ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Experimental Study of 4-Stroke Cylinder Water Cooled Rope Brake Diesel Engine Using Cotton Seed Oil

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ABSTRACT:

In this experimental investigation, the various percentage of cotton seed oil are blended with diesel and the performance and emission characteristics of 4-stroke diesel engine are calculated. The optimal percentage of cso blend had derived to find out the maximum possibility of fossil fuel replacement. The addition of diethyl ether in the percentages of 0, 5, 10, 15 and 20 were done respectively and the observations are compared. The results indicated that brake thermal efficiency of CSO blends were improved than others.

Key Words:

4-Stroke Cylinder, Vegetable Oils, Cotton Seed Oil, Biodiesel

1.1 INTRODUCTION:

The rise in civilization may be closely tied to improvements in transportation. Our present transportation system consists of railroads, ships automobiles and planes depend on mechanical power. Practically all of this power is derived from combustion engines are divided into two general cases, external combustion engines and internal combustion engines. Internal combustion engines are one of the important forms of prime movers, which run essentially on liquid fuels. IC engines can be divided into two main categories viz. petrol and diesel based engines otherwise called spark ignition engines and compression engines. Compression ignition engines due to their inherit fuel economy, easiness in operation, maintenance and long life, find wide usage in the fields of transportation, marine, earth, moving machines, industries power generation and agriculture.

Better part load performance and improved emission characteristics have made it popular in small automobile engines for passenger cars and light trucks. In India, the number of CI engines is so large that the bulk of available petroleum is consumed in the form of Diesel fuel. According to the oil Co-ordination Committee, in India, the Diesel oil consumption rate was 28.3 million tons in 1994-95 and 39.3 million tons in 1999-2000 and is estimated to reach a figure of 46.5 million tons by 2004-2005, whereas during the same period, the petrol consumption is estimated to rise from 3.1 million tons. This demand is partly being met through import of diesel oil an exorbitant price.

Diesel engines dominate the field of commercial transportation and agricultural machinery on account of its superior fuel efficiency. Due to shortage of petroleum diesel fuel and its increasing cost, an alternate source of fuel for diesel is very much needed. It has been found that vegetable oils hold special promise in this regard, since they can be produced from the plants grown in rural areas. Vegetables oils from crops such as cotton seed oil, soybean, peanut, sunflower, rape, coconut, karanja, neem, mustard, jetropha, linseed, and castor have been evaluated in many parts of the world, which lack petroleum reserves as fuels for compression ignition engines.

The results show that because of the long chain hydrocarbon structure, vegetable oils have good ignition characteristics, however they cause serious problems as carbon deposits buildup they have poor durability, and also poor thermal efficiency. While shorter tests were encouraging, longer-term endurance tests revealed problems generally attributable to inefficient combustion.

These problems of incomplete combustion are more prevalent with direct injection engines than with pre-chamber types. Additional research, in the U.S. and abroad demonstrated that the methyl esters derived from vegetable oils create fewer diesel engines. It was therefore suggested that on-road vehicles be tested using vegetable oil methyl esters (Biodiesel). It is a clean burning, renewable, non-toxic, biodegradable and environmentally friendly transportation fuel that can be used in neat form or in blends with petroleum derived diesel in diesel engines. It is the only EPA approved alternative fuel for diesel engines. Biodiesel has physical properties very similar to conventional petroleum diesel.

Emission properties, however are better for biodiesel than for conventional diesel except oxides of nitrogen which slightly higher than diesel. Biodiesel runs in any conventional, unmodified diesel engine and yields approximately equal performance as petroleum diesel. So basically, the engine just runs like normal (except for the smell). Esters have lower viscosities than the parent oils. Accordingly, they improve the injection process and ensure better atomization of the fuel in the combustion chamber. Biodiesel can be blended in any ratios for emissions and the increased lubricity makes for a better running vehicle. The most common is a mix of 20% biodiesel and 80% petroleum diesel, called "B20".

1.2 URGENCY FOR AN ALTERNATE FUEL:

1.2.1 ALTRNATE FUELS

In the present industrialized world, the consumption of the petroleum products has an index of countries prosperity. It is increasing at a very rapid rate. Out of known reserves only a part may technically and economically feasible to expose. This I fact coupled with the present and expected consumption rates implies that these reserves may not beyond next 30 years. For India the situation could be even more difficult, over the last 15 years. The demand for the petroleum products in India has risen by an annual compound rate of 6.1%.

Apart from the petroleum conservation there is a global threat through the environment due to the polluting nature of the conventional fuels.The existing reserves are largely in countries of the Middle East, which come under OPEC (oil producing and exporting countries). The world is just as was a decade ago on oil. While new source and plateau in consumption have temporally reduced OPEC leverage, the fundamental vulnerability to reduce supply remains and the punishing economic consequences of current prices continue. Automobiles are the most efficient and convenient way to travel. Unfortunately, most of the automobiles use fossil fuels, such as oil. After the engine consumes gasoline it releases carbon monoxide and other harmful gases. These chemicals cause air pollution, acid rains and build up of green house gases in the atmosphere. Thus also results in destructions of ozone layer. The metro cities are most severely affected with the highest number of motors vehicles as much as 70% of air pollution is attributed to vehicular exhaust.

This is why environment pollution (prevention & control) authority was asked to pay a special attention to the measures for containment of vehicular pollution. It is unlikely that technology will ever provide us pollution solution no car or the fuel it runs on, is truly. Clean from ecological point of view. If ever all cars pollute, some more than others like wise all fuels. The table 3.1 will depict some of the pollutants and their effects to the nature.

Table 3.1 pollutants and their causes and effects:

Pollutants	Cause	Effects
CO	Incomplete combustion	Heart disorders
HC	When carbon molecule fails to burn	Drowsiness, coughing
NO	High-pressures	Morbidity, bronchitis

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"Light gives us fuels", the energy of light that shown millions of years ago were stored by plants in their bodies. After these plants had died, they changed into coal, petroleum and natural gas. Today we are using their energy for various purposes like automobile, industry agricultural. Surging of petroleum products is very difficult and fortune and this surging create many environmental destructions & refining of petroleum products. Surging oil prices as a result of frequent" petroquakes" and environmental concerns have renewed the interest of oil industry to seek alternative fuels.In the context of depletion of fossil fuels, burden on economy sector of the country due to increase of fuel prices at international market, more usage of the fuel, not only in agricultural sector but also in transport sector due to enormous increase of the vehicle population and increase in pollution levels with fossil fuels, the search for alternative fuels has become important.

1.2.3 REASON FOR NOT BEING IMPLEMEMTED:

In spite of search and development in the field of alternate fuel program, the alternate fuel programs have e not really taken off in most countries due to the following reasons Of course, it is 400,000 vehicles around the world, but it is drop in the ocean.

The reasons are:

1) No one agrees that urgent action is required to meet the energy crisis the media are advising that a global glut of oil exists and that price reductions will inevitably ensue.
2) The OPEC rising initiatives and production policies, while adversely effecting the world's economy have to date stopped short of driving consumers nations into an al-out effort to find substitutes for oil as transportation fuel. The Saudi oil minister had said that, through internal or external pressures, it could produce and unmanageable glut of oil in the world, or leave it desperately short. Without any Saudi production there is simply not enough oil to go around. They have spoken of the "oil weapon" and cautioned world.
3) The existing worldwide commitment to gasoline and diesel fuels, which posses and economic threshold that is difficult to overcome, is the main reason. There is an existing infrastructure and business complex, which is firmly entrenched. This threshold existing for other fuels and has to be overcome at individual level for any alternate fuel program to be effective.

The particular reason for the car owners from not using alternate fuels as second fuel is that while the engine can burn any alternate fuels, it has not been designed for such a purpose. Furthermore the car body has been designed to accommodate approximate storage tanks for alternate fuels, which may be gaseous in nature. These fuels must be compressed several hundred folds into a cylinder or liquefied by temperature reduction. Therefore the owners face a substantial cost for the additional equipment.

1.3 SCENARIO OF ALTERNATE FUELS:

Research is on since interception of IC engines to find out the alternative fuels, also experimented as a dual fuel with existing fuel i.e., blended in certain proportions with existing fuel. I.I.Ps, various relevant research centers, I.I.Ts did experiments on available vehicle engines and compared the performance, stability, resources availability and economy. They classified alternate fuel into 3 categories as

- Existing fuels: diesel, petrol, blended with alcohols
- Fuels of tomorrow: CNG, LPG, vegetable oils
- Fuels of future: hydrogen, ammonia, electricity

2.1 EXISTING FUELS:

2.1.1 Ethanol

Ethanol is an alcohol typically fermented from grain. It is an octane enhancer added to motor fuel up to 10 percent. It will increase octane 2.5 to 3 points at a 10 percent concentration.

Ethanol is a fuel oxygenate. Specially designed vehicles are being manufactured to run on 85 to 95 percent ethanol. Ethanol, C_2H_5OH,(also called Ethyl alcohol) is the second member of the aliphatic alcohol series. It is a clear colorless liquid with a pleasant smell. Except for alcoholic beverages, nearly all the ethanol used industrially is a mixture of 95% ethanol and 5% water, which is known as 95% alcohol. Although pure ethyl alcohol (known as absolute alcohol) is available, it is much more expensive and is used only when definitely required.

Ethanol reduces the consumer cost of gasoline by extending supplies, providing an alternative to costly imported oil and leverage for independent gasoline marketers to compete against the larger, more powerful integrated oil companies. The ethanol tax incentive is crucial to farmer's bottom lines. Ethanol production helps boost U.S farm income by $4.5 billion.

Ethanol is only environmentally friendly, renewable fuel available for use in fuel cells. In fuel reformers, which convert the ethanol and other hydrocarbons to hydrogen, ethanol has demonstrated fewer emissions, higher efficiencies and better performance. E-diesel, a blend of 15% ethanol, 5% blending additive, and at least 80% diesel is being developed. Testing to date has proven that E-diesel can lower particulate emissions by 20-30%, reduce the sulphur content, and out-perform No.2 diesel fuel in winter conditions, all without mechanical changes or problems.

Additional research is under way to move E-diesel towards commercialization. Ethanol is proven octane enhancer and replacement for lead and other toxic compounds in gasoline. The blending of 10% ethanol boosts the octane rating of gasoline by an average of 3 points. Ethanol-blended fuels are use in small engines too including outboard motors, snowmobiles, lawn movers, motorcycles and chain saws. All small engine manufactures that have tested a 10% ethanol blend have approved its use.Ethanol reduces particulate emissions, especially the fine-particles that pose a health threat to children, senior citizens, and those with the respiratory ailments. A recent study by the governor's Ethanol coalition concluded that ethanol poses no threat to surface or ground water. Since the ethanol is naturally occurring substance produced during the fermentation of organic matter, it is expected to rapidly biodegrade in essentially in all environments. Ethanol, a renewable fuel made from agricultural feedstock's, is one of the best tools we have to fight air pollution.

2.2 FUELS OF FUTURE:

2.2.1 VEGETABLE OILS

The best substitutes for petroleum are the vegetable oils because they have the same base chemical structure as petroleum. Since the first crisis of 1970's various alternative fuels have been investigated with the goal of replacing conventional petroleum supplies. Some of the major oil seeds used in the world production is shown in table 4.1. The initial interest was mainly one of the fuel supply security, but recently more attention has been focused on the use of renewable fuels in order to reduce the net production of CO_2 from the combustion sources. Ethanol and methanol are the two accepted alternate fuels, which posses the potential to be produced from the biomass sources. Neither of these fuels is well suited for use in compression ignition engines and the use of ignition improves and high compression ratios are common.

One type of fuel, which is well suited from use in compression ignition engines, is that of vegetable oils based fuels. They are renewable and produced easily in rural areas. The choice of the vegetable oil for compression ignition engine fuel naturally depends upon the local conditions.A number of oils is being considered worldwide for the use as rice bran oil, cottonseed oil, sunflower oil, rapeseed oil etc. Different studies all over the world have successfully demonstrated that given the adequate availability of these oils, they can be partially or fully replace petroleum oils as engine fuels and lubricant. The usage could be in vegetable oil blends, complete sustainable to diesel.

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There is no doubt that the production of oil seeds can be stopped up several folds if the governments take a deliberate decision to use them as sources of fuel. However, considering the huge consumption of petroleum at present it is clear that vegetable oils can, at best provide only a partial replacement. But they can do it in very critical areas. The rural regions of developing nations, which are highly energetic, starved. In spite of wide variety of vegetable oils and their important properties fall within a fairly narrow band. Vegetable oils have a slightly lower heating value than diesel and slightly lower cetane numbers. Carbon residue is also higher. The high viscosity leads to pumping and atomization problems in the fuel injection system of diesel engine. The high carbon residue causes heavy smoke emissions and their poor volatility rules out their use in SI engines.

Table 2.1 World Production of some Major oil Seeds:

S.No	CROP	PRODUCTION (million tones)	% of total production
1	Soybean	100.2	56.8
2	Cottonseed	25.7	14.6
3	Sunflower	15.5	8.8
4	Groundnut	11.9	6.7
5	Rapeseed	10.9	6.2
6	Copra	4.6	2.6
7	Linseed	3.2	1.8
8	Palm kernels	1.4	0.8
9	Castor seed	1.0	.6
10	Others	2.1	1.1
	Total	175.6	100.0

2.2.2 Composition of Vegetable oils:

Fats and oils are water insoluble hydrophobic substance primarily composed of fatty ester of glycerol (triglycerides) successfully: a triglyceride is a reaction product of one molecules of water and molecule of triglyceride.The chemical structure of vegetable oil an organic acid ester is a glycerin with up three fatty acids linked to describe the arrangement. The process of squeezing the seeds to remove oil and leave the meal, which usually has value as animal feed, is the chemical process of converting an organic acid ester to another ester of the same acid.

Esterification removes the glycerin slem from the molecule and the resulting ester has much smaller molecule, which improves characters such as viscosity that are desirable for use as an engine fuel.

3.0 BIODIESEL

Biodiesel is a diesel replacement fuel that is manufactured from vegetable oils, recycled cooking greases or oil or animal facts. Because plants produced oils from sunlight and air, and can do year after year on cropland, these oils are renewable. Animal facts are produced when the animal consumes plant oil and other fats, and they too are renewable. Used cooking oils are mostly made from vegetables oils but may also contain animal fats. Used cooking oils are both recycled and renewable.

The biodiesel manufacturing process converts oils and fats into chemicals called long chain mono alkyl esters, or biodiesel. These chemical are also referred to as fatty acid methyl esters are FAME. In the manufacturing process, 100 pounds of oils are fats, are reacted with 10 pounds of a short chain alcohol (usually methanol) in the presences of a catalyst (usually sodium or potassium hydroxide) to form 100 pounds of biodiesel and 10 pound of glycerin. Glycerin is a sugar, and is co-product of the biodiesel process.

Raw or refined vegetable oil, are recycled greases that have not been processed into biodiesel, are not biodiesel and should be avoided. Research shows that vegetable oil or greases used in CI engines at levels as low as 10% to 20% can cause long-term engine deposits, ring sticking, lube oil gelling and other maintenances problems and can reduce engine life, these problems are caused mostly by the greater viscosity, or thickness, of the raw oils (around $40mm^2/s$) compare to that of the diesel fuel for which the engines and injectors were designed (between 1.4 and $4.1mm^2/s$). To avoid viscosity-related problems, vegetable oils and other feedstocks are converted into biodiesel.

Though the process of converting vegetable oil or greases to biodiesel, we reduce viscosity of the fuel to values similar to conventional diesel fuel (biodiesel values are typically between 4 and $5mm^2/s$). The biodiesel manufactured from the cotton seed oil is used in our project as an alternate fuel. Esterification process is carried out in order to purify the oil and obtain the esterified oil. The following figure shows the cotton seeds from which the oil is extracted. In this way the waste is used to run the automobiles which in turn help in reducing the depletion of fossil fuels.

Fig 3.1: COTTON

Fig 3.1: COTTON Fig 3.2: COTTON SEEDS

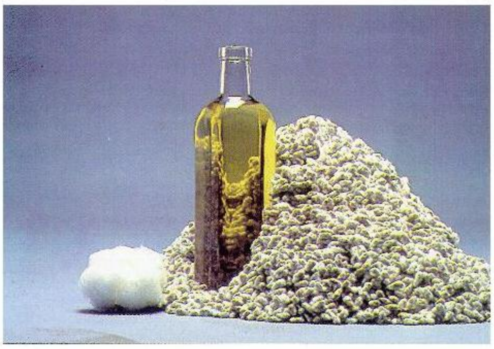

Fig 3.3: COTTON SEED OIL

3.2 BENEFITS OF BIODIESEL USE:

- Biodiesel Displaces Imported Petroleum
- Biodiesel Reduces Emissions

4.0 PREPARATION OF BIODIESEL:

4.1 BIODIESEL TRANESTERIFICATION

The process of producing biodiesel is known as "Esterification". In this present work an attempt is made to produce the biodiesel in laboratory.Biodiesel is made through a chemical process called transesterification where by glycerin is separated from the fat or vegetable oil. The process leaves behind two products-methyl esters and glycerin, a byproduct that can be used for the production of soap. This process can happen on any scale in a mason jar or in large scale production facility. Making biodiesel is a simple process. Although the end product is more biodegradable than sugar and less toxic than table salt. One must use caution as some of the materials are caustic and can cause serious health problems. A basic production process, which is a good starting point for those experimenting for their first time involves mixing ingredients settling and draining.

4.2 ESTERIFICATION PROCESS:

First 1.5 Kg of methanol and 0.75 Kg of Potassium Hydroxide in mass basis are taken and mixed thoroughly and then this mixture is poured in a vessel where 15 liters of crude cotton seed oil has been taken. Since temperature catalyst type and concentration ratio of alcohol to fuel and stirring rate will influences the Esterification process to greater extent; care has been taken to maintain the same.The vessel has been heated and maintained between 60 to 70 degrees centigrade. The stirrer speed is maintained at 150 rpm.The oil heated at the temperature range of 60-65°c for a period of 2 hours and then it is allowed for natural cooling. After it has been cooled, it is seen that glycerol is deposited at the bottom of the vessel. Then by using separating funnel the fatty acid ester is separated from the glycerol.

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The purpose of providing the condenser is to condense alcohol vapor which is produced during the chemical reaction. Figure 6.1 shows the path for the Esterification process of crude oil. The CSO blends with diesel used for our project are shown in figure 6.5.

4.3 Etherification to produce biodiesel fuel

Crude Oil + Methyl Alcohol (CH 3OH) + KOH → Bio Diesel + Glycerin

Flow Chart to Prepare the Biodiesel:

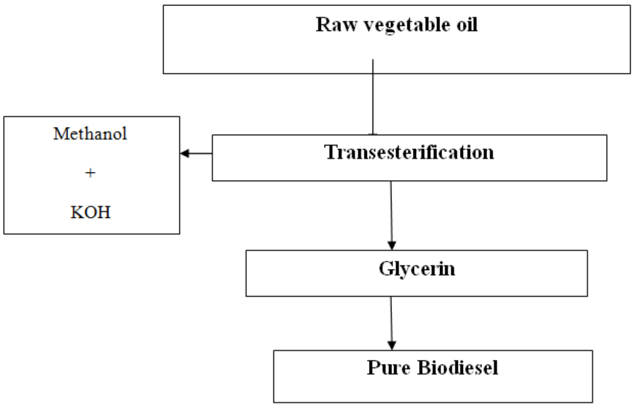

Fig. 4.1: Preparation of Biodiesel

5.0 PERFORMANCE TEST:

The test for study consists of two broad phases. In Phase 1 all the preliminary investigations were done to ascertain the feasibility of the use of CSO as fuel. In Phase 2 the final investigations concerning the actual running of the engine with CSO as the fuel was attempted and the performance parameters recorded.

5.1PRELIMINARY INVESTIGSTIONS:

This phase of investigation was done with utmost care, as any discrepancy in the test result would have disastrous effects on the engine without the test objectives having been fulfilled. This phase consisted of the following tests:

5.1.1 Tests for density and specific gravity determinations of the test fuel in order to ascertain its mess characteristics compared to diesel oil:

EXPERIMENTAL SET UP

The usual beam balance and flask was used to determine the density and specific gravity of the test fuel and various blends.

PROCEDURE

In this test a standard flask was taken. The test fuel was filled and weighed in a beam balance. Later the weight of the empty flask as well as the flask filled with water was weighed and observations are recorded. The procedure was repeated for blends of CSO and Diesel. The table 7.1 shows specific gravity and density of diesel and its blends.

5.1.2 Tests for determining the viscosity of the oil/blends to find its flow ability and its effect on injection pressures:

EXPERIMENTAL SET UP

The viscosity tests were conducted on Engler's Viscometer which is shown in fig 7.1 with an electrically heated water bath. A usual measuring jar was used to collect a known volume of the test fuel.

PROCEDURE

As mentioned earlier the test was filled in the inner cup of the Engler's viscometer, the cup was placed in oil bath. The time efflux of a known volume of the fuel was noted in Engler's standard seconds.

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International Journal & Magazine of Engineering, Technology, Management and Research
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Fig.5.1: Engler's Viscometer

Table 5.1: COMPARISION OF BLENDS PROPERTIES

	Density Kg/m³	Specific gravity	Calorific value KJ/Kg
B00	830	0.83	42500
B05	829.24	0.829	42404
B10	839.4	0.8394	42308
B15	818.2	0.8182	42212
B20	853.4	0.8534	42116

5.1.3Tests for the determination of the flash and fire points of the test fuel and its blends:

EXPERIMENTAL SET UP

An Able's apparatus was used to find the flash and fire points of the test fuels and its blends along with diesel.

PROCEDURE

The oil was filled in a cup and is placed in an electrically operated heating enclosure. A thermometer was placed in the cup and the spark was directed at the fuel surface for every 2 or 3^{o}c.The flash point is the "minimum temperature at which oil gives of sufficient vapor to ignite when flame is brought near to it". The fire point is the "lowest temperature at which the vapors of the oil burn continuously when flame is brought near to it". The test was replaced for diesel as well as other blends of CSO with diesel and the observations plotted in the form of the bar charts to study the variation of flash point with the content of CSO in the CSO-diesel blend.

5.2 FINAL INVESTIGATIONS:

After the preliminary investigations the broad behavior of the fuel was estimated.The blends along with diesel poured in the engine and the performance analysis was done at constant speed and varying loads.

Table 5.3 ENGINE SPECIFICATIONS

Make and model	Kirloskar
BHP and speed	5Hp and 1500-1580rpm
Type of engine	Single cylinder, DI and 4S
Compression Ratio	16.5:1
Bore and stroke	80mm and 110mm
Method of cooling	Water
Method of starting	Manual starting
Method of Loading	Mechanical Brake

EXPERIMENTAL SET UP

The test engine is 4 stroke single cylinder water cooled vertical diesel engine, with a mechanical rope brake loading. The specifications for the engine is shown in table 7.3.A naturally aspirated engine was selected for the evaluation of CSO for 2 reasons. First, naturally aspirated engine represents a large population of engines sold in agricultural and construction equipment during the last 20 years. Second, a naturally aspirated is more sensitive to fuel quality due to longer

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
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ignition delays and performance injection equipment in the engine design.

PROCEDURE:

Connect water line to the engine jacket inlet and calorimeter inlet to water source. Decompress the engine by decompression lever provided on the top of the engine head lift after pouring the test fuel into the tank, crank the engine slowly with the help of handle powered, increasing cranking rate and pull the decompression lever down. Now the engine starts, allow the engine to run and stabilizing at 1500 rpm. Now load the engine placing the necessary dead weights to hanger. Allow the engine to stabilize on each step load. Record the required parameters and draw various graphs to show its performance.

Fig.5.3: 4-Stroke Single Cylinder Water Cooled Rope Brake Diesel Engine

Procedure to take the readings is as follows:

1. Using the engine specifications calculate the maximum load on the engine
2. Connect the water line of the engine jacket inlet and calorimeter inlet to a water source with a constant head of 5m through respective calorimeter.
3. Open the respective gate valve and set the optimum flow rate on rotameter.
4. Connect the panel instrumentation, input power line 230V, 50Hz single phase power source. Now the digital meters display the respective readings (temperature, speed).
5. Fill the fuel into the fuel tank mounted on the panel frame.
6. Then check the lubrication oil in the engine sump with the help of dipstick.
7. Open the fuel lock provided under the fuel tank and ensure no air trapped in the fuel line connecting fuel tank and engine.
8. Decompress the engine by decompression lever provided on to of the engine head to start the engine
9. Crank the engine slowly with the help of handle provided and has certain proper flow of the fuel in to the pump and in turn through the nozzle in to the engine cylinder
10. Note down the following parameter at no load
    a. Speed of the engine from digital rpm indicator.
    b. Time for ‘x’ cc fuel consumption in sec.
    c. Volume flow rate of cooling water through engine calorimeter using calorimeter.
    d. Volume flow rate of cooling water through engine jacket using rotameter.
    e. Net load (w-s) in kg fro amount of weight added on the pan(w) in kg/min. spring balance reading in kg
11. Now load the engine by placing the dead weights on the weight hanger to load the engine in steps of ¼, ½, ¾, & full load, allow the engine to stabilize on each step and note down the above parameters.
12. To stop the engine after the experiment is completed push or pull the governor lever towards the engine working side.
13. With the above parameters recorded at each step of the load.

6.0 RESULTS AND DISCUSSIONS

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
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GRAPHS

The Frictional Power can be determined by plotting WILLMANS graph i.e. by taking Brake power on X-axis and mass flow rate of fuel on Y-axis.

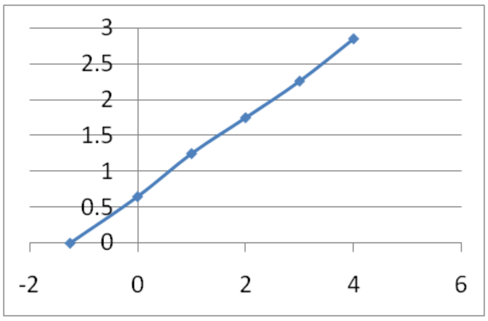

FIG 8.1 MF VS BP (DIESEL)

The above graph is for pure diesel where FP is 1.25.

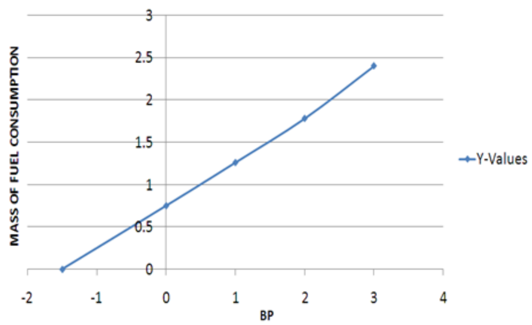

FIG 8.2 MF VS BP (B5)

The above graph is for B5 i.e. 5% SCO and 95% diesel who's FP is 1.5.

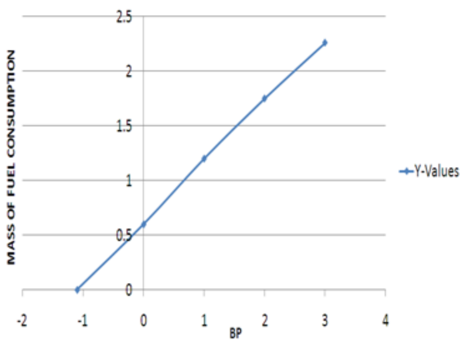

FIG 8.3 MF VS BP (B10)

The above graph is for B10 i.e. 10%CSO and 90% diesel who's FP is 1.1.

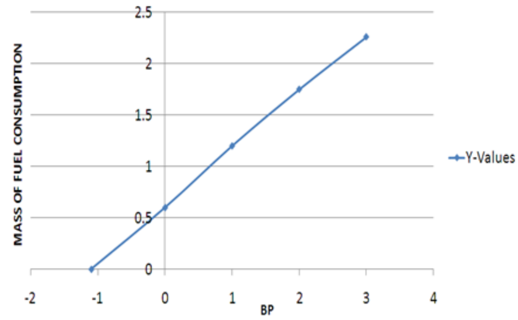

FIG 8.4 MF VS BP (B15)

The above graph is for B15 i.e. 15%CSO and 85% diesel who's FP is 0.95.

7.0 CONCLUSION AND RECOMMENDATION

7.1 CONCLUSION:

Conservation of energy had become a matter of serious concern in the past decades as petroleum resources are limited and are being consumed at alarming rates has intensified the search for alternatives to petroleum based fuels. There are wide varieties of transportation fuels, which can be reducing dependence upon petroleum. Many of these fuels will be cost competitive with gasoline in a near future. When performance test conducted on 4-Stroke single cylinder water cooled diesel engine using pure diesel and diesel/CSO blend the following conclusions were observed.

1. Blends of CSO and diesel have higher specific gravities, higher viscosities and higher flash and fire points. Among the blends 20% CSO and 80% diesel has the highest specific gravity, viscosity and flash & fire points.
2. The calorific value of the blends is decreasing as the percentage of CSO in the blends is increasing.
3. The Brake thermal efficiency, Indicated thermal efficiency is approximately nearer for blends and pure diesel. The values of BTH for diesel and its blends are clearly understood from the graphs i.e. forB0-33%;B5-32.14%;B10-32.4%;B15-32.9%;B20-32%. Therefore it is all similar for all the oil mixtures used.

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

4. Brake Specific Fuel Consumption is minimum for diesel compared to blend mixture.

Hence from the above conclusions blends of CSO/diesel can be used as alternative fuel for the diesel engine, even though there may be some fuel economy problem it can be used as substitute for diesel since the use of these blends will decreases the consumption of the diesel as there is a fear of exhaust. All the energy used does, however some negative impacts have on the environment. Therefore, whatever the fuel we use for the transportation they should be used in most efficient manner possible.

7.2 RECOMENDATIONS:

1. In order for usage of 100% CSO as a fuel lines must be suitably replaced and an injection pump of higher capacity is to used while the increase in injection pressure of the nozzle is also a necessity.
2. To overcome problem of restricted flow of CSO in fuel lines noe of the methods is to integrate a heat exchanger on to the system which heats the fuels (to the temperature at which viscosity comes near to that of diesel) using the exhaust gas, There by obtaining considerable reduction in exhaust gas temperatures.
3. In order to overcome the cost barrier, several decisions should be taken by the government as well as stepped u production can bring the price of the CSO under control also it can be used with great ease as a fuel in agricultural engines and in times of acute oil shortage.
4. Resolve Operational Issues

a. Cold flow performance
b. Filter & materials compatibility issues

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