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PERFORMANCE OF AN IC ENGINE RUNNING ON VARIOUS BLENDS OF DIESEL AND LINSEED OIL

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ABSTRACT

Exploring new feed stocks for biodiesel production is now receiving widespread attention world over .Biodiesel fuel can be made from new or used vegetable oils and animal fats, which are non toxic, biodegradable and renewable resources. The vegetable oils were not acceptable in diesel engine because it pose problems such as injector choking, cylinder deposits, piston ring sticking and higher smoke emissions because of its higher density. Biodiesel has become more attractive recently because of its environmental benefits. Major portion of today's energy demand in India is being met with fossil fuels. Hence it is high time that alternate fuels for engines should be derived from indigenous sources. As India is an agriculture country, there is a wide scope for the production of vegetable oils from different oil seeds. The present work focuses on non-edible oils as fuel for engines as the edible oils are in great demand and far too expensive. The aim of this study to partial replacement of diesel fuel with linseed oil and their effects on the engine performance and exhaust emissions. For this purpose, four different blends containing 10%, 20%,30%,40%, of linseed oil with diesel fuel and tested in single cylinder compression ignition high speed diesel engine.

1. NEED FOR AN ALTERNATIVE FUEL

The major sources of energy in the world are oil, coal, natural gas, hydro energy etc. Oil is the most popular and abundant source of energy worldwide. However so, the price of crude oil is very volatile and supply is driven by price. While developed industrialized countries consume around43 million barrels daily on an average, whereas developing countries only consume 23 million barrels a day on average. Something similar goes for coal and natural gas as well. Renewable energy sources are gaining popularity. In Asia,3.7% growth has been projected over the ten year period from 2000 to 2010.

As we are well aware of the depletion of fossil fuels ,also the use of fossil fuels is degrading the environment in various ways. The pollution created by the increasing number of vehicles on the road, use of old technology also vents many pollutants in the atmosphere. There have been reported cases of new diseases linked with pollution, and increasing use of fossil fuel is solely responsible for these causes. Knowing the present global energy scenario, it is almost desperately important and essential to come up with an alternative solution. Alternative fuels are an option and the abundance of resources for producing bio-fuels can be successfully implemented. Bio-fuels consumption leaves us with less pollution or no pollution and can be produced without using the already depleting resources of fossil fuels.

Biodiesel, defined as an alternative fuel composed of mono-alkyl esters of long-chain fatty acids prepared from vegetable oils or animal fats, has attracted considerable interest as a substitute or blend component for conventional petroleum diesel fuel (petro diesel).Biodiesel possesses significant technical advantages over petro diesel, such as derivation from renewable feed stocks, displacement of imported petroleum, inherent lubricity, essentially no sulfur content, superior flash point and biodegradability, reduced toxicity, as well as a reduction in most exhaust emissions.

2. HISTORY OF BIOFUEL

A biofuel is a type of fuel whose energy is derived from biological carbon fixation. Biofuels include fuels derived from biomass conversion, as well as solid biomass, liquid fuels and various biogases. Biofuels are gaining increased public and scientific attention, driven by factors such as oil price hikes and the need for increased energy security. However, according to the European Environment Agency, biofuels address global warming concerns only in specific cases. Bioethanol is an alcohol made by fermentation, mostly from carbohydrates produced in sugar or starch crops such as corn or sugarcane. Cellulosic biomass, derived from non-food sources, such as trees and grasses, is also being developed as a feedstock for ethanol production. Ethanol can be used as a fuel for vehicles in its pure form, but it is usually used as a gasoline additive to increase octane and improve vehicle emissions. Bio ethanol is widely used in the USA and in Brazil.

Current plant design does not provide for converting the lignin portion of plant raw materials to fuel components by fermentation. Biodiesel is made from vegetable oils and animal fats. Biodiesel can be used as a fuel for vehicles in its pure form, but it is usually used as a diesel additive to reduce levels of particulates, carbon monoxide, and hydrocarbons from diesel- powered vehicles .Biodiesel is produced from oils or fats using transesterification and is the most common bio fuel in Europe.In 2010, worldwide biofuel production reached 105 billion liters (28 billion gallons US), up 17% from 2009, and biofuels provided 2.7% of the world's fuels for road transport, a contribution largely made up of ethanol and biodiesel. Global ethanol fuel production reached 86 billion liters (23 billion gallons US) in 2010, with the United States and Brazil as the world's top producers, accounting together for 90% of global production. The world's largest biodiesel producer is the European Union,accounting for 53% of all biodiesel production in 2010. As of 2011, mandates for blending biofuels exist in 31 countries at the national level and in 29 states or provinces.

3. FIRST-GENERATION BIOFUEL

'First-generation' or conventional biofuels are made from sugar, starch, or vegetable oil.

(i) Bio-alcohols

Main article: Alcohol fuel

Neat ethanol on the left (A), gasoline on the right (G) at a filling station in Brazil Biologically produced alcohols, most commonly ethanol, and less commonly propanol and butanol, are produced by the action of microorganisms and enzymes through the fermentation of sugars or starches (easiest), or cellulose (which is more difficult). Bio-butanol (also called bio gasoline) is often claimed to provide a direct replacement for gasoline, because it can be used directly in a gasoline engine (in a similar way to biodiesel in diesel engines). Ethanol fuel is the most common biofuel worldwide, particularly in Brazil. Alcohol fuels are produced by fermentation of sugars derived from wheat, corn, sugar beets, cane, molasses and any sugar or starch from which alcoholic beverages can be made (such aspotato and fruit waste, etc.). The ethanol production methods used are enzyme digestion (to release sugars from stored starches), fermentation of the sugars, distillation and drying. The distillation process requires significant energy input for heat (often unsustainable natural gas fossil fuel, but cellulosic biomass such as bagasse, the waste left after sugar cane is pressed to extract its juice, can also be used more sustainably).

Ethanol can be used in petrol engines as a replacement for gasoline; it can be mixed with gasoline to any percentage. Most existing car petrol engines can run on blends of up to 15% bio ethanol with petroleum/gasoline. Ethanol has a smaller energy density than that of gasoline; this means it takes more fuel (volume and mass) to produce the same amount of work. An advantage of ethanol (CH_3CH_2OH) is that it has a higher octane rating than ethanol-free gasoline available at roadside gas stations, which allows an increase of an engine's compression ratio for increased thermal efficiency. In high-altitude (thin air) locations, some states mandate a mix of gasoline and ethanol as a winter oxidizer to reduce atmospheric pollution emissions.

Ethanol is also used to fuel bio ethanol fireplaces. As they do not require a chimney and are "flueless", bio ethanol fires are extremely useful for newly built homes and apartments without a flue gas. The downside to these fireplaces is their heat output is slightly less than electric heat or gas fires. In the current corn-to-ethanol production model in the United States, considering the total energy consumed by farm equipment, cultivation, planting, fertilizers, pesticides, herbicides, and fungicides made from petroleum, irrigation systems, harvesting, transport of feedstock to processing plants, fermentation, distillation, drying, transport to fuel terminals and retail pumps, and lower ethanol fuel energy content, the net energy content value added and delivered to consumers is very small. And, the net benefit (all things considered) does little to reduce imported oil and fossil fuels required to produce the ethanol.

Although corn-to-ethanol and other food stocks have implications both in terms of world food prices and limited, yet positive, energy yield (in terms of energy delivered to customer/fossil fuels used), the technology has led to the development of cellulosic ethanol. According to a joint research agenda conducted through the US Department of Energy, the fossil energy ratios (FER) for cellulosic ethanol, corn ethanol, and gasoline are 10.3, 1.36, and 0.81, respectively. Even dry ethanol has roughly one-third lower energy content per unit of volume compared to gasoline, so larger (therefore heavier) fuel tanks are required to travel the same distance, or more fuel stops are required. With large current unsustainable, unsalable subsidies, ethanol fuel still costs more per distance traveled than current high gasoline prices in the United States.

Methanol is currently produced from natural gas, a nonrenewable fossil fuel. It can also be produced from biomass as bio-methanol. Thermo ethanol economy is an alternative to the hydrogen economy, compared to today's hydrogen production from natural gas. Butanol (C4H9OH) is formed by ABE fermentation (acetone, butanol, and ethanol) and experimental modifications of the process show potentially high net energy gains with butanol as the only liquid product. Butanol will produce more energy and allegedly can be burned "straight" in existing gasoline engines (without modification to the engine or car), and is less corrosive and less water-soluble than ethanol, and could be distributed via existing infrastructures. DuPont and BP are working together to help develop butanol. Coli strains have also been successfully engineered to produce butanol by hijacking their amino acid metabolism.

(ii) Biodiesel

Main articles: Biodiesel and Biodiesel around the world

In some countries, biodiesel is less expensive than conventional diesel. Biodiesel is the most common biofuel in Europe. It is produced from oils or fats using transesterification and is a liquid similar in composition to fossil/mineral diesel. Chemically, it consists mostly of fatty acid methyl (or ethyl) esters (FAMEs). Feed stocks for biodiesel include animal fats, vegetable oils, soy, rapeseed, jatropha, mahua, mustard, flax, sunflower ,palm oil, hemp, field pennycress, Pongamiapinnata and algae. Pure biodiesel (B100) is the lowest- emission diesel fuel. Although liquefied petroleum gas and hydrogen have cleaner combustion, they are used to fuel much less efficient petrol engines and are not as widely available. Biodiesel can be used in any diesel engine when mixed with mineral diesel. In some countries, manufacturers cover their diesel engines under warranty for B100 use, although Volkswagen of Germany, for example, asks drivers to check by telephone with the VW environmental services department before switching to B100. B100 may become more viscous at lower temperatures, depending on the feedstock used. In most cases, biodiesel is compatible with diesel engines from 1994 onwards, which use 'Viton' (by DuPont) synthetic rubber in their mechanical fuel injection systems. Electronically controlled 'common rail' and 'unit injector' type systems from the late 1990s onwards may only use biodiesel blended with conventional diesel fuel. These engines have finely metered and atomized multiple-stage injection systems that are very sensitive to the viscosity of the fuel. Many current-generation diesel engines are made so that they can run on B100 without altering the engine itself, although this depends on the fuel rail design. Since biodiesel is an effective solvent and cleans residues deposited by mineral diesel, engine filters may need to be replaced more often, as the biofuel dissolves old deposits in the fuel tank and pipes. It also effectively cleans the engine combustion chamber of carbon deposits, helping to maintain efficiency. In many European countries, a 5% biodiesel blend is widely used and is available at thousands of gas stations. Biodiesel is also an oxygenated fuel, meaning it contains a reduced amount of carbon and higher hydrogen and oxygen content than fossil diesel. This improves the combustion of biodiesel and reduces the particulate emissions from unburnt carbon. Biodiesel is also safe to handle and transport because it is as biodegradable as sugar, one-tenth as toxic as table salt and has a high flash point of about 300°F (148°C) compared to petroleum diesel fuel, which has a flash point of 125°F (52°C). In the USA, more than 80% of commercial trucks and city buses run on diesel. The emerging US biodiesel market is estimated to have grown 200% from 2004 to 2005. "By the end of 2006 biodiesel production was estimated to increase fourfold [from 2004] to more than" 1 billion US gallons (3,800,000 m3).

(iii) Vegetable oil

Main article: Vegetable oil used as fuel

Straight unmodified edible vegetable oil is generally not used as fuel, but lower- quality oil can and has been used for this purpose. Used vegetable oil is increasingly being processed into biodiesel, or (more rarely) cleaned of water and particulates and used as a fuel.Also here, as with 100% biodiesel (B100), to ensure the fuel injectors atomize the vegetable oil in the correct pattern for efficient combustion, vegetable oil fuel must be heated to reduce its viscosity to that of diesel, either by electric coils or heat exchangers. This is easier in warm or temperate climates. Big corporations like MAN B&W Diesel, Wärtsilä, and Deutz AG, as well as a number of smaller companies, such as Elsbett, offer engines that are compatible with straight vegetable oil, without the need for after-market modifications.

Vegetable oil can also be used in many older diesel engines that do not use common rail or unit injection electronic diesel injection systems. Due to the design of the combustion chambers in indirect injection engines, these are the best engines for use with vegetable oil. This system allows the relatively larger oil molecules more time to burn. Some older engines, especially Mercedes, are driven experimentally by enthusiasts without any conversion, a handful of drivers have experienced limited success with earlier pre- "Pumpe Duse" VW TDI engines and other similar engines with direct injection. Several companies, such as Elsbett or Wolf, have developed professional conversion kits and successfully installed hundreds of them over the last decades. Oils and fats can be hydrogenated to give a diesel substitute. The resulting product is a straight-chain hydrocarbon with a high cetane number, low in aromatics and sulfur and do\es not contain oxygen. Hydrogenated oils can be blended with diesel in all proportions. They have several advantages over biodiesel, including good performance at low temperatures, no storage stability problems and no susceptibility to microbial attack.

(iv)Bio-ethers

Bio-ethers (also referred to as fuel ethers or oxygenated fuels) are cost- effective compounds that act as octane rating enhancers. They also enhance engine performance, whilst significantly reducing engine wear and toxic exhaust emissions. Greatly reducing the amount of ground-level ozone, they contribute to air quality.

(v)Biogas

Main article: Biogasis methane produced by the process of anaerobic digestion of organic material by anaerobes. It can be produced either from biodegradable waste materials or by the use of energy crops fed into anaerobic digesters to supplement gas yields. The solid byproduct, digestate, can be used as a biofuel or a fertilizer. Biogas can be recovered from mechanical biological treatment waste processing systems. Note: Landfill gas, a less clean form of biogas, is produced in landfills through naturally occurring anaerobic digestion. If it escapes into the atmosphere, it is a potential greenhouse gas. Farmers can produce biogas from manure from their cattle by using anaerobic digesters.

(vi)Solid biofuel

Example include wood, sawdust, grass trimmings, domestic refuse, charcoal, agricultural waste, nonfood energy crops, and dried manure.When raw biomass is already in a suitable form (such as firewood), it can burn directly in a stove or furnace to provide heat or raise steam. When raw biomass is in an inconvenient form (such as sawdust, wood chips, grass, urban waste wood, agricultural residues), the typical process is to density the biomass. This process includes grinding the raw biomass to an appropriate particulate size (known as hog fuel), which, depending on the densification type, can be from 1 to 3 cm (0 to 1 in), which is then concentrated into a fuel product. The current processes produce wood pellets, cubes, or pucks. The pellet process is most common in Europe, and is typically a pure wood product. The other types of densification are larger in size compared to a pellet, and are compatible with a broad range of input feedstocks. The resulting densified fuel is easier to transport and feed into thermal generation systems, such as boilers.

One of the advantages of solid biomass fuel is that it is often a byproduct, residue or waste-product of other processes, such as farming, animal husbandry and forestry. In theory, this means fuel and food production do not compete for resources, although this is not always the case. A problem with the combustion of raw biomass is that it emits considerable amounts of pollutants, such as particulates and polycyclic aromatic hydrocarbons. Even modern pellet boilers generate much more pollutants than oil or natural gas boilers. Pellets made from agricultural residues are usually worse than wood pellets, producing much larger emissions of dioxins and chlorophenols.

Notwithstanding the above noted study, numerous studies have shown biomass fuels have significantly less impact on the environment than fossil based fuels. Of note is the US Department of Energy Laboratory, operated by Midwest Research Institute Biomass Power and Conventional Fossil Systems with and without CO2 Sequestration – Comparing the Energy Balance, Greenhouse Gas Emissions and Economics Study? Power generation emits significant amounts of greenhouse gases (GHGs), mainly carbon dioxide (CO2).Sequestering CO2 from the power plant flue gas can significantly reduce the GHGs from the power plant itself, but this is not the total picture. CO2 capture and sequestration consumes additional energy, thus lowering the plant's fuel- to-electricity efficiency. To compensate for this, more fossil fuel must be procured and consumed to make up for lost capacity. Taking this into consideration, the global warming potential (GWP), which is a combination of CO_2, methane (CH_4), and nitrous oxide(N_2O) emissions, and energy balance of the system need to be examined using a life cycle assessment. This takes into account the upstream processes which remain constant after CO_2 sequestration, as well as the steps required for additional power generation. Firing biomass instead of coal led to a 148% reduction in GWP.

A derivative of solid biofuel is bio-char, which is produced by biomass pyrolysis. Bio-char made from agricultural waste can substitute for wood charcoal. As wood stock becomes scarce, this alternative is gaining ground. In eastern Democratic Republic of Congo, for example, biomass briquettes are being marketed as an alternative to charcoal to protect Virunga National Park from deforestation Associated with charcoal production.

Second-Generation (Advanced) Biofuel

Second-generation biofuels are produced from sustainable feedstock. Sustainability of a feedstock is defined, among others, by availability of the feedstock, impact on GHG emissions, and impact on biodiversity and land use. Many second-generation biofuels are under development such as Cellulosic ethanol, Algaefuel., bio-hydrogen, bio- methanol, DMF, Bio-DME, Fischer- Tropsch diesel, bio-hydrogen diesel, mixed alcohols and wood diesel.

Cellulosic ethanol production uses nonfood crops or inedible waste products and does not divert food away from the animal or human food chain. Lignocelluloses is the "woody" structural material of plants. This feedstock is abundant and diverse, and in some cases (like citrus peels or sawdust) it is in itself a significant disposal problem. Producing ethanol from cellulose is a difficult technical problem to solve. In nature, ruminant livestock (such as cattle) eat grass and then use slow enzymatic digestive processes to break it into glucose (sugar). In cellulosic ethanol laboratories, various experimental processes are being developed to do the same thing, and then the sugars released can be fermented to make ethanol fuel.

In 2009, scientists reported developing, using "synthetic biology", "15 new highly stable fungal enzyme catalysts that efficiently break down cellulose into sugars at high temperatures", adding to the 10 previously known. The use of high temperatures has been identified as an important factor in improving the overall economic feasibility of the biofuel industry and the identification of enzymes that are stable and can operate efficiently at extreme temperatures is an area of active research. In addition, research conducted at Delft University of Technology by Jack Pronk has shown that elephant yeast, when slightly modified, can also produce ethanol from inedible ground sources (e.g. straw).

The recent discovery of the fungus Gliocladiumroseum points toward the production of so-called myco-diesel from cellulose. This organism (recently discovered in rainforests of northern Patagonia) has the unique capability of converting cellulose into medium-length hydrocarbons typically found in diesel fuel. Scientists also work on experimental recombinant DNA genetic engineering organisms that could increase biofuel potential. Scientists working with the New Zealand Company Lanzatech have developed a technology to use industrial waste gases, such as carbon monoxide from steel mills, as a feedstock for a microbial fermentation process to produce ethanol. In October 2011, Virgin Atlantic announced it was joining with Lanzatech to commission a demonstration plant in Shanghai that would produce an aviation fuel from waste gases from steel production.

4. LINSEED OIL

Linseed oil, otherwise known as flax seed oil or simply flax oil. Its scientific name is Linaceae. The yellowish drying oil is derived from dried ripe seeds of flax plant through pressing and extraction. It is available in varieties such as Cold Pressed, alkali refined, sun Bleached, sun thickened, and polymerized (stand oil) marketed as flaxseed oil. Linseed oil is the most commonly used carrier in oil paint. Several coats of linseed oil acts as the traditional protective coating for the raw willow of a cricket bat. Fresh, refrigerated and unprocessed, linseed oil is used as nutritional supplement. It is available in Asian countries. The engine was operated on diesel first and then of linseed blends. The fuel blends tested are B10, B20, B30 and B40 of linseed biodiesel. The different blends and mineral diesel were subjected to performance and emission tests on the engine. The performance data were then analyzed from the graphs regarding brake thermal efficiency, brake specific energy consumption and emission of all fuels.

The Reason for Selection of Linseed Oil

The main reason for selection of linseed oil is its density which is close to that of diesel however it cannot be used without blending it with diesel has its calorific value is less. Biodiesel fuel has better properties than that of petroleum diesel fuel such as renewable, biodegradable, non–toxic, and essentially free of sulfur and aromatics. The purpose of transesterification process is to lower the viscosity of the oil. The viscosity values of linseed oil highly decrease after the transesterification process.

5. EXPERIMENTAL SET-UP AND MEASUREMENT

(I)Apparatus Required For Blending 100 ml flask – 1no's
Burette
Pipette – 2no's
Funnel
Filter paper
1 liter bottle – 4no's

Fuel Property Testing Equipments

The testing equipment which are used to found out the viscosity, density, flash point, fire point and calorific valve of the fuel are as follows:

Redwood Viscometer

Figure1Red wood viscometer

A redwood viscometer in which the viscosity is determined by the time, in seconds, required for a certain quantity of liquid to pass out through the orifice under given conditions

Cleveland Open Cup Apparatus

Figure.2.Open Cup Apparatus

A laboratory apparatus used to determine flash point and fire point of fuel products.

Bomb calorimeter

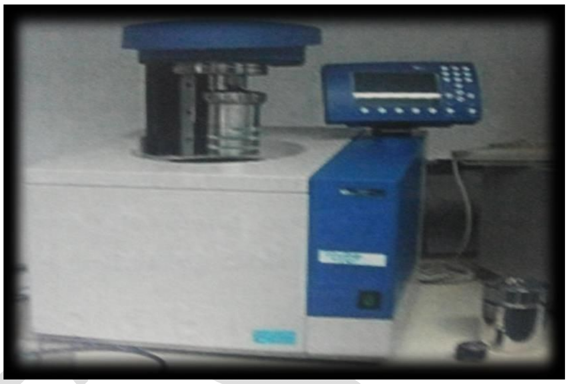

Figure .3Bomb Calorimeter

A bomb calorimeter is a type of constant – volume calorimeter used in measuring the heat of combustion of a particular reaction. Bomb calorimeters have to withstand the large pressure within the calorimeter as the reaction is being measured. Electrical energy is used to ignite the fuel; as the fuel is burning, it will heat up the surrounding air, which expands and escapes through a tube that leads the air out of the calorimeter.When the air is escaping through the copper tube it will also heat up the water outside the outside the tube. The temperature of the water allows for calculating calorie content of the fuel.

6. FLASH & FIRE POINT

Flash point of a volatile liquid is the lowest temperature at which it can vaporize to form an ignitable mixture in air. Measuring a liquid flashpoint requires an ignition source. At the flash point, the vapour may cease to burn when the source at a rate to sustain the fire. Fire point of a fuel is the temperature at which it will continue to burn after ignition for at least 5 seconds. Industrially, fire point is the lowest temperature at which the fuel produces sufficient vapour to form a mixture in air that continuously supports combustion after ignition. The flash and fire point for different ratios of linseed oil – diesel blends are founded using "Cleveland open cup apparatus" and the results are presented in the following table.

VISCOSITY & DENSITY

The viscosity of a fluid is an important property in the analysis of liquid behavior and fluid motion near solid boundaries. The viscosity is the fluid resistance to shear flow and is a measure of the adhesive/cohesive or frictional fluid property. In short "viscosity is a measure of a fluid resistance to flow" The knowledge of viscosity is needed for proper design of required temperatures for storages, pumping or injection of fluids. There are two related measures of fluid viscosity known as dynamic and kinematic viscosity.Dynamic viscosity (absolute) is the tangential force per unit area required to move one horizontal plane with respect to the other at unit velocity at maintained a unit distance apart by the fluid. Kinematic viscosity is the ratio of absolute or dynamic viscosity to density – a quantity in which no force is involved. Kinematic viscosity can be obtained by dividing the absolute viscosity of a fluid with its mass density.Density is defined as an object mass per unit volume.

Calorific Value

The Calorific value of a substance is the amount of heat released during the combustion of the combustion of a specified amount of it. The calorific value is a characteristic for each substance. It is measured in units of energy per unit of the substance. Heating value is commonly determined by using bomb calorimeter.

Properties of Linseed Oil

Table 1Properties of Linseed oil

SI.NO	PROPERTIES	VALUES
1	density@15c in gm/cc	0.838
2	Kinematic viscosity@40°c (pa s)	$1.9\text{-}4.1\times10^{-4}$
3	Flash point by PMCC method	75ºc
4	Fire point by PMCC method	-
5	Gross calorific value in KJ/KG	43000

Table.2 Engine specification

SN	SPECIFICATIONS	VALUES
1	Type of engine	Vertical 4 stroke, single acting, high speed engine.
2	Type of ignition	Compression ignition
3	Speed	1500 rpm
4	Maximum power output	4.4 kw
5	Bore diameter	85.5 cm
6	Stroke length	110 cm
7	Cubic capacity	.666 litres
8	Nominal compression ratio	17.5:1
9	Type of lubrication	Forced full pressure lubricatio
10	Type of cooling	Water cooled

7. PERFORMANCE INVESTIGATION

General

The engine is four stroke single cylinder Forced full pressure lubrication vertical diesel engine. The engine performance test is conducted in order to determine the following main characteristics of the engine:

- Brake power of the engine
- Total fuel consumption
- Specific fuel consumption
- Indicated power of the engine
- Mechanical efficiency
- Indicated thermal efficiency

8. TESTING PROCEDURE

The fuel is first filled in the tank. Before starting the engine the brake drum circumference is noted. Before starting check and assure that there is no load on the weight hanger. Now the engine is started and the time taken for 10 cc of fuel consumption is noted with the help of a stop watch. This reading corresponds to no load condition. Now place weight in the weight hanger and take the above mentioned readings. The spring balance reading is also noted down. The above procedure is repeated for various loads and the readings are tabulated. The calculations are done and graphs are plotted.

Properties of Diesel Used

Table 3 Properties of Diesel

S.N	PROPERTIES	VALUES FOR RATIOS			
		90:10	**80:20**	**70:30**	**60:40**
1	density@15ºc in gm/cc	0.9327	0.9386	0.9438	0.9474
2	Kinematic viscosity@40°c (pa s)	21.15	18.33	13.12	6.08
3	Flash point by PMCC method	192ºc	147ºc	113ºc	80ºc
4	Fire point by PMCC method	224ºc	167ºc	135ºc	92ºc
5	Gross calorific value in KJ/KG	39039.58	39977.47	40890.24	41777.8

The above given are the specifications and properties of the engine and diesel which is used as the fuel for baseline test. The baseline test is taken as the standard for testing the linseed oil's performance.

READING TABLE FOR DIESEL

Table. 3Reading Taken From the Diesel Engine

Engine condition :Normal Date:14/3/13 **Time** :10:45 am **Temp** :28ºc **Sheet no** 1

Fuel : Original Diesel **Calorific value** :43500kj/kg **Ratio** : -

SI NO	LOAD	Time taken for 10cc of fuel consumption in sec			Manometer reading			Water temp (ºc)		Exhaust gas temp (ºc)	Emission				
					H2	H1	H2-h1	In	Out		Co	Co2	Hc	Nox	O2
1	0	3	13	1.02	21.5	16	5.5	32	34	95	0.17	0	1375	36	20.80
		15	25	1.04	21.5	16	5.5	32	33	98					
2	25	3	13	45	21.5	16	5.5	32	42	171	0.26	12.9	1232	35	20.66
		21	31	45	21.5	16	5.5	32	43	168					
3	50	0	10	0.35	21.5	16	5.5	32	48	243	0.37	6.27	1618	38	20.80
		12	22	0.35	21.5	16	5.5	32	47	250					
4	75	10	20	0.31	21.3	16.2	5.1	32	55	324	0.48	4.46	2083	19	20.95
		22	32	0.30	21.3	16.2	5.1	32	56	330					
5	100	0	10	0.21	21	16.5	4.5	32	60	424	0.56	2.39	2310	15	21.05

Table 4 diesel Calculation

SI NO	LOAD			Time taken for 10cc of fuel con in sec	TFC-X10^-4 KG/S	BP KW	Q input Kw	break thermal efficiency (%)	Indicate d power Kw	Indicated thermal efficiency (%)	Mech efficiency (%)	SFC Kg/kw,hr
	V	I	VI									
1	250	0	0	1.10	4.47	0	19.4	0	4	20.57	0	∞
2	235	10.6	2512.2	0.46	9.80	2.79	42.6	6.54	6.79	15.93	41.09	1.26
3	242	19.6	4826.5	0.35	12.42	5.36	54	9.92	9.36	17.32	57.27	0.83
4	240	30.2	6880.8	0.39	13.94	7.64	60.6	12.60	11.64	19.20	65.65	0.65
5	224	41.6	9349.6	0.22	18.35	10.38	79.8	13.01	14.38	18.02	72.19	0.63

Table Performance parameters of engine such as Brake thermal efficiency, Indicated thermal efficiency and Mechanical efficiency are decreased, Brake specific fuel consumption and Total Fuel Consumption, Exhaust gas temperature are increased for diesel. This is because of high viscosity coupled with lower heating value of the fuels. Smoke, CO, and Un-burnt HC with lower Performance to diesel. In view of improving the performance and reducing the emissions.The decrease in carbon monoxide emission for diesel is due to more oxygen molecule present in the fuel.The decrease in CO emission may be due to better vaporization biodiesel fuel at higher injection pressure and more oxygen present in the biodiesel, resulting in complete combustion. Efficiency

Final Result and Graph

Table 5diesel Result Table

SI NO	Load	Brake thermal efficiency	Indicated thermal efficiency	Mechanical efficiency
1	0	0	20.57	0
2	25	6.54	15.93	41.09
3	50	9.92	17.32	57.27
4	75	12.6	19.2	65.65
5	100	13.01	18.02	72.19

9. MODEL CALCULATION

5.1Ratio: 80:20

1) Total fuel consumption (TFC):-
TFC = (n/t) x (1/1000) x 0.75
= 10/45 x 1/1000 x 0.75
TFC = 1.66x10-4kg/s.

2) Break Power (BP):-
BP = (V x I)/ (0.9 x1000)
= 2491/ (0.9 x1000) BP =2.76 kW. 3) HEAT INPUT (Q input):-
Q in = (TFC x CV)
= (1.66 X 10-4) x (39977.48) Q in = 6.636kW.

4) Break Thermal Efficiency (η B.th):-
η B.th = (BP/Qin) x 100
= (2.76/6.636) x 100
η. B.th = 41.59%.

5) Frictional Power (FP):-
FP = 1.475 kW

6) Indicated power (IP):-
IP = Bp + Fp
= 2.76+1.475
IP = 4.235kW.

7) Mechanical Efficiency:-
η. Mech = (BP/IP) x100
= (2.76/4.235) x100
η. Mech =65.17 %

8) Indicated Thermal EFFiciency:-
η. Indica = (IP/Qin) x100
=(4.235/6.636) x100
η. Indica =63.8 %.

9) Specific Fuel Consumption (SFC):-
SFC = (TFC/BP) x3600
= (1.66 x 10-4)/2.76 x (3600) SFC = 0.216 kg/ kw.hr.

EMISSION ANALYSIS

The test is carried out using a calibrated smoke meter which assesses the density of the smoke from compression ignition engine to compare it with the Tamilnadu Pollution Control Board (TNPCB) norms.

Testing Procedure

The engine will be accelerated up to governed speed. The smoke density is measured. Engine that emit very little smoke and complies with standard will pass the test. If the test is not passed on the first acceleration a further two accelerations will be carried out. The average of the three acceleration readings will be calculated and it is compared with the emission standards. If the average is higher, a further acceleration will be carried up to a maximum of six accelerations. If the vehicle doesn't comply with the standards even after the six accelerations the vehicle will fail the test.

Smoke, CO, and Un-burnt HC with lower Performance to diesel. In view of improving the performance and reducing the emissions.The decrease in carbon monoxide emission for diesel is due to more oxygen molecule present in the fuel.The decrease in CO emission may be due to better vaporization biodiesel fuel at higher injection pressure and more oxygen present in the biodiesel, resulting in complete combustion Carbon Monoxide: Shows the variation of Carbon Monoxide emission with Brake power output for Castor oil and its blends with Diesel in the test engine. 25% blend of Linseed oil has lower CO emission compared to all other blends. Linseed oil has the highest CO emission at rated load.CO emission for 20% blend of Linseed oil is 80% for diesel it is 1.95%. CO emission for 20% blend of Linseed oil is higher by 80% compared to diesel. At rated load, for Neat castor oil CO emission is 3.50% corresponding to diesel it is 1.95 %. CO emission for neat Linseed oil at rated load is higher by 79.48% compared to diesel. This is because of incomplete combustion of the fuel. Carbon Dioxide: Shows the variation of Carbon Dioxide emission with Brake power output for Linseed oil and its blends with diesel in the test engine. 20% blend of Linseed oil has lower CO_2 emission compared to all other blends.CO_2 emission for 2o% blend of Linseed oil is slightly higher compared to diesel at all loads. Linseed oil has the highest CO_2 emission compared to all other blends and diesel for all loads. At rated load, CO_2 emission for 20% blend and Linseed oil is 5.35 % and 6.24%, for diesel it is 5.16 %. CO2 emission for 20% blend and Linseed oil at rated load is higher by 3.68 %and 20.93% Respectively compared to diesel. This is attributed to excess supply of oxygen.

Un-burnt Hydrocarbons: Shows the variation of Un-burnt Hydrocarbon emission with Brake power output for Linseed oil and its blends with Diesel in the test engine. 20% blend of Linseed oil has lower UHC emission compared to all other blends. UHC emission of 20% blend and Linseed oils are 79 ppm and 94ppm, for diesel it is 74ppm. At rated load, UHC emission for 20% blend and neat Linseed oil is higher by 6.75% and 27.02% respectively compared to diesel. These higher levels are caused by rich air fuel mixture formation. Nitrogen Oxides: Shows the variation of Nitrogen Oxide emission with Brake power output for Linseed oil and its blends with Diesel in the test engine. 25% blend of Linseed oil has slightly lower NOx emission compared to all other blends. Diesel has higher NOx emission compared to all other blends for all loads. Linseed oil has maximum NOx emission 4 Kw load.

10. CONCLUSION

Following are the conclusions based on the experimental results obtained while operating diesel engine fueled with linseed oil blends in different Proportion with diesel fuel.The lower blends of linseed oil can be used in diesel engine without any engine modifications. The fuel filter needs to be changed after some interval of time. Smoke, HC and CO emission for diesel at different loads was found to be higher as compared to biodiesel blends of B90:10, B80:20 B70:30, B60:40. With the properties of linseed biodiesel close to diesel fuel it can provide a useful substitute fuel for diesel engine.

CO, and Un-burnt HC with lower Performance to diesel. In view of improving the performance and reducing the emissions.The decrease in carbon monoxide emission for diesel is due to more oxygen molecule present in the fuel.The decrease in CO emission may be due to better vaporization biodiesel fuel at higher injection pressure and more oxygen present in the biodiesel, resulting in complete combustion. Blend 80% of Diesel 20% of Linseed oil gave best results so it could be considered as an optimum fuel blend in terms of performance and reduced emission. From the above calculations and results we have deduced that 80% diesel and 20% linseed oil which gave us 61.13%

11. PHOTOGRAPHY

P.1 Engine Set-Up Photo

Figure 4.Engine Set-up

P.2Linseed Oil and Bio Diesel:

Figure5 .Linseed oil & Bio diesel

REFERENCES

[1]. Allen, C.A.W., Watts, K.C., Ackman, R.G., 1999. Predicting the surface tension of Bio-diesel fuels from their fatty acid composition. J. Am. Oil Chem. Soc. 76, 317– 323.

[2]. ASTM, 2008a. Standard specification for diesel fuel oils. In: Annual Book of ASTM Standards, ASTM International, West Conshohocken, Method D975-08a

[3]. ASTM, 2008b. Standard specification for diesel fuel oil, biodiesel blend (B6 to B20). In: Annual Book of ASTM Standards, ASTM International, West Conshohocken, Method D7467-08a

[4]. ASTM, 2008c. Standard specification for biodiesel fuel (B100) blend stock for distillate fuels. In: Annual Book of ASTM Standards, ASTM International, West Conshohocken, Method D6751-08a.

[5]. Aggarwal, D. L. Kumar, Aggrawal, A.K., "Performance Evaluation of a Vegetable oil fuelled CI Engine" Renewable Energy, (2007).

[6]. Bernardo, A. Howard-Hildige, R O'Connell, A., Nichol, R., Ryan, J., Rice, B., Roche, E., Leahy, J.J., 2003. Camelina oil as a fuel for diesel transport engines. Ind. Crops Prod. 17, 191–197.

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[8]. Biodegradation of vegetable oils: A review.Scientific Research and Essay. 4 (6), 543- 548. SclerocaryaBirrea Plant Oil: A Potential Indigenous Feedstock for Biodiesel Production in Botswana Global Journal of Researches in Engineering Volume XII Issue vI Version I (A) January 2012 © 2012 Global Journals Inc. (US)

[9]. Balat, M., Balat, H., 2008.A critical review of biodiesel as a vehicular fuel.Energy conversion and management. 19 (10), 2727-2741.14].

[10]. Burger, A.E.C., de Villiers, J.B.M., du Plessis, L.M., 1987. Composition of the kernel oil and protein of the marula seed. South African Journal of Science 83, 733-735

[11]. Chao–Chin Lai, SitiZullaikah, Shaik RamjanVali and Yi–Hsu Ju, "Lipase–catalysed production of biodiesel from rice bran oil", Journal of chemical Technology and Biotechnology,80: 331–337(2005).

[12]. De Almeida, S.C.A., Belchior, C.R., Nascimento,M.V.G., Vieira, L.D.S.R., Fleury, G., 2002.Performance of a diesel generator fuelled with palm oil. Fuel. 81 (16), 2097–2102.

[13]. Günther, Fischer, Leo, Schrattenholzer, "Global bioenergy potentials through 2050"Biomass and Bioenergy, 20(3): 151–159(2001).

[14]. Gemma, Vincente, Mercedes, Martinez, Jose, Aracil, "Integrated biodiesel production: a comparison of different homogeneous catalysts systems", Bioresource Technology 92: 297 305(2004)

[15]. Hanna, M.A., Loren Isom& John Campbell, "Biodiesel: Current Perspectives and Future", Journal of Scientic&Industrial Research, 64: pp. 854–857(2005).

[16]. Hideki, Fukuda, Akihiko, Kondo & Hideo, Noda, "Biodiesel Fuel Production by Transesterification of oils", Journal ofBioscience & Bioengineering", 92(5): pg 405–416(2001).