ISSN: 2278-4632
Vol-12 Issue-01 No.01: 2022

BIO GAS PURIFICATION SYSTEM AND EXPERIMENTAL INVESTGATION USING COTTON OIL & SUN FLOWER OIL AS FLUENTS

[#1]**SUNDRA SRINUBABU,** *M.Tech Student,*

[#2]**Dr.VELMURUGAN.P**, *Professor,*

Department of Mechanical Engineering,

KAKAINADA INSTITUTE OF TECHHNOLOGICAL SCIENCES, RAMACHANDRAPURAM, AP

ABSTRACT: In a modern day world alternative source of energy are given importance due to gradual depletion of fossil fuels reserves vegetable oils can be used as an alternative to diesel in CI engines. The use of vegetable oils in CI engine results in low CO and HC emissions compared to conventional diesel fuel. The present study covers the various aspects of biodiesels fuel derived from cottonseed oil. Cottonseed oil is converted to cottonseed oil methyl esters by trans esterification process An experimental investigations were carried out on C.I.engine with Bio Diesel blends of cotton seed Methyl Esters and Neem Oil Methyl Esters .The engine used for the experiments was single cylinder Four Stroke water cooled, constant speed diesel engine . cotton seed Methyl ester (CSOME) and Neem oil methyl ester (NOME) are derived through transesterification process and parameters of trans esterification were optimized. The blends of various proportions of the CSOME & NOME with diesel were prepared, analyzed and compared with diesel fuel, and comparison was made to suggest the better option among the bio diesel. Various Tests have been carried out to examine properties, performance of different blends (C05, C10, C15, and C20) of CSOME and NOME in comparison to diesel. From the experimental Results it is indicated that C20 have closer performance to diesel. However, its diesel blends showed reasonable efficiencies. From the experimental results it is observed that cotton seed methyl ester gives better performance compared to Neem methyl esters and also the emissions and smoke for these diesel blends are less as compare to the pure diesel.

---

1. INTRODUCTION

An alternative fuel vehicle is a vehicle that runs on a fuel other than "traditional" petroleum fuels (petrol or diesel); and also refers to any technology of powering an engine that does not involve solely petroleum (e.g. electric car, hybrid electric vehicles, solar powered). Because of a combination of factors, such as environmental concerns, high oil prices and the potential for peak oil, development of cleaner alternative fuels and advanced power systems for vehicles has become a high priority for many governments and vehicle manufacturers around the world.

Hybrid electric vehicles such as the Toyota Prius are not actually alternative fuel vehicles, but through advanced technologies in the electric battery and motor/generator, they make a more efficient use of petroleum fuel. Other research and development efforts in alternative forms of power focus on developing all-electric and fuel cell vehicles, and even the stored energy of compressed air.

As of 2011 there were more than one billion vehicles in use in the world, compared with around 70 million alternative fuel and advanced technology vehicles that had been sold or converted worldwide as of December 2011, and made up mainly of:

27.1 million flexible-fuel vehicles through December 2011, led by Brazil with 16.3 million, followed by the United States with almost 10 million, Canada (600,000), and Europe, led by Sweden (228,522). The Brazilian fleet includes 1.5 million flexible-fuel motorcycles sold since 2009. 17.5 million LPG powered vehicles by December 2010, led by Turkey with 2.39 million, Poland (2.32 million), and South Korea (2.3 million). 14.7 million natural gas vehicles by December 2011, led by Iran with 2.86 million, Pakistan (2.85 million), Argentina (2.04 million), Brazil (1.7 million), and India (1.1 million). 5.7 million neat-ethanol only light-vehicles built in Brazil since 1979, with 2.4 to 3.0 million vehicles still in use by 2004.

More than 4.5 million hybrid electric vehicles sold through December 2011, led by the United States with 2.16 million units,[16][17] followed by Japan with more than 1.5 million hybrids. Toyota Motor Company is the market leader with more than 3.5 million Lexus and Toyota hybrids sold worldwide, followed by Honda Motor Co., Ltd. with cumulative sales of more than 800,000 hybrids, and Ford Motor Corporation with more than 185,000 hybrids sold in the United States by December 2011.

More than 530,000 plug-in electric vehicles (PEVs) sold worldwide by December 2011. Most electric vehicles in the world roads are low-speed, low-range neighborhood electric vehicles (NEVs), with about 479,000 NEVs on the road by 2011.The world's top selling NEV is the GEM, with global sales of 45,000 units through December 2010. The world's best selling highway-capable plug-in electric car is the Nissan Leafall-electric car, with more than 21,000 units sold worldwide through December 2011, followed by the Mitsubishi i-MiEV electric car, with global cumulative sales of more than 17,000 units through October 2011, and the Chevrolet Volt plug-in hybrid, with 8,272 units sold through December 2011 in the U.S. and Canada. The United States and Japan are the world's largest highway-capable plug-in electric car markets as of December 2011. Since December 2010, around 18,000 plug-in electric cars have been sold in the U.S. through December 2011, led by the Nissan Leaf (9,693 units) and the Chevrolet Volt (7,997 units). Since July 2009, more than 13,000 electric cars have been sold in Japan by November 2011, which includes more than 8,000 Leafs and 5,000 i-MiEVs

What is an alternative fuel?

Alternative fuels, known as non-conventional or advanced fuels, are any materials or substances that can be used as fuels, other than conventional fuels.

Conventional fuels include: fossil fuels (petroleum (oil), coal, propane, and natural gas), as well as nuclear materials such as uranium and thorium, as well as artificial radioisotope fuels that are made in nuclear reactors, and store their energy.

Some well known alternative fuels include biodiesel, bio alcohol (methanol, ethanol, butanol),chemically stored electricity (batteries and fuel cells), hydrogen, non-fossil methane, non-fossil natural gas, vegetable oil, and other biomass sources.

Types of Alternative Fuels

There are many different types of alternative fuels that are being developed these days which is an exciting innovation in the vehicle industry. Alternative fuels are the wave of the future as scientists look for cleaner burning fuels that won't damage the environment while providing great advantages to the vehicle owner. They have come up with several.

Probably the most well known type of alternative fuel is ethanol. Ethanol is often called grain alcohol as it is made from corn and/or soybeans. Right now on the market is E85 which is 85 percent ethanol and 15 percent gasoline. Even though it still has gasoline in it, ethanol burns much cleaner than regular gas and saves on gas mileage for those who use it. Ethanol can also be made from organic materials including agricultural crops and waste, plant material left from logging, and trash including Another type of alternative fuel is methanol, a cousin of ethanol as they are both alcohol based products. Methanol is sometimes called wood alcohol and can be made from various biomass resources like wood, as well as from coal. However, today nearly all methanol is made from natural gas, or methane, because it is cheaper. .

Propane, or compressed natural gas has long been used to provide energy to homes, but it is rising in popularity as a type of alternative fuel for vehicles.

One of the most interesting and promising type of alternative transportation fuels is hydrogen. While mostly only experimental vehicles are operating on this fuel now, the potential for this unique energy source is excellent. Hydrogen is the lightest of all elements and is easy to produce which is why it is sending excitement waves throughout the alternative fuel industry as they next big type of alternative fuel that can be used in vehicles. .

These are only a few types of alternative fuels and more are being developed all the time. With a growing concern over global warming, the use of alternative fuels will grow in popularity over time and you will likely begin to see many other types of alternative fuels make their appearance.

These days, you can drive a variety of cars and trucks off the dealer showroom floor that use something besides gasoline or diesel fuel for a power source. The pages linked to the list below discuss some of the alternative fuels that are available today. There are no commercially-available hydrogen-powered vehicles (yet!), but vehicles that use all of the other fuels are available in at least part of the United States.

They are shown below:

- Liquefied Petroleum Gas (LPG, commonly known as propane)
- Compressed Natural Gas (CNG)
- Liquefied Natural Gas (LNG)
- Methanol (M85)
- Ethanol (E85)
- Biodiesel (B20)
- Electricity
- Hydrogen

BIOMASS

Biomass is the oldest form of renewable energy, has been used for thousands of years. However, its relative share has declined with the emergency of fossil fuels. Currently some 13% of the world's primary energy supply is covered by biomass, but there is a strong regional difference: developed countries source around 3%of their energy needs of biomass, while Africa's share ranges from 70-90%.

With environmental effects such as climate change coming to the forefront, people everywhere are rediscovering the advantages of biomass. Potential benefits include:

- Reducing carbon emissions if managed (produced, transported, used) in a sustainable manner
- Enhancing energy security by diversifying energy sources and utilizing local sources;
- Providing additional revenues for the agricultural and forestry sectors;
- Reducing waste

Fuel Property Measurement

The improvement in the performance of the CI engines, over the past century, has resulted from the complimentary refinement of the engine design and fuel properties. Calculate the fuel properties like flash point, fire point, specific gravity, calorific value for different oils for different blends using the suitable equipment. Some of the fuel properties include are Flash point Fire point Specific gravity Calorific value Viscosity Carbon residue

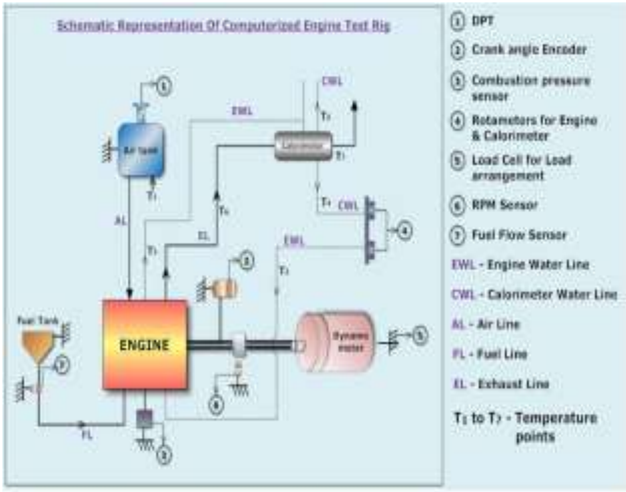


FIG. fuel property of 4 stroke diesel engine

2. LITERATURE SURVEY

Fuel blending and heating have the advantage of nonindustrial intervention, which is ideal for rural, remote areas where the farmers do not have easy access to the market. Many researchers have worked in these methods with different VO types, with positive results. However, for the purposes of this study, a specific investigation in previous work related to three VOs [sunflower oil (Sun), rapeseed oil (Rap), and cottonseed oil (Cotton)] was carried out.

Wafer and Rice [11] tested RapO blends up to neat RapO in an IDE and concluded that all blends were acceptable in comparison to DF and the 50% blend gave the best results. In particular, BSFC was in the same level for all fuels; except in high load levels where neat RapO gave higher BSFC. Thermal efficiency (TE) was found to be better as oil content in the tested fuel was increased. Exhaust gas temperature followed the same trend as thermal efficiency and engine lubrication oil performed well, showing acceptable viscosity reduction. Unburned hydrocarbons were lessened when neat RapO was used.

McDonnell et al. [12] used semirefined RapO blends up to 75% in an agricultural tractor direct injection diesel engine (DDE) and resulted that oil blends up to 25% were suitable alternative fuels. More specifically, as oil content in the fuel was increased, Power was reduced and BSFC was augmented, but according to the tractor operators, engine performance was not affected highly; while engine lubricating oil was slightly influenced from the fuel alteration and injector fouling was increased, but not quantified.

Karaosmanoğlu et al. [13] completed a 50-hour endurance test of a DDE with SunO, and there were no significant changes in engine operation in comparison to DF. More precisely, there was no significant drop or increase of power or fuel consumption. The lubrication oil was not affected remarkably and injector nozzle was clean.

Altin et al. [14] compared several preheated VOs in a DDE with minor power loss and emission increase. Between the tested VOs, SunO, CotO, and RapO were tested and rapeseed had better engine performance and cottonseed better emissions. The worst torque release was obtained with SunO and the best with RapO. The least power output was released with CotO, while the highest values were taken when RapO was used. SunO gave the highest BSFC. CO emissions were most increased with RapO, and CO_2 was higher with SunO, followed by RapO and CotO. NO_2 was lower with cotton, followed by SunO and RapO. Smoke level was the highest with RapO, followed by CotO and SunO.

Rao and Mohan [15] investigated the effect of supercharging on a DDE performance with Cotton and found that changes in injection pressure did not affect performance, but supercharging, even if low, provided better performance with BSFC reduction. Wafer [16] examined fuel inlet temperature effect on RapO and resulted that fuel heating was beneficial at low speed and part-load operation. Particularly, RapO was selected to be preheated at 70°C according to laboratory tests, and it was seen that peak cylinder pressure was increased accompanied by a reduced delay period in comparison to unheated RapO.

In addition, heat release was early like with DF, in contrast to unheated RapO where it is late. BSFC was increased with preheated RapO, compared to unheated RapO. In high loads, this increment was eliminated due to the fact that combustion temperature dominated the delivery rates and flow velocities in the fuel line and resulted in the same system temperature for both preheated and unheated RapO. Preheated RapO deteriorated TE compared to unheated RapO, explained by the higher viscosity of neat oil that acts like a lubricant and as a sealant between the piston rings and the cylinder wall.

Ramadhas et al. [10] conducted a literature review about VO use in Compression Ignition (CI) engines and concluded that in technical terms it is important to carry out experimental work with different engine types and sizes to increase confidence in these fuels.

He and Bao [17] used cottonseed oil blends in an agricultural diesel engine and preliminary testing revealed that 30% CotO had the best blend homogeneity (no sediment appearance). Therefore, they tried to optimize four parameters (intake valve closing angle, exhaust valve opening angle, fuel delivery angle, and injection pressure) to reach the highest TE. They came to the conclusion that fuel delivery angle was the most important factor and that 3–5°CA in advance would increase TE.

Rakopoulos et al. [5] used 10 and 20% blends of CotO, SunO, soybean, corn, and olive kernel oil with DF in a DDE and resulted that low oil content biofuels could be used safely and advantageously in diesel engines. They found out that TE was maintained close to DF, with small BSFC increase. Smoke and CO were augmented as the oil content in the fuel was increased. NO_x emissions were reduced as fuel oil percentage was increased.

Wang et al. [18] used VO/DF blends in a DDE and concluded that power and BSFC was almost the same with DF and NO_x, while CO and unburned hydrocarbons (HC) were lowered. Fontaras et al. [19] and Fontaras et al. [20] tested, respectively, 10% and 20% CotO/DF blends in a Euro 3 common rail DDE of a passenger vehicle, and there was no significant influence in either engine performance or emissions. The 10% CotO blend was found to cover all EN590 standard specifications, and it was used successfully on the car for 12000 km millage. Fuel consumption and CO_2 were fluctuating within the acceptable accuracy limits. NO_x were increased slightly in some cases, but never exceeded the Euro 3 emission limit.

In this study, a comparative study of SunO, RapO, and CotO was performed to observe a typical agricultural tractor engine behavior in terms of performance and emissions. The VOs were both preheated and blended with DF to minimize the high viscosity effect on engine operation. According to literature, a comparison of the selected VOs has not been executed on a total engine operation range and especially in an agricultural tractor engine. For Greek agriculture, it is also important to carry out testing of these VOs, which are major crops in the country and could be used for farm energy needs.

3. BACKGROUND WORK

The main purpose of fuel is to store energy, which should be in a stable form and can be easily transported to the place of production. Almost all fuels are chemical fuels. The user employs this fuel to generate heat or perform mechanical work, such as powering an engine. It may also be used to generate electricity, which is then used for heating, lighting or electronics purposes.

BIODIESEL

Biodiesel is a safe alternative fuel to replace traditional petroleum diesel. It has high-lubricity, is a clean-burning fuel and can be a fuel component for use in existing, unmodified diesel engines. This means that no retrofits are necessary when using biodiesel fuel in any diesel powered combustion engine. It is the only alternative fuel that offers such convenience. Biodiesel acts like petroleum diesel, but produces less air pollution, comes from renewable sources, is biodegradable and is safer for the environment. Producing biodiesel fuels can help create local economic revitalization and local environmental benefits. Many groups interested in promoting the use of biodiesel already exist at the local, state and national level.

Biodiesel is designed for complete compatibility with petroleum diesel and can be blended in any ratio, from additive levels to 100 percent biodiesel. In the United States today, biodiesel is typically produced from soybean or rapeseed oil or can be reprocessed from waste cooking oils or animal fats such as waste fish oil. Because it is made of these easily obtainable plant-based materials, it is a completely renewable fuel source.

Production of Bio Diesel

Bio diesel production is the process of making bio diesel, a liquid fuel source largely compatible with petroleum based furl. The following can be performed in a small home based bio diesel processor, or in large industrial facilities. The process is similar to either case.

- Steps in the process
- Production methods
- Oil preparation
- Base catalyzed Trans-Etherification of the bio liquid method

Biodiesel Production Cycle

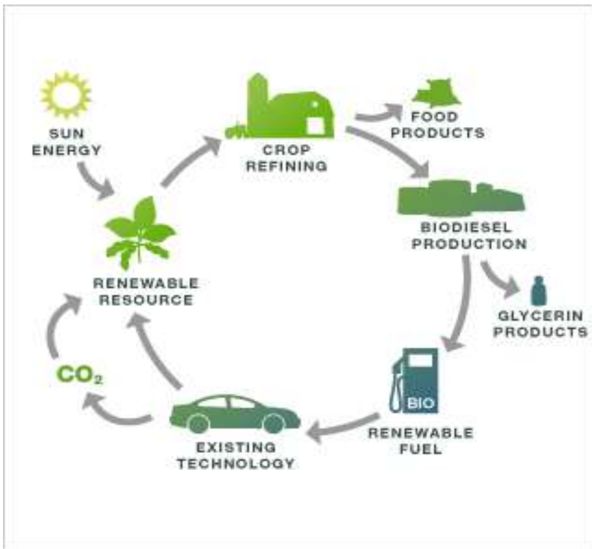


Figure: Bio diesel life cycle

Steps in the process

i. Preparation: Cleaning /heating of bio diesel. With wet oil will obtain soap with the bio diesel, the conversion index from vegetable oil to bio diesel will be smaller and one will obtain an excess of triglycerides.

ii. Titration of the sample: Optimal pH for bio diesel is 7 (neutral), the same as distilled water (and most tap water). Some fat has a high level of free fatty acids which require an acid Esterification (to obtain a pH lower than 3) before the alkaline Trans-Esterification.

iii. Mixing the Bio-Alcohol and catalyst in exact amounts, to produce methoxide

iv. Combing at 50 ºc Methoxide with the Biolipids.

v. Separation

- Bio diesel and Glycerol (by Distillation, Centrifugation etc……..)
- Removal of Alcohol (by Distillation)

Vi. Bio diesel purification: Separation from the bio diesel of the wastes (catalyst and soap): washing add drying the bio diesel.

vii. Disposal of the waste material.

PRODUCTION METHODS

There are three basic routes to bio diesel production from bio-lipids (biological oil and fats):

- Base Catalyzed Trans-Esterification of the bio-lipid.
- Direct Acid Catalyzed Trans-Esterification of the bio lipid.
- Conversion of the bio lipid to its Fatty Acids and then to bio diesel.

Almost all bio diesel is produced using case catalyzed Trans-Esterification, as it is the most economical process requiring only low temperatures and pressures and producing in 98% conversion yield. For this reason only this process will be used mainly.

OIL PREPARATION

Bio diesel processor machines need the vegetable oil to have some specific properties:

Suspended particles lower than 1%(mass/mass) and than 5 micrometers because of this, the following are necessary:

- Filtration to 5 micrometers.
- Washing with hot water.
- Decantation.
- Heating of the oil.
- Second decantation.

Anhydrous (waterless) because of this, the final step of preparation, after the second decantation is drying.

Easy solubility in the alcohol to use.

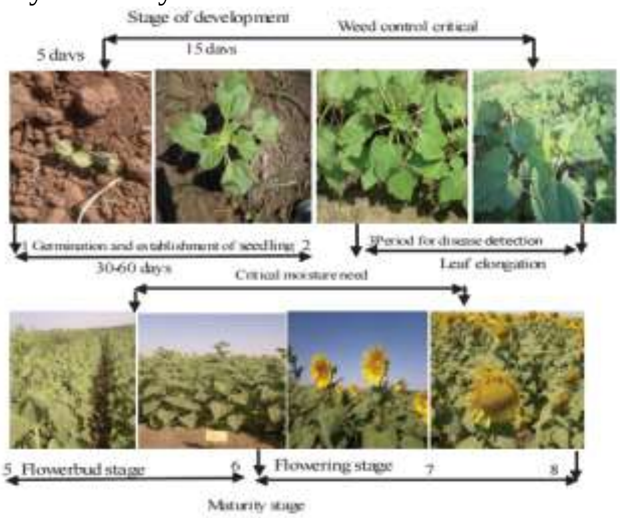


Fig: steps in sun flower

The lower energy content of biodiesel translates into slightly reduced performance when biodiesel is used in 100% form, although users typically report little noticeable change in mileage or performance. When blended with petroleum diesel at B20 levels, there is less than 2% change in fuel energy content, with users typically reporting no noticeable change in mileage or economy.

Superior Lubrication for Engine

The injection system of many diesel engines relies on the fuel to lubricate its parts. The degree to which fuel provides proper lubrication is its lubricity. Low lubricity petroleum diesel fuel can cause premature failure of injection system components and decreased performance. Biodiesel provides excellent lubricity to the fuel injection system. Recently, with the introduction of low sulfur and ultra low sulfur diesel fuel, many of the compounds which previously provided lubricating properties to petro-diesel fuel have been removed. By blending biodiesel in amounts as little as 5%, the lubricity of ultra low sulfur diesel can be dramatically improved, and the life of an engine's fuel injection system extended.

ALTERNATIVE FUELS:

important component of the strategy for energy security.

Bio-diesel Society of India (BDSI) formed keeping in view of the depleting oil reserves, increasing crude prices and rising global temperature, a group of likeminded entrepreneurs, scientists, bureaucrats and social workers have formed asociety to promote the use of bio-diesel. The objective of the society is to promote the consumption of bio-diesel. Due

The selection of alternative fuels for IC-engines include the following factors should be available in plenty and derived continuously from renewable sources. They should have high specific energy content. Should permit easy transportation and storage. Should cause less environmental pollution. Should be safe in handling.

The various alternative fuels for compression ignition engines are as follows.

ALCOHOLS:

Alcohol is an important renewable energy sources that can substitute petroleum products to certain extent. The two alcohols that are of main interest are

ETHANOL:

Ethanol is a convenient liquid fuel and can act as a substitute for petrol and diesel. Usually 95% (hydrous) ethanol can be directly used in modified engines. 100% (anhydrous) ethanol can be mixed with dry petrol to produce gasohol comprising 10% anhydrous ethanol with 90% petrol. The excellent combustion properties of ethanol enable an engine to produce up to 20% more power. Mass, density and calorific value of ethanol are less than that of petrol but on account of its improved combustion properties of ethanol fuel consumption from for ethanol, gasohol or petrol is more or less than the same. Ethanol as petrol additive raises the octane rating of the mixture, as anhydrous ethanol is an octane fuel. Distinctive advantage of ethanol is that it can be produced by renewable sources unlike nonrenewable fossil fuels.

VEGETABLE OILS:

Vegetable oils can be classified as edible and non-edible oils. In India the consumption of edible oils is more than the production. Hence, we can depend on non-edible oils for use in CI engines. Edible oils such as sunflower, coconut, rice bran etc. can be used. Non-edible oils such as mahua, karanji, rapeseed, cottonseed etc. can be substituted in CI engines.

VISCOSITY:

The direction injection in open combustion chamber trough nozzle and pattern of fuel spray decides the case of combustion and thermal efficiency of the engine. Viscosity plays a vital role in the combustion. Low viscosity can lead to excessive internal pumping leakage where as high viscosity can increase system pressure to unacceptable levels and will effect injection during spray atomization.This effect is critical particularly at low speed or light load condition as pure vegetable oils have high viscosity. The derivatives of vegetable oils are called monsters and have low kinematics viscosity than that of oils. The monoesters are able to give stable solutions in wide range of proportions with diesel fuel, vegetable oils and with alcohol too. They can be solubilizers and can also make it possible to influence the viscosity of blended oils.

How Fuel Is Converted

Biodiesel is created by removing glycerin from soybean oil. The United Soybean Board terms it this way: Biodiesel is a mono-alkyl oxygenated fuel made from soybean or othervegetable oils or animal fats. Biodiesel is registered with the US Environmental Protection Agency as a pure fuel or as a fuel additive. This fuel may be one of the following:

- A pure non-petroleum alternative fuel, which is known as B100.
- A combination of petroleum-based diesel fuel and biodiesel. In some areas this is called B20, a blend of 20 percent soy and 80 percent petroleum-based diesel.
- In addition, the use of biodiesel reduces CO2 in the earth's atmosphere. This is due to the fact that growing soybeans consumes nearly four times as much CO2 as the amount of CO2 produced from biodiesel exhaust.

3. PROCEDURE AND SAMPLE CALCULATIONS

PROCEDURE

- The engine is started and run for at least 15 minutes for warming up. Motor for circulating the water is simultaneously started .Then, under no load condition, the time taken for the consumption of 10cc of fuel, the load applied, the speed and manometer readings are recorded.
- The load is increased and allowed to run for 10 minutes. Then, the time taken for the consumption of 10cc of fuel, the load applied, the speed and manometer readings are recorded.
- The load is further increased in approximately four equal steps up to the rated value and readings are noted as in earlier steps.
- In addition, the temperature of cooling water at the inlet and outlet, temperature of exhaust gas and discharge of water are required at every load.
- The engine is then stopped taking suitable precautions.

The Test Samples Are

- B0(Pure Diesel)
- B10 (10% Soya bean Oil and 90% Pure Diesel)
- B20(20% mahua Oil and 80% Pure Diesel)

TESTING PROCEDURE

The testing procedure is carried by mixing the specimen samples with diesel in calculated proportions. The mixture of specimen sample and diesel is used in single cylinder diesel engine and several tests are conducted under controlled atmospheric conditions.

Fig Single cylinder diesel engine

Step 1: Take bio diesel blend say ethanol B10, the composition contains 100 ml of ethanol and 900 ml of diesel, as ethanol is very dangerous proper atmospheric condition are to be maintain, water is used as the cooling agent in the experiment when the fuel is added to engine and cranking is done. Calculated proportions are taken and constant atmospheric conditions are maintained.

Step 2: load to be added to engine to engine and increased simultaneously with the help of the electrical loading and the mean difference of the two gauges are calculated to fine the exact torque applied on engine

Loads are added in ascending order. The adding of load the rpm of the engine will be changing simultaneously that will be displayed on the digital meter. All this testing will give the performance of the fuel used in the engine and will be used in calculating to find the brake power and mechanical efficiency of the engine with using different types of test specimens.

Figure: blending diesel with mahua biodiesel

Step 3: The temperature rise in the engine will noted with help of thermo couples placed inside the engine and the time taken for consumption of 10 ml of fuel will be calculated with help of stop watch

The readings for the gauge and temperature indicators are tabulated, with help of these readings the work done by the engine is calculated and the fuels efficiency is calculated with help of calculating the following:

1. Volumetric efficiency
2. Brake power
3. Specific fuel consumption
4. Brake thermal efficiency
5. Indicated thermal efficiency
6. Mechanical efficiency

Different graphs are plotted to find the effectiveness of specimen fuel and there consistency on the engine working

4. RESULTS

1. Experimental values for diesel

S.NO	ITEMS	UNITS	TEST-1	TEST-2	TEST-3	TEST-4	TEST-5	TEST-6
1	Load	KE	0	1	2	3	4	5
2	Speed	RPM	1554	1541	1528	20.3	14.98	1493
3	Time taken for sec and fuel	SEC	38.1	31.4	24.7	19.2	19.2	18.8
4	Monometer reading	MM	15.2	15.2	15.2	15.2	15.2	15.2
5	Cooling water	RPM	4.6	4.6	4.6	4.6	4.6	4.6
6	Total fuel consumption n	Kg/Kj	039.6	0.7940	0.602	0.732	0.775	0.791
7	Specific fuel consumption n	Kg/Kj-h	140	0.6674	0.444	0.40657	0.342	0.2974
8	Break power	Kw	2.7900	0.7101	1.34751	1.80276	2.7405	2.6248
9	Friction power	Kw	1.85	1.85	1.85	1.85	1.85	1.85
10	Indicated power	Kw	1.85299	1.8579	3.2096	3.652	4.1205	4.51
11	Mechanical efficiency	%	0.1595	0.1505	42.3106	49.36	55.11	59.2
12	Break theramal efficiency	%	1.6758	1.6075	24.65	35.165	53.911	72.199
13	Actual air intake	m^3/min	389.6	1080	307.102	3.07102	3.07*10	3.0710
14	Theritical air intake	m^3/min	10.93	0053	0.2314	0.2762	0.00278	0.02851
15	Volumetric efficiency	%		3.709	1090	11.11	11.12	11.16
16	Co	%vol		1.53		0.003		0.023
17	Hc	Ppm		10		13		16

2. Experimental values for 15%cotton +85% diesel:

s.no	items	units	Test-1	Test-2	Test-3	Test-4	Test-5	Test-6
1	load	Kw	0	1	2	3	4	5
2	Speed	Rpm	1553	1529	1527	1516	1503	1496
3	Time taken f sec	Sec	36.8	29.3	25.5	21.5	19.9	174
4	Monometer readings	Mm	15.2	15.2	15.2	15.2	15.2	15.2
5	Cooling wate flow rate	Rpm	4.6	4.6	4.6	4.6	4.6	4.6
6	Total fu consumption	Kg/hr	0.404	0.507	0.583	0.692	0.747	0.855
7	Specific fu consumption	Kg/kw-hr	150.37	0.7661	0.455	0.3882	0.3882	0.3301
8	Break power	Kw	0.00269	0.663	1.2827	1.78312	1.7812	2.59006
9	Friction powe	Kw	1.75	1.75	1.75	1.75	1.75	1.75
10	Indicate powe	Kw	1.75269	2.413	3.0327	3.53312	3.9679	4.3409
11	Mechanical efficiency	%	0.00153	27.47	42.295	50.468	55.892	59.68
12	Break Thermal efficiency	%	1.44*10	6.98	22.738	37.049	53.03	63.3099
13	Actual a intake	M^3/min	0.00307	0.00307	0.0030	0.00307	0.00307	0.00307
14	Theoretical a intake	M^3/min	0.02862	0.02818	0.0281	0.02794	0.0277	0.02757
15	Value metr efficiency	%	10.72	10.89	10.90	10.98	11.08	11.13
16	Co	%vol		0.074		0.038		0.047
17	HC	Ppm		13		15		24
18	Co_2	%vol		1.89		2.17		6.33
19	o2	%vol		18.02		17.61		11.66

ISSN: 2278-4632
Vol-12 Issue-01 No.01: 2022

3. Experimental values for 45% cotton seed oil +55%diesel

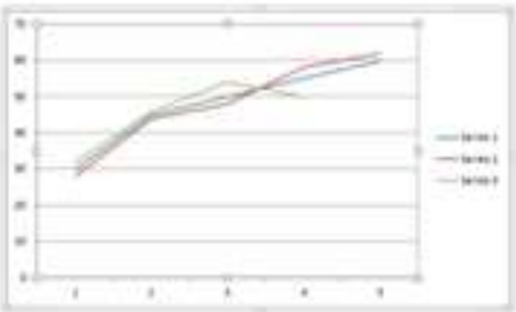
s.no	items	units	Test-1	Test-2	Test-3	Test-4	Test-5	Test-6
1	load	Kw	0	1	2	3	4	5
2	Speed	Rpm	1558	1543	1526	1513	1506	1496
3	Time taken f sec	Sec	38.4	32.7	26.5	21.9	19.5	17.4
4	Monometer readings	Mm	15.2	15.2	15.2	15.2	15.2	15.2
5	Cooling wate flow rate	Rpm	4.6	4.6	4.6	4.6	4.6	4.6
6	Totalfuel consumption	Kg/hr	0.387	0.561	0.659	0.679	0.762	0.855
7	Specific fu consumption	Kg/kw-hr	150.37	0.7661	0.455	0.3882	0.3882	0.3354
8	Break power	Kw	0.00269	0.663	1.2827	1.78312	1.7812	2.55
9	Friction power	Kw	1.75	1.75	1.75	1.75	1.75	1.6
10	Indicate power	Kw	1.75269	2.413	3.0327	3.53312	3.9679	4.15
11	Mechanical efficiency	%	0.00153	27.47	42.295	50.468	55.892	61.445
12	Break Therm efficiency	%	1..51*10^-4	6.98	22.711	35.419	53.03	61.33
13	Actual air intak	M^3/min	0.00307	0.00307	0.00307	0.00307	0.00307	0.00307
14	Theoretical a intake	M^3/min	0.0287	0.02818	0.0281	0.0278	0.0277	0.0275
15	Value metr efficiency	%	10.69	10.80	10.92	11.04	11.08	11.26
16	Co	%vol		0.11		0.063		0.043
17	HC	Ppm		18		19		22
18	Co_2	%vol		2.26		3.93		3.99
19	o2	%vol		16.97		14.84		14.83

4. Experimental values for 30% cotton seed oil +70% diesel

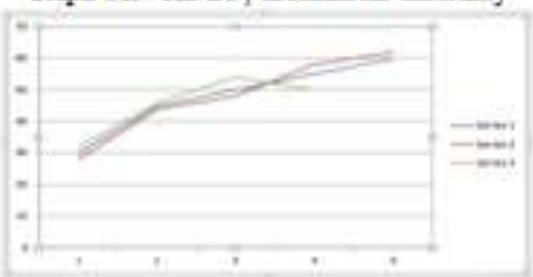
s.no	items	units	Test-1	Test-2	Test-3	Test-4	Test-5	Test-6
1	load	Kw	0	1	2	3	4	5
2	Speed	Rpm	1550	1539	1527	1514	1509	1501
3	Time taken f sec	Sec	35	29.3	25.5	21.5	19.9	174
4	Monometer readings	Mm	15.2	15.2	15.2	15.2	15.2	17.8
5	Cooling wate flow rate	Rpm	4.6	4.6	4.6	4.6	4.6	15.2
6	Total fu consumption	Kg/hr	0.425	0.507	0.583	0.692	0.747	4.6
7	Specific fu consumption	Kg/kw-h	158.699	0.7661	0.455	0.3882	0.3398	0.836
8	Break power	Kw	0.00269	0.663	1.2827	1.78312	2.2011	0.3233
9	Friction pow	Kw	1.75	1.75	1.75	1.75	1.65	61.05
10	Indicate pow	Kw	1.65268	2.413	3.0327	3.53312	3.8511	64.51
11	Mechanical efficiency	%	0.0062	27.47	42.295	50.468	57.15	0.00307
12	Break Thermal efficiency	%	1.36*10	6.98	22.738	37.049	52.25	0.0276
13	Actual a intake	M^3/min	0.00307	0.00307	0.00307	0.00307	11.	11.12
14	Theoretical a intake	M^3/min	0.02862	0.0283	0.02814	0.02794	0.048	0.037
15	Value metr efficiency	%	10.73	10.84	10.9	11.00	11.04	11.12
16	Co	%vol		0.074		0.038		0.037
17	HC	Ppm		13		15		20
18	Co_2	%vol		1.89		2.17		3.5
19	o2	%vol		18.02		17.5		15.71

GRAPH

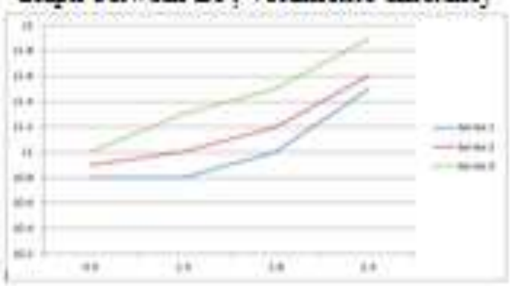
Comparison Of Load And Mechanical Efficiency



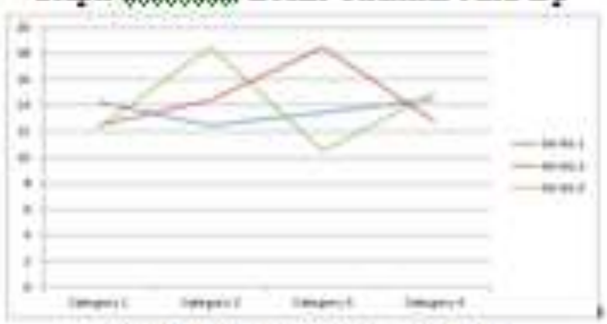
Graph between BP, mechanical efficiency



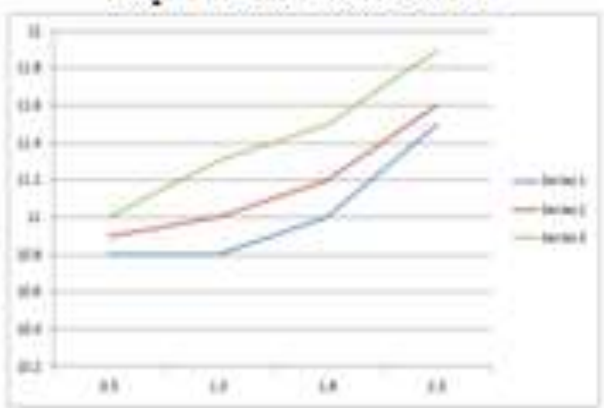
Graph between BP, volumetric efficiency



Graph Between Break Thermal And Bp



Graph between SFC and BP



5. CONCLUSION

An experimental investigation was conducted to evaluate the performance and exhaust emissions of three Vegetable oils [Sunflower Oil (SunOil), Rapeseed Oil (RapO), and Cottonseed Oil (cotton oil)] and their blends with Diesel Fuel (DF) and compare the results with the reference fuel (DF). The work was conducted in a fully instrumented direct injection agricultural tractor engine. The conclusions extracted in terms of engine performance and exhaust emissions were as follows.

- All vegetable oil fuels provided as fuels to the engine had resulted in normal operation without problems during the short-term experiments.
- The 20/80 blends showed unstable results with unclear trends, in comparison to higher oil content fuels.
- Power, Torque, and BSFC were higher as oil content was increased in the tested fuel.
- RapO-based fuels gave the best results in terms of Power and Torque increment with a simultaneous lower BSFC increase. As a result, engine thermal efficiency was significantly better than when using the other vegetable oils. CotO fuels were on average better than SunO fuels.
- NOx emissions were augmented as oil percentage in the fuel was increased.(vi)RapO fuels increased the NOx production less than CotO fuels, leaving SunO fuels last.
- CO_2 emissions showed an increase tendency as the oil content was evolved when RapO and CotO fuels were used. SunO fuels gave blurred results on this issue.
- The highest CO_2 emissions were produced when CotO fuels were tested, followed by RapO and SunO fuels.

REFERENCES

- http://www.eea.europa.eu/data-and maps/figures/final-energy-consumption-by-sector-4, In: Agency EE, editor. 2011.
- P. Panagakis, G. Papadakis, T. Natsis, and S. Kyritsis, "Strategic R&D for better energy efficiency in the agricultural sector," In: CSMC) EPCNJ-C—GD, editor. 1996.
- T. W. Ryan, T. J. Callahan, and L. G. Dodge, "Characterization of vegetable oil for use as fuels in diesel engines," in Proceedings of the International Conference on Plaint Oils as Fuels, pp. 70–81, American Society of

Agricultural Engineers, 1982, ASAE no. 49085.

- R. C. Strayer, W. K. Craiq, and G. C. Zoerb, "Engine deposit and pour point studies using canola oil as a diesel fuel," in Proceedings of the International Conference on Plant and Vegetable Oils as Fuels, pp. 347–353, American Society of Agricultural Engineers, 1982, ASAE no. 49085.
- C. D. Rakopoulos, K. A. Antonopoulos, D. C. Rakopoulos, D. T. Hountalas, and E. G. Giakoumis, "Comparative performance and emissions study of a direct injection diesel engine using blends of diesel fuel with vegetable oils or bio-diesels of various origins," Energy Conversion and Management, vol. 47, no. 18-19, pp. 3272–3287, 2006. View at Publisher • View at Google Scholar • View at Scopus
- M. Zejewski, H. Goettler, and G. L. Pratt, "Influence of vegetable oil based alternate fuels on residue deposits and components wear in a diesel engine," SAE paper 860302, 1986.
- F. Karaosmanoğlu, "Vegetable oil fuels: a review," Energy Sources, vol. 21, no. 3, pp. 221–231, 1999. View at Google Scholar • View at Scopus
- P. Higelin, Huiles Vegetables—Biocombustible Diesel. Incidence des Aspects Thermiques Lies au Type de Moteur sur la Combustion, University of Orleans, New Orleans, La, USA, 1992.
- H. J. Geottler, M. Ziejewski, and A. M. Knudson, "Performance of a diesel engine operating on blends of diesel fuel and crude sunflower oil at normal and elevated fuel temperature," SAE paper 852087, 1985.
- S. Ramadhas, S. Jayaraj, and C. Muraleedharan, "Use of vegetable oils as I.C. engine fuels—a review," Renewable Energy, vol. 29, no. 5, pp. 727–742, 2004. View at Publisher • View at Google Scholar • View at Scopus
- O. M. I. Nwafor and G. Rice, "Performance of rapeseed oil blends in a diesel engine," Applied Energy, vol. 54, no. 4, pp. 345–354, 1996. View at Publisher • View at Google Scholar • View at Scopus
- K. P. McDonnell, S. M. Ward, P. B. McNulty, and R. Howard-Hildige, "Results of engine and vehicle testing of semirefined rapeseed oil," Transactions of the American Society of Agricultural Engineers, vol. 43, no. 6, pp. 1309–1316, 2000. View at Google Scholar • View at Scopus
- F. Karaosmanoğlu, G. Kurt, and T. Özaktaş, "Long term CI engine test of sunflower oil," Renewable Energy, vol. 19, no. 1-2, pp. 219–221, 2000.
- R. Altin, S. Çetinkaya, and H. S. Yücesu, "Potential of using vegetable oil fuels as fuel for diesel engines," Energy Conversion and Management, vol. 42, no. 5, pp. 529–538, 2001. View at Publisher
- G. A. P. Rao and P. R. Mohan, "Effect of supercharging on the performance of a DI diesel engine with cotton seed oil," Energy Conversion and Management, vol. 44, no. 6, pp. 937–944, 2003. View at Publisher• View at Google Scholar • View at Scopus