 2: Schematic Diagram of Biodiesel Production.

Biodiesel is produced by trans-esterification reaction process from animal fats, vegetable oils, and alcohol. Those chemical reaction change animal fats and vegetable oils into a mixture of esters of the fatty acids, which make up the oil from fats. Then the mixture fatty acid methyl esters are purified to obtained biodiesel. A catalyst is also mixture in reaction to enhance the chemical reaction of biodiesel formation. On the basis of the catalyst used in the enhancement of reaction, trans-esterification can be classified into acidic (enzymatic), basic, and former being is most commonly used. A usual trans-esterification reaction is shown in equation RC00RO represent an ester, R0O0H alcohol, RO0H glycerol (another alcohol), RC00ROO an ester mixture and a catalyst RC00RO Þ R0OOH, cat RO0H Þ RC00ROO. When methanol alcohol used in the trans-esterification process, the produced product of the reaction is a mixture of methyl esters, similarly if ethanol was more important alcohol used in biodiesel production methanol. It most widely used, in spite of its venomousness. It is a liquid material of petrochemical origin. Ethanol fewer used, because it needs more sophisticated production technology and reaction process are lower. It can be easily produced from biomass.

Most of the time trans-esterification reactions is used for biodiesel production at all production scale. For industrial production scale acid less used, occasionally applied the first stage with very acidic raw materials. The enzymatic used very rarely. Lipases are used in the enzymes, the product of the reaction process could be an ethyl esters mixture. In above, both cases glycerin will be the coproduct of the reaction. However, trans-esterification is an extremely crucial step in biodiesel production due to it produces a mixture of esters. Some more steps are needed to obtain a product that follows international standards. In resultant, when the trans-esterification's chemical reaction is completed and the two phases are separated (a mixture of glycerin and esters). To reduce the concentration of agreeable levels the mix of methyl esters must be purified. These comprise the residue of catalyst, methanol, and water; the latter is commonly mixed in standby proportion with the raw materials in order to reach supreme conversion efficiency in the trans-esterification reaction. In the mentioned sections the methods of purification process will be given in details. By treatment of raw materials the content of free fatty acids, moisture and not saponifiable matters are main parameters to obtain high conversion efficiency in the trans-esterification reaction process. The use of available basic catalysts in triglycerides with more content of free fatty acids is not suitable because part of the latter reacts with the catalyst to form soaps. In outcome, part of the catalyst is spent, and no far available for trans-esterification. In short, the efficiency of the reaction reduces with the enhancement of the acidity of the oil. Fundamentals esterification reaction of ethanol with dimethyl carbonate produce glycerol carbonate and methanol. Stages of the biodiesel production process by treatment of raw materials alcohol catalyst mixing chemical reaction dissociation product refinement of the reaction products. Introduction to biodiesel production from vegetable oils, poke, coconut, poultry, animal fats from cattle, an acid trans-esterification is needed a starting stage to retard the level of FFA as per the noted value. Besides having less humidity and acidic material; it is essential that the oil present in a low level of not saponifiable material. If the latter were to exist in considerable amount and soluble in biodiesel. It would lower the level of esters in the product, building it arduous to observe with the less ester content expected by the standards. The American Oil Chemists' Society (AOCS) standards list the expected properties of oils. Anyway, the properties expected by the oils are ultimately determined by the biodiesel industry in every nation. For instance, in Argentina the oils for biodiesel production ordinarily have: Density at 15^{0}C: 0.70-0.80 g/ml, Moisture content: 450-550 PPM, Peroxide index: 10 mEq/kg, Acidity level: 0.1 mg KOH/g, Non-saponifiable substances: >1%, Kinematic viscosity at 40 ^{0}C: 2-4.3 cSt, Cetane index minimum: 45-55.

Alcohol catalyst blends the alcohol applied for biodiesel production must be mixed with the catalyst before the addition of oil. The mixture is well stirred until the catalyst is perfectly dissolved in the alcohol. It should be noted that for the reasons stated in the last paragraph, alcohol should be water-free (waterless). Sodium and potassium hydroxide is one of the most generally used catalysts. For production on an industrial scale, Sodium or potassium methoxide or methylates are commercially available. Of course, caution is required, and all applicable safety rules Interpretation must be followed, when with methanol, hydrogen and methoxides are independently working on the production scale. Alcohol-to-oil volume ratio, R is another major transformation of the transesterification process. In the stoichiometric ratio, 1 liter of oil is needed to react with 3 liters of alcohol, 3 liters of fatty acids, methyl ester (FAME) and 1 Liter to obtain glycerin. However, since the reaction is reversible, substitute balance on the right side of the additional alcohol equation as a reaction. Which will increase the quantity of products (since it can be estimated from the principle of Le Chatelier). Although a high alcohol-to-oil ratio does not change in the properties of FAME, it is to separate biodiesel from glycerin will make it arduous because it will later enhanced the solubility of the former. Typically, a 100% alcohol intake is used in practice, i.e. 6 mol of alcohol per mol of oil. It concur to 1: 4 alcohol-to-oil volume ratio (R = 0.25). The relationship between alcohol-to-oil ratios, the dielectric properties of FAME, will be discussed later. Lastly, it should be well-known that the essential quantity of catalyst is determined to keeping in mind the acidity of the oil. Biodiesel production action chemical reaction occurs, when the oil needs to be described in the preceding paragraph is mixed with the alkoxide (alcohol-catalyst mixture). It requires certain circumstance of time, temperature and stirring. Due to the high stagnation of the set emulsion, problems arise in the purification of the biodiesel and disjunction, when the use of ethanol in the reaction. A trans-esterification process can be done at different temperatures. For the same reaction time, the conversion is more at high temperature. Because the boiling point of methanol is almost 67^{0}C (340 K or 153 ^{0}F), the temperature for trans-esterification in atmospheric pressure often occurs in the limit between 48^{0}C and 58^{0}C. For paradigm, for the production of biodiesel through rapeseed oil (whose main SFAs are linoleic, palmitic, linolenic, and oleic) and methanol with potassium hydroxide as a catalyst, 64 isomers of triglycerides, 8 monoglycerides, 32 diglycerides can be theoretically possible to find. Their methyl esters, potassium salts of fatty acids, water, potassium meth oxide etc. Reflections on this topic signalize the subsequent general guidelines:

For greater reaction time, the concentration of triglycerides retard the concentration of esters, increases and the concentration of mono-and diglycerides enhanced to a maximum and then retard. Most chemical reactions happen throughout the first minutes.

At the start of the chemical reaction, mono- and the absence of digly (diglycerides) the enhance furthermore retard in their concentration during the position and reaction confirms that ester production from trigly (tricerides) occurs in three platforms, as shown by the subsequent equations:

$$\text{Tri-gly.} + \text{Methanol} \xrightarrow{KOH} \text{Di-gly.} + \text{Methyl esters}$$

$$\text{Di-gly.} + \text{Methanol} \xrightarrow{KOH} \text{Mono-gly.} + \text{Methyl esters}$$

$$\text{Mono-gly.} + \text{Methanol} \xrightarrow{KOH} \text{Glycerine} + \text{Methyl esters}$$

Introduction to Biodiesel Production Several methods, with different levels of equipment complexity and training requirements, have been devised to analyze samples that are mixtures of fatty acids and esters from triglycerides obtained from transesterification of vegetable oils. Where MOH methanol indicates, ME is methyl ester, TG, DG, and MG respectively are tri, DI and monoglyceride, and G is glycerine. The tenors of biodiesel production have been developed to examine the samples with several levels of stuff complexity and training demands, which are a compound of fatty acids and esters from triglycerides, which are acquired from the transformation of vegetable oils.

2.3 Combustion

Combustion in Diesel Engines

For the combustion process that occurs in the diesel engine, there is a relationship between the pressure inside the combustion chamber and the crank angle. Raising the fuel temperature, makes the fuel to ignite immediately, still it is not exposed to a flame. The least temperature that this happens is termed the autogenous ignition point (self-ignition temperature). The fuel is introduced into the combustion chamber and warmed by the air of high temperature and pressure. Then, the fuel self-ignites and burns. In a diesel engine, the fuel ignitability is developed because as the compression ratio rises, the temperature rises suddenly.

Ignition delay period

The interval between the start of fuel injection and the start of combustion in the flaming chamber is associated as the ignition delay period. The opening of diaphragm opens with the change in the tilt on the diagram, or by heat discharge analysis of the data, or in the experimental conditions luminous detector. The opening of the injection can be determined by a needle-lift indicator when the injector needle is removed from its seat. It is more difficult to accurately determine the inside. This is best recognized by changing the tilt of the heat discharge rate from the cylinder discharge data. The engine is well marked in the ignition, IDI engine to recognize in the ignition point is hard.

Premixed combustion stage

Throughout the ignition delay period, the combustion of fuel mixed with air inside the flammability border is accelerated gradually in the crank angle degree - large heat liberation characteristics in this phase. If the fuel received in the combustion chamber during the ignition delay the amount is very high - the pressure in the large heat liberation rate rises immediately which creates the diesel knockdown. For the mean ignition number of the fuel, with a delay in ignition, the expansion stroke happens late in the ignition - deficient combustion, low power formation, poor fuel conversion efficiency. If the pressure gradients are in the scale of 0.4 - 0.5MPa / o CA, the running of the engine is not smooth and Diesel knock starts. This value should be between 0.2 to 0.3MPa / o CA.

Mixing-controlled combustion stage

Once the fuel and air which is incorporated while the ignition delay are consumed, the speed of burn (heat discharge rate) is regulated by the rate at which the mixture becomes ready for burning. The rate of burning at this stage fuel vapour and air mixture are mainly controlled by the process. Liquid fuel atomization, evaporation, pre-flame chemical reactions further affect the rate of heat liberation. Heat wave the rate of price seldom touches to a second peak (which is lighter in magnitude) and next decreases with the graduation of the state. In usual, TDC for low particle emission and high performance (and efficiency). It is acceptable to have a combustion process.

Late combustion stage

Energy discharge rate is resuming at a cheaper rate in the stroke - there are various causes for this: a tiny part of the fuel can't burn still, a part of the energy is being in the burning of burning and fuel-rich products and can be discharged. Cylinder Charge is non-uniform and through this phase the mixture develops a full combustion and light isolated output gases.

2.4 Emission Characteristics

Smoke Emission

The configuration of smoke happens on extreme air lack. The shortage of air or oxygen is being locally inside the diesel engines. As the proportion of the fuel to the air drops, it grows. The test results show that Smoke discharges rise with load increment for all compression proportions, because the development of smoking is strongly reliant on the weight. For three separate compression proportions. There is a change in the smoke discharge for the B20 mix with the load. The smoke values for compression 18 were the smallest of them. Since the engine trying to decrease the emission of better emission smoke in the raised compression ratio can be inside the cylinder. The values of the smoke of diesel and biodiesel blends in full load performance. For the objective of conducting biodiesel due to atomic oxygen, the value of smoke is reduced, which helps in normal combustion, decreases the smoke.

Un-burnt hydrocarbon (HC)

Another emission result presented by diesel locomotives is UBHC. It includes fuel that is entirely unpublished or only partially burnt. The amount of the UBHC depends on the running conditions of the engine and the fuel attributes. For the different compression ratios, It seems that B20 honge considers the UBHC variation for methyl esters. UBHC emissions were high because the high compression ratio was low Pressure and better combustion can be secured in the temperature and high compression ratio. U-H-17 appearances the UBHC emission for total diesel and biodiesel blends in full load situation. HC discharge was low for biodiesel blends. HC discharges in case the fuel mixture was retard with enhancing quantity of biodiesel. In its molecular structure, the inbuilt oxygen content may be capable for the complete combustion and thus can diminish the HC level.

CO Emission

In the diesel engine, CO intermediate is produced during the combustion phase. But, the diesel engines which operate on the lower side of the emissions of stoichiometric proportion, are smaller. The variation of CO with load for the B20. Emissions on the load will be diminished and it arises for full load as it can be understood from the graph. For the diesel, the emission of CO at full load and simultaneous biodiesel have three separate. The compaction is mixed in compression ratios. CO emissions were lower compared to diesel value for biodiesel services. With the enhanced amount of biodiesel in the emissions, the emission was reduced. The excess amount of oxygen in the biodiesel is suitable for the combustion inside the cylinder, and consequently diminishes CO emissions.

3. EXPERIMENTAL SETUP

B.P.	:	3 kW
MAXIMUM SPEED	:	1500 rpm
NUMBER OF CYLINDER	:	1
TYPE OF IGNITION	:	COMPRESSION IGNITION
METHOD OF STARTING	:	CRANK START
METHOD OF LOADING	:	ELECTRICAL LOADING

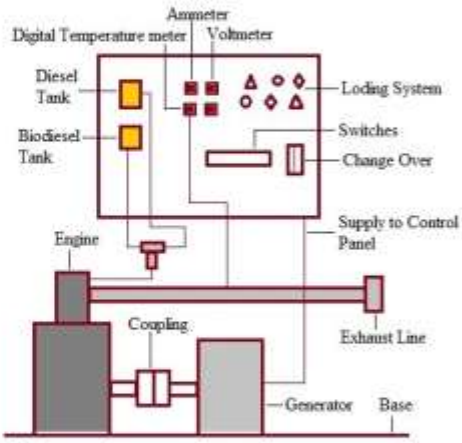

Fig- 3: Schematic diagram of experiment setup

3.1 Loading System

Testing to D.C. Compound is attached to the generator and loaded by an electric bulb. Fuel provided by the central fuel tank through a measuring jar. To prevent the time to stop the fuel consumption of many times to estimate fuel consumption of the engine, fill 10ml fuel the jar by opening the cocked tank several times.

B.P. = $(V*I)/(\eta_g*1000)$ kW

η_g = Efficiency of generator.

3.2 Fuel Measurement

The fuel provided from the central fuel tank through a measuring burette with 3 way manifold system. To estimate the fuel consumption of the engine charges the burette by opening the cork marked "tank" in the manifold block, by starting a stopped clock measure the time taken to drain 10 ml of fuel.

m_f = (10*density of fuel*3600)/ (1000*time) kg\hr.

Density of diesel = 848 kg\m^3

Density of biodiesel = 875 kg\m^3

Fig-4: Experimental setup

4. RESULTS AND DISCUSSION

4.1 Observations

Time for 10 ml fuel consumption from jar = t_f , (S)

Exhaust Gas Temperature = E.G.T., (^{0}C)

4.1.1 For High Pressure and Advance Injection Timing

On diesel fuel

Table 1 shows the speed versus load for CI engine with diesel fuel. Fuel injection timing and pressure has a major influence on engine performance, combustion, and emission, and these impacts have mainly executed in case of late injection cases. But, for advance injection timing with high pressure and high heat liberation will attain high values. For homogeneous charging combustion operation engine, compression stroke at advance injection timing and high pressure has been set to ensure better fuel/air mixture quickly. For the end of the ignition, it has electricity 198 V and 1.3 A at 728 rpm while 192 V and 13.8 A at 638 rpm.

Table -1: Summarized various data on diesel fuel

On diesel fuel				
Load (kW)	Speed (RPM)	Vol.(V)	Amp.(I)	t_f(Sec)
0.25	728	198	1.3	108.3435
0.50	723	204	1.6	110.6758
0.75	716	209	2.4	84.7411
1.00	724	213	3.4	75.6188
1.25	712	216	4.6	64.0850
1.50	702	221	5.4	55.4759
1.75	695	215	6.7	47.3648
2.00	677	218	7.7	42.9241
2.25	682	204	8.5	39.0235
2.50	650	198	9.4	35.2992
2.75	664	203	11.4	27.3690
3.00	638	192	13.8	22.0053

On biodiesel fuel

Table 2 shows the speed versus load for CI engine with biodiesel fuel. Fuel injection timing and pressure has a major influence on engine performance, combustion, and emission, and these impacts have mainly executed in case of late injection cases. But, for advance injection timing with high pressure and high heat liberation will attain high values. For homogeneous charging combustion operation engine, compression stroke at advance injection timing and high pressure has been set to ensure better fuel/air mixture quickly. For the end of the ignition, it has electricity 194 V and 1.2 A at 734 rpm while 194 V and 11.4 A at 669 rpm.

Table -2: Summarized various data on biodiesel fuel

On biodiesel fuel				
Load(kW)	Speed(rpm)	Vol.(V)	Imp.(I)	t_f(Sec)
0.25	734	194	1.2	99.5689
0.50	728	203	1.8	84.6215
0.75	722	208	2.5	78.5430
1.00	706	213	3.4	77.0221
1.25	712	218	4.6	64.6261
1.50	705	224	5.8	52.8362
1.75	708	216	6.3	55.0595
2.00	698	206	7.4	51.1388
2.25	691	192	8.7	49.9456
2.50	684	210	9.6	44.6176
2.75	677	206	10.8	34.2358
3.00	669	194	11.4	28.3468

4.1.2 For Normal Pressure and Advance Injection Timing

On diesel fuel

Table 3 shows the speed versus load for CI engine with diesel fuel. Fuel injection timing and pressure has a major influence on engine performance, combustion, and emission, and these impacts have mainly executed in case of late injection cases. But, for advance injection timing with normal pressure and high heat liberation will attain high values. For homogeneous charging combustion operation engine, compression stroke at advance injection timing and normal pressure has been set to ensure better fuel/air mixture quickly. For the end of the ignition, it has electricity 195 V and 1.1 A at 722 rpm while 172 V and 10.2 A at 652 rpm.

Table -3: Summarized various data on diesel fuel

On diesel fuel				
Load (kW)	Speed (RPM)	Vol.(V)	Amp.(I)	t_f(Sec)
0.25	722	195	1.1	168.2820
0.50	712	183	1.7	159.3133
0.75	701	198	2.4	141.5092
1.00	688	205	3.5	110.8045
1.25	692	208	4.6	89.1738
1.50	677	202	5.4	85.7189
1.75	684	212	6.8	62.4419
2.00	671	203	7.4	68.7748
2.25	663	194	8.2	69.5214
2.50	652	186	8.9	70.0011
2.75	643	176	9.4	66.1861
3.00	652	172	10.2	57.3018

On biodiesel fuel

Table 4 shows the speed versus load for CI engine with biodiesel fuel. Fuel injection timing and pressure has a major influence on engine performance, combustion, and emission, and these impacts have mainly executed in case of late injection cases. But, for advance injection timing with normal pressure and high heat liberation will attain high values. For homogeneous charging combustion operation engine, compression stroke at advance injection timing and normal pressure has been set to ensure better fuel/air mixture quickly. For the end of the ignition, it has electricity 196 V and 0.9 A at 718 rpm while 181 V and 10.7 A at 655 rpm.

Table -4: Summarized various data on biodiesel fuel

On biodiesel fuel				
Load(kW)	Speed(rpm)	Vol.(V)	Imp.(I)	t_f(Sec)
0.25	718	196	0.9	96.9150
0.50	712	192	1.4	87.2072
0.75	686	203	2.5	61.3572
1.00	696	205	3.4	52.9973
1.25	689	202	4.8	41.5831
1.50	676	209	5.3	40.0998
1.75	672	197	6.6	35.5884
2.00	648	193	7.4	34.7806
2.25	634	207	8.1	30.7963
2.50	662	194	8.8	31.7150
2.75	642	189	9.5	31.2605
3.00	655	181	10.7	26.3242

4.2 Result

4.2.1 For High Pressure and Advance Injection Timing

On diesel fuel

Table 5 shows the load versus brake power, s.f.c., brake thermal efficiency, and exhaust gas temperature for CI engine with diesel fuel. Fuel injection timing and pressure has a major influence on engine performance, combustion, and emission, and these impacts have mainly executed in case of late injection cases. But, for advance injection timing with high pressure and high heat liberation will attain high values. For homogeneous charging combustion operation engine, compression stroke at advance injection timing and high pressure has been set to ensure better fuel/air mixture quickly. For the end of the ignition, it has B.P. 0.3300 kW, s.f.c. 0.8538 kg/kW-hr, and brake thermal efficiency 9.92% at 0.25 kW load while B.P. 1.8467 kW, s.f.c. 0.3489 kg/kW-hr, and brake thermal efficiency 24.27% at 1.75 kW load.

Table -5: Summarized various data on diesel fuel

On diesel fuel				
Load (kW)	B.P. (kW)	s.f.c. (kg/kW-hr)	B.T.E. (%)	E.G.T. (^{0}C)
0.25	0.3300	0.8538	09.92	233
0.50	0.4184	0.6591	12.85	238
0.75	0.6430	0.5601	15.12	247
1.00	0.9284	0.4348	19.48	255
1.25	1.2738	0.3739	22.65	278
1.50	1.5300	0.3596	23.55	301
1.75	1.8467	0.3489	24.27	319
2.00	2.1520	0.3304	25.63	335
2.25	2.2230	0.3518	24.07	347
2.50	2.3861	0.3624	23.37	361
2.75	2.9669	0.3759	22.53	372
3.00	3.3969	0.4083	20.74	381

On biodiesel fuel

Table 6 shows the load versus brake power, s.f.c., brake thermal efficiency, and exhaust gas temperature for CI engine with biodiesel fuel. Fuel injection timing and pressure has a major influence on engine performance, combustion, and emission, and these impacts have mainly executed in case of late injection cases. But, for advance injection timing with high pressure and high heat liberation will attain high values. For homogeneous charging combustion operation engine, compression stroke at advance injection timing and high pressure has been set to ensure better fuel/air mixture quickly. For the end of the ignition, it has B.P. 0.2984 kW, s.f.c. 1.0599 kg/kW-hr, and brake thermal efficiency 10.63% at 0.25 kW load while B.P. 2.5846 kW, s.f.c. 0.2731 kg/kW-hr, and brake thermal efficiency 41.25% at 2.50 kW load.

Table -6: Summarized various data on biodiesel fuel

On biodiesel fuel				
Load (kW)	B.P. (kW)	s.f.c. (kg/kW-hr)	B.T.E. (%)	E.G.T. (^{0}C)
0.25	0.2984	1.0599	10.63	221
0.50	0.4684	0.7946	14.18	229
0.75	0.6666	0.6015	18.73	239
1.00	0.9284	0.4404	25.58	247
1.25	1.2856	0.3791	29.72	269
1.50	1.6656	0.3579	31.48	288
1.75	1.7446	0.3279	34.36	311
2.00	1.9543	0.3151	35.75	322
2.25	2.1415	0.2945	38.26	334
2.50	2.5846	0.2731	41.25	348
2.75	2.8523	0.3225	34.93	362
3.00	2.8353	0.3919	28.75	373

4.2.2 For Normal Pressure and Advance Injection Timing

On diesel fuel

Table 7 shows the load versus brake power, s.f.c., brake thermal efficiency, and exhaust gas temperature for CI engine with diesel fuel. Fuel injection timing and pressure has a major influence on engine performance, combustion, and emission, and these impacts have mainly executed in case of late injection cases. But, for advance injection timing with normal pressure and high heat liberation will attain high values. For homogeneous charging combustion operation engine, compression stroke at advance injection timing and normal pressure has been set to ensure better fuel/air mixture quickly. For the end of the ignition, it has B.P. 0.2750 kW, s.f.c. 0.6596 kg/kW-hr, and brake thermal efficiency 12.84% at 0.25 kW load while B.P. 2.1223 kW, s.f.c. 0.2054 kg/kW-hr, and brake thermal efficiency 41.22% at 2.50 kW load.

Table -7: Summarized various data on diesel fuel

On diesel fuel				
Load (kW)	B.P. (kW)	s.f.c. (kg/kW-hr)	B.T.E. (%)	E.G.T. (^{0}C)
0.25	0.2750	0.6596	12.84	229
0.50	0.3988	0.4804	17.63	234
0.75	0.6092	0.3541	23.92	244
1.00	0.9198	0.2995	28.28	256
1.25	1.2266	0.2790	30.35	268
1.50	1.3984	0.2546	33.26	281
1.75	1.8482	0.2645	32.02	294
2.00	1.9258	0.2304	36.75	309
2.25	2.0394	0.2153	39.34	327
2.50	2.1223	0.2054	41.22	341
2.75	2.1210	0.2174	38.95	345
3.00	2.2492	0.2368	35.76	354

On biodiesel fuel

Table 8 shows the load versus brake power, s.f.c., brake thermal efficiency, and exhaust gas temperature for CI engine with biodiesel fuel. Fuel injection timing and pressure has a major influence on engine performance, combustion, and emission, and these impacts have mainly executed in case of late injection cases. But, for advance injection timing with normal pressure and high heat liberation will attain high values. For homogeneous charging combustion operation engine, compression stroke at advance injection timing and normal pressure has been set to ensure better fuel/air mixture quickly. For the end of the ignition, it has B.P. 0.2261 kW, s.f.c. 1.4371 kg/kW-hr, and brake thermal efficiency 7.84% at 0.25 kW load while B.P. 2.3019 kW, s.f.c. 0.4377 kg/kW-hr, and brake thermal efficiency 25.74% at 2.75 kW load.

Table -8: Summarized various data on biodiesel fuel

On biodiesel fuel				
Load (kW)	B.P. (kW)	s.f.c. (kg/kW-hr)	B.T.E. (%)	E.G.T. (^{0}C)
0.25	0.2261	1.4371	7.84	224
0.50	0.3446	1.0481	10.75	236
0.75	0.6506	0.7890	14.28	246
1.00	0.8935	0.6651	16.94	258
1.25	1.2430	0.6093	18.49	271
1.50	1.4201	0.5531	20.37	284
1.75	1.6669	0.5309	21.22	294
2.00	1.8310	0.4946	22.78	300
2.25	2.1496	0.4758	23.68	313
2.50	2.1887	0.4537	24.83	328
2.75	2.3019	0.4377	25.74	344
3.00	2.4829	0.4819	23.38	361

4.3 GRAPHS FOR THERMAL EFFICIENCY

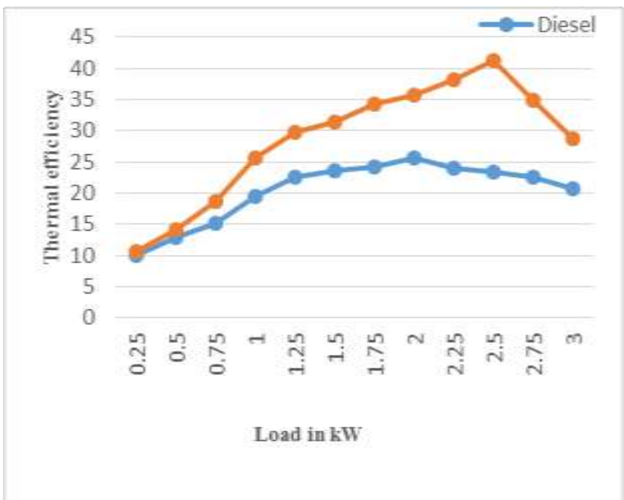

Chart -1: High Pressure Advanced Injection Timing

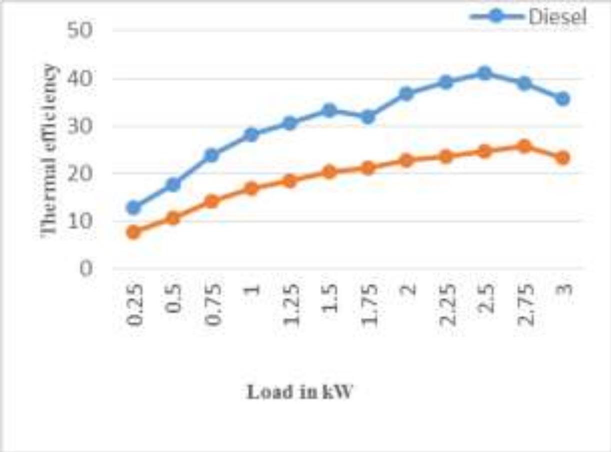

Chart -2: Normal Pressure and Advanced Injection Timing

5. CONCLUSIONS

After examining the record and expertise of those practicing biodiesel, this is desirable that biodiesel is an effective supplement for petroleum diesel for use in heavy vehicles. It provides too many advantages to overlook biodiesel transit agencies. Unlike petroleum diesel, biodiesel is a renewable energy source which is fabricated domestically, which can diminish the reliance on foreign holes and provide more energy assurance. These circumstances singly create biodiesel deserving attention. Comparative experiments were performed to estimate the performance of biodiesel corresponded to diesel on single cylinders compression ignition engine, water cooled. Engine load, engine speed, fuel consumption, and exhaust gas temperature measurement are taken. The result of the experiment can be compiled as follows.

[1] Outcomes confirm that when the fuel is charged with biodiesel, the engine's performance are alike with petroleum diesel.

[2] Fuel consumption with biodiesel is higher than fuel, when fuel is provided with petroleum diesel, because the engine should be provided with a bit more biodiesel to produce the similar amount of work, as before the low calorific value described was done by.

[3] Biodiesel performance in high pressure is compared to diesel.

[4] Combustion properties of the engine confirmed that the highest peak mixture has been shown for diesel after B20.

[5] Better thermal efficiency with high pressure but with advanced timing there is a little more reformation occur.

[6] Performance report of the engine shows that mixes B20 and B50 as a result of high BTE (brake thermal efficiency) corresponded to diesel. The maximum BTE was recorded for the B50, which is 17% more than the diesel.

[7] The brake power for both the fuel examined is comparable. There are little changes with changed parameters.

[8] At advance injection timing and normal injection pressure the thermal efficiency of engine enhanced.

[9] There was slight increase in the broken power of the engine under advance pressure.

[10] When the engine fueled the biodiesel, it would take time to get a steady state.

[11] Exhaust gas temperature (EGT) enhanced when the engine fuels the biodiesel.

[12] In the blends, B20 and B50 produced low CO emissions, compared to Diesel, in B50 a decrease of 34.21% compared to the maximum recorded diesel.

Current test results confirm that biodiesel can be successfully used in existing diesel engines with injection time and injection pressure changes. Biodiesel fuel can be recognized as a competent, engine friendly and environmentally friendly alternative to diesel oil. From the point of view of the social economy. The use of biodiesel a partial diesel option can increase the earnings of farmers. This will also help overcome the uncertainty of the availability of fuel.

REFERENCES

[1] Monteiro MR, Alessandra Regina Pepe Ambrozin, Luciano Morais Lião, Antonio Gilberto Ferreira., (2008) "Critical review on analytical methods for biodiesel characterization." Talanta Vol. 77 pp. 592–605.

[2] Amigun B, Sigamoney R., Blottnitz HV, (2008) 'Commercialisation of biofuel industry in Africa: A review.' Renewable and Sustainable Energy Reviews, Vol.12 pp.689–710.

[3] Agarwal, Avinash Kumar., (2007) "Biofuels (alcohols and biodiesel) applications as fuels for internal combustion engines." Development in Energy and Combustion Science. pp. 230-270.

[4] Agarwal, A K., (2005) "Experimental investigations of the effect of biodiesel utilization on lubricating oil tribology in diesel engines." Prof. IMechE, Vol. 219, Part D: Automobile Engg.

[5] Agarwal Deepak and Agarwal AK., (2007) "Performance and emissions characteristics of Jatropha oil (preheated and blends) in a direct injection compression ignition engine.", Applied Thermal Engg., Vol. 27, pp.2315–2325.

[6] Canakci, Mustafa. Gerpen, Jon H. Van., (2001) "Comparison of engine performance and emissions for petroleum diesel fuel, yellow grease biodiesel, and soybean biodiesel." ASAE Annual International Meeting. No. 016050.

[7] Giibitz G.M, Mittelbach M, Trab M., (1999) "Exploitation of the tropical oil seed plant *Jatropha curcas* L.", Vol.67, pp. 74-82.

[8] Canakci, Mustafa., (2007) "Combustion characteristics of a turbocharger DI compression

ignition engine fueled with petroleum diesel fuels and biodiesel." Bioresource Technology.1169-1175.

[9] Pramanik K., (2007) "Properties and use of jatropha curcas oil and diesel fuel blends in compression ignition engine.", Renewable Energy, Vol.28, pp. 238-247.

[10] Canakci, Mustafa., (2007) "Combustion characteristics of a turbocharger DI compression ignition engine fueled with petroleum diesel fuels and biodiesel." Bioresource Technology.1165-1177.

[11] Forson F.K., Oduro E.K. and Hammond-Donkoh., (2004) "Performance of Jatropha oil blends in a diesel engine.", Renewable Energy ,Vol.29, pp.1133–1147.

[12] Cengel, Yunus A., Boles, Michael A., (2008) "Thermodynamics: An Engineering Approach.", McGraw-Hill.

[13] Agarwal D. and Agarwal A.., (2009) "Performance and emissions characteristics of Jatropha oil (pre-heated and mixture) in a ID compression ignition engine.", Applied Thermal Engg., Vol. 27, pp.2317–2328.