A STUDY DIFFERENT BIODIESEL ON ENGINE PROPERTIES,PERFORMANCE AND EMISSION

Prashant Kurve
Department of Mechanical Engineering
RMD SOE,Warje
PUNE,INDIA
prashantkuve6@gmail.com

Rajale Ranjit Vasant
Department of Mechanical Engineering
SCSMCOE Nepti, Ahmednagar
Ahmednagar, Maharashtra, India
ranjit.rajale@gmail.com

Abstract— Energy is an essential and vital input for economic activity. Building a strong base of energy resources is a pre-requisite for the sustainable economic and social development of a country. Indiscriminate extraction and increased consumption of fossil fuels have led to the reduction in underground-based carbon resources and release harmful emissions which is the main reason for global warming and ozone layer depletion. Biomass derived vegetable oils are quite promising alternative fuels for agricultural diesel engines. Use of biodiesel in diesel engines leads to slightly inferior performance and higher smoke emissions due to their high viscosity.

Keywords—vortex; stream; temperature separation; kinetic energy;

I. INTRODUCTION

Diesel fuel has an essential function in the industrial economy of a developing country and used for transport of industrial and agricultural goods and operation of diesel tractors and pump sets in agricultural sector. The requirement of petrol diesel in India is expected to grow from 39.815 MMT in 2001-02 to 90 MMT in 2014-15.[1] The domestic supply of crude oil will satisfy only about 22% of the demand and the rest will have to be met from imported crude. This has stimulated recent interest in alternative sources to replace petroleum-based fuels. Of the alternative fuels, bio-diesel obtained from vegetable oils holds good promises as an eco friendly alternative to diesel fuel. Vegetable oil is a promising alternative fuel for CI engine because it is renewable, environment friendly and can be produced in rural areas. The use of non-edible vegetable oils compared to edible oils is very significant in developing countries because of the tremendous demand for edible oils as food and they are too expensive to be used as fuel at present. There has been renewed interest in the use of rice bran oils for making biodiesel because it is less polluting and renewable. It is biodegradable and non-toxic. Worldwide biodiesel production is mainly from edible oils such as soybean, peanut, coconut, sunflower and canola oils. [1]

II LITERATURE SURVEY

Energy demand is increasing due to ever-increasing number of vehicles employing internal combustion engines. Also, world is presently confronted with the twin crisis of fossil fuel deflection and environmental degradation. Fossil fuels are limited resources; hence, search for renewable fuels is becoming more and more prominent for ensuring energy security and environmental protection. Now a day's various incentives and regulations can be used to encourage the production, sale and use of alternative fuel vehicles, including diesel, LPG, methanol, ethanol, hydrogen, hydrogen-peroxide and electricity. These fuels reduce per-mile energy consumption and emissions, although net benefits are sometimes small when all impacts are evaluated on a lifecycle. Thus increasing focus on the environmental impacts of fossil fuel based power generation has led to increased research with the aim of reducing emissions and improving combustion efficiency. Much of this work is driven by the increasing interest into alternative fuels such as biodiesel, bio-alcohol, chemically stored electricity, hydrogen, non-fossil methane, non-fossil natural gas, oil, and other biomass sources.

2.1 Biodiesel

Biodiesel is produced by mixing vegetable or animal oil with a small quantity of methanol in a process known as esterification. Potential fuel crops include rice bran oil rapeseed oil, soybean oil, and palm oil and used vegetable oils. In northern Europe oilseed rape is the most appropriate crop for the climatic conditions, but requires intensive agricultural practices, pesticides and fertilizers. There are some adverse impacts on vulnerable farm land habitats and bird species.

Total European bio-diesel output in 2000 was 700,000 tones, with half the total production coming from France, followed by Austria, Germany, Italy, Spain and Sweden. This still represents only 6 % of world production. A draft European specification for bio-diesel has recently been developed, and production targets have been set of 2.3million tones by 2003 and 8.3 million tons by 2010, in order to reduce greenhouse and air polluting gas emissions. Zero fuel duty rates in Germany, Austria, Italy and Spain and a variable duty regime in France may further encourage production of crops. Current diesel engines can operate with up to 5% diesel extension using bio-diesel. Emissions depend on the type of vehicle and fuel specification, but there are few air quality benefits relative to conventional diesel. Bio-diesel is non-toxic and biodegradable, making it suitable for use on inland waterways and other sensitive marine environments. Like bio-ethanol, climate change benefits ultimately depend on how the crop is produced.

Gautam Kumara et.al. [1] States that the objective is an experimental investigation has been conducted on single cylinder diesel engine fueled with blends of Mahua and diesel. Five concent rations of biodiesel are taken for investigation and the engine performance characteristics has been studies under different loading conditions. The biodiesel with concentration of 20% is found suitable among all blends of biodiesel and pure diesel.

R.Saravanan et.al.[2] states his objective to the research is examine the characteristics of Sapotaceae oil and its blends. Sapotaceae butyl ester is derived through transesterification process in the presence of two different processes such as pre-process and post process. A single cylinder, water cooled, four stroke diesel engine was used for this work. The following fuels were tested such as diesel, B10, B20, B30,PB10,PB20,PB30 (where PB are denoted ass post process) observe their properties and performance. To observe the results of diesel, Sapotaceae oil butyl esters and their blends with diesel by volume were compared. In this process the yield in preprocess is 60% per litre and 75% in post process

Jagannath B. Hirkude et. al.[3] in his paper discusses the results of investigations carried out on a single-cylinder, four-stroke, direct- injection, diesel engine operated on methyl esters of waste fried oil blended with mineral diesel. The performance of the engine with diesel was considered as the baseline data. The performance parameters for different WFOME blends were found to be very close to diesel and the emission characteristics of engine improved significantly. At rated output, brake thermal efficiency of blend B50 (50% biodiesel + 50% min- eral diesel) found 6.5% lower than that of diesel. For B50, brake specific consumption observed was 6.89% higher than that of diesel. CO emissions were reduced by 21–45% for different blends. The particulate matters were lower by 23–47%. Because of insignificant sulphur content, the sulphur dioxide emissions were lower by 50–100% for different blends.

Jo-Han Ng et.al [4] states his objective to evaluate the suitability of biodiesel for on-road usage based on the engine-out responses of a light-duty diesel engine. Palm methyl ester (PME) was the biodiesel fuel used .the effects of engine speed and load over the entire operational range on engine performance and pollutant emissions when fuelled with neat PME (B100) and a B50 PME–diesel blend were identified.

Ahmet Necati Ozsezen et.al.[5] states his objective to evaluate performance and combustion characteristics of a direct injection (DI) diesel engine fuelled with biodiesels such as waste (frying) palm oil methyl ester (WPOME) and canola oil methyl ester (COME). In order to determine the performance and combustion characteristics, the experiments were conducted at the constant engine speed mode (1500 rpm) under the full load condition of the engine.

Lokanatham R et.al [12] states objective to covers the various aspects of bio-diesel fuel derived from jatropha curcas and pongamia pinnata. Concluded that both pongamia pinnata and jatropha curcus oils have substantial prospects as long-term substitutes for petrodiesel fuels. The 95% petrodiesel and 5% SVO of pongamia pinnata or jatropha curcus blend competed favorably with petrodiesel fuel and offer a reasonable substitute alotheough blend of 85% diesel and 15% SVO of pongamia pinnata or jatropha curcus can also be used without any significant loss in engine output and without any major operational difficulties.

4. COMPARISON OF DIFFERENT PARAMETERS OF BIODIESEL

4.1 Sources and Economic Avaibility

4.1.1 Diesel

Petroleum diesel, also called petrodiesel or fossil diesel is the most common type of diesel fuel. It is produced from the fractional distillation of crude oil between 200 °C and 350 °C at atmospheric pressure, resulting in a mixture of carbon chains that typically contain between 8 and 21 carbon atoms per molecule.

4.1.2 Mahua

The Mahua trees are indigenous to India, grow even in draught prone areas and are found abundantly over several parts of India. If the seeds fallen are collected, and oil is extracted at village level expellers, few million tons of oil will be available for lighting lamps in rural area. In some countries, Mahua oil is considered edible as it is used only for preparing ghee, but in our country it has been considered as non-edible oil. Growing Mahua trees would also help in protecting the environment and benefit the farmers as well. It is the best substitute for kerosene. Since these are spread over a large area, collection of seeds for Biodiesel manufacture is not viable. A compact plantation can support a Biodiesel plant.

4.1.3 Palm Oil

Also known as Dende Oil is an edible vegetable oil derived from the Mesocarp (reddish pulp) of the fruit of the oil palms, primarily the African oil palm Elaeis Guineensis,and to a lesser extent from the American oil palm Elaeis oleifera and the Maripa Palm Attalea Maripa.

Palm oil is naturally reddish in colour because of high beta-carotene content. It is not to be confused with palm kernel oil derived from the kernel of the same fruit, or coconut oil derived from the kernel of the coconut palm (Cocos nucifera). The differences are in colour (raw palm kernel oil lacks carotenoids and is not red), and in saturated fat content: Palm mesocarp oil is 41% saturated, while palm kernel oil and coconut oil are 81% and 86% saturated respectively.

Previously, palm oil could be listed as "vegetable fat" or "vegetable oil" on food labels in the European Union (EU). From December 2014, food packaging in the EU is no longer allowed to use the generic terms "vegetable fat" or "vegetable oil" in the ingredients list. Food producers are required to list the specific type of vegetable fat used, including palm oil. Vegetable oils and fats can be grouped together in the ingredients list under the term "vegetable oils" or "vegetable fats" but this must be followed by the type of vegetable origin (e.g. Palm, sunflower or rapeseed) and the phrase "in varying proportions".

4.1.4 Rapeseed

(Brassica napus), also known as rape, oilseed rape, rapa, rappi, rapaseed, (and, in the case of one particular group of cultivars, canola), is a bright-yellow flowering member of the family Brassicaceae (mustard or cabbage family), (consumed in China and Southern Africa as a vegetable. The name derives from the Latin for turnip, rāpa or rāpum, and is first recorded in English at the end of the 14th century. Older writers usually distinguished the turnip and rape by the adjectives 'round' and 'long' (-'rooted'), respectively.[2] Rutabagas, Brassica napobrassica, are sometimes considered a variety of B. Napus. Some botanists also include the closely related B. Campestris within B. Napus.

Worldwide production of rapeseed (including canola) has increased sixfold between 1975 and 2007. The production of canola and rapeseed since 1975 has opened up the edible oil market for rapeseed oil. Since 2002, production of biodiesel has been steadily increasing in EU and USA to 6 million metric tons in 2006. Rapeseed oil is positioned to supply a good portion of the vegetable oils needed to produce that fuel. World production is thus expected to trend further upward between 2005 and 2015 as biodiesel content requirements in Europe go into effect. Every ton of rapeseed yields about 400 kg of oil. Rapeseed oil takes between 135 and 150 days to mature, with some varieties only taking 110

4.1.5 Soybean

The soybean in the US, also called the soya bean in Europe (Glycine max) is a species of legume native to East Asia, widely grown for its edible bean which has numerous uses. The plant is classed as an oilseed rather than a pulse by the UN Food and Agriculture Organization (FAO).

Fat-free (defatted) soybean meal is a significant and cheap source of protein for animal feeds and many packaged meals; soy vegetable oil is another product of processing the soybean crop. For example, soybean products such as textured vegetable protein (TVP) are ingredients in many meat and dairy analogues.Soybeans produce significantly more protein per acre than most other uses of land.

Traditional nonfermented food uses of soybeans include soy milk, and from the latter tofu and tofu skin. Fermented foods include soy sauce, fermented bean paste, natto, and tempeh, among others. The oil is used in many industrial applications. The main producers of soy are the United States (36%), Brazil (36%), Argentina (18%), China (5%) and India (4%).The beans contain significant amounts of phytic acid, alpha-linolenic acid, and is flavones.

4.1.6 Cottonseed

The mature seeds are brown avoids weighing about a tenth of a gram. By weight, they are 60% cotyledon, 32% coat and 8% embryonic root and shoot. These are 20% protein, 20% oil and 3.5% starch. Fibres grow from the seed coat to form a boll of cotton lint. The boll is a protective fruit and when the plant is grown commercially, it is stripped from the seed by ginning and the lint is then processed into cotton fibre. For unit weight of fibre, about 1.6 units of seeds are produced. The seeds are about 15% of the value of the crop and are pressed to make oil and used as ruminant animal feed. About 5% of the seeds are used for sowing the next crop found all over the world

4.1.7 Vegetable oil

Vegetable oil can be used as an alternative fuel in diesel engines and in heating oil burners. When vegetable oil is used directly as a fuel, in either modified or unmodified equipment, it is referred to as straight vegetable oil (SVO) or pure plant oil (PPO). Conventional diesel engines can be modified to help ensure that the viscosity of the vegetable oil is low enough to allow proper atomization of the fuel. This prevents incomplete combustion, which would damage the engine by causing a build-up of carbon. Straight vegetable oil can also be blended with conventional diesel or processed into biodiesel or bioliquids for use under a wider range of conditions.

As of 2000, the United States was producing in excess of 11 billion liters (2.9 billion U.S. gallons) of recycled vegetable oil annually, mainly from industrial deep fryers in potato processing plants, snack food factories and fast food restaurants. If all those 11 billion liters could be recycled and used to replace the energy equivalent amount of petroleum (an ideal case), almost 1% of US oil consumption could be offset. Use of used vegetable oil as a direct fuel competes with some other uses of the commodity, which has effects on its price as a fuel and increases its cost as an input to the other uses as well.

III SETUP

The schematic of flexible test rig and measuring equipments which are used in this study are shown in Fig. [11]

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4.2 Cost Analysis

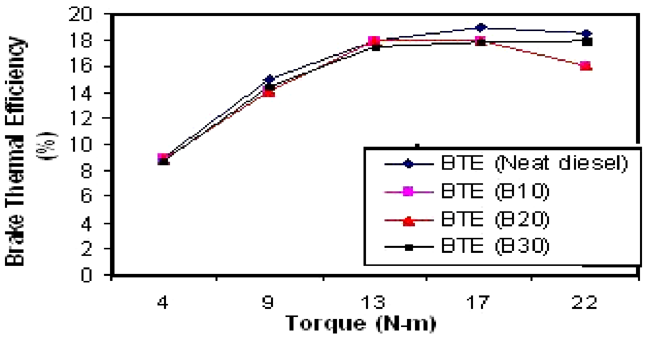
Different types of vegetable oil that are available with their prices are

Table No 4.2.1 – Different Prices of Oils in India [1][21][22]

Oil Name	Current Price In India Rs Per Liter
Disel (Subsidized)	51.82
Mahua	45
Waste Fried Oil	24.30
Palm Oil	46
Rapa Seed	300
Soya bean	64
Cotton Seed	68

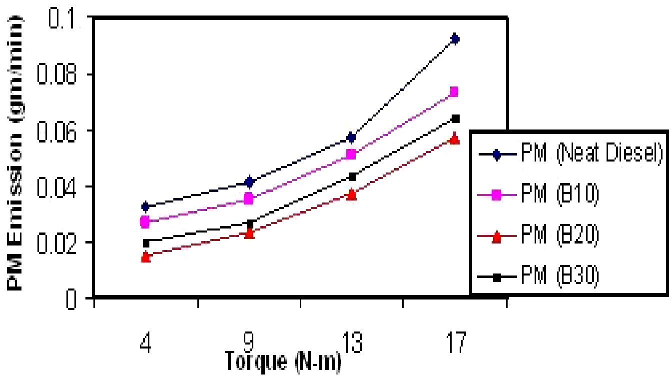
4.4.1. Cotton Seed Oil

4.4.1.1 Brake Thermal Efficiency and Brake Specific Fuel Consumption



4.4.1.2.3 PM Emissions.

Figure 4.4.1.2.3.Shows the PM emission with neat diesel fuel and 20% biodiesel mixtures. The primary reason of the particulate emission from CI engine is improper combustion and combustion of heavy lubricating oil. Diesel PM, is the particulate component of diesel exhaust, which includes diesel soot and aerosols such as ash particulates, metallic abrasion particles, sulphates, and silicates. When released into the atmosphere, PM can take the form of individual particles. In this experiment, PM was measured by filter cloth method. It was found that particulate emission with 20% biodiesel mixture was lower than that of neat diesel fuel because neat biodiesel contains 10-12% extra oxygen, which resulted in better combustion, lowers PM emission. With 20% biodiesel mixtures, PM emission was reduced by 24% compared with neat diesel fuel.[18]



4.4.1.2.4. Smoke Emission.

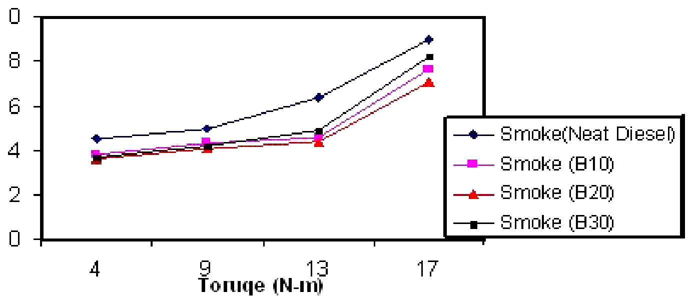


Figure 4.4.1.2.4. Variation of Smoke Emission with Torque (Engine Speed 850rpm).[18]

The variation of smoke emission with engine torque for neat diesel fuel and 10% mixture was shown in Figure12. For 10% biodiesel mixtures, smoke emission was less, compared to neat diesel fuel. The maximum reduction of smoke emission with 10% biodiesel mixtures was observed by 14%. Because of the heterogeneous nature of diesel combustion, fuel-air ratio, which affects smoke formation, tends to vary within the cylinder of a diesel engine. Smoke formation occurs primarily in the fuel-rich zone of the cylinder, at high temperatures and pressures. If the applied fuel is partially oxygenated, locally over-rich regions can be reduced and primary smoke formation can be limited. [18]

4.4.2. Soya bean Oil

4.4.2.1 Engine Performance

Fuel Type	BSFC (g/kW–hr)	% Change in BSFC	Thermal Efficiency (%)	% Change in Thermal Efficiency
Diesel	228.42 (c)	–	36.96 (a)	--
20% SME	234.55 (b)	2.69	36.90 (a)	–0.16
20% YGME	234.29 (b)	2.57	36.99 (a)	0.07
SME	259.33 (a)	13.53	37.13 (a)	0.45
YGME	260.94 (a)	14.24	37.14 (a)	0.49

In order to understand the effect of the biodiesel on engine efficiency, the brake specific fuel consumption (BSFC) and thermal efficiency of the engine were measured at full load (258 N–m) and at an engine speed of 1400 rpm. The engine load and speed were kept constant for all of the test fuels. The BSFC and the percentage change in the BSFC from the baseline diesel fuel are listed in table 4. As seen in the table, the methyl esters have higher BSFCs than the diesel fuel. The increase in BSFC is understandable since the methyl esters have heating values that are about 12% less than for No. 2 diesel fuel. These results are similar to those of Monyem (1998) and McDonald et al. (1995), who fuelled diesel engines with soybean oil methyl ester and No. 2 diesel fuel. In those studies, a 13% to 14% increase in BSFC for the methyl esters was found. Ali (1995) found a 12% to 14% increase in BSFC for beef tallow methyl ester.[6][7]

A statistical analysis technique called "Tukey grouping" was performed on the data to determine whether the differences observed between the fuels are statistically significant at the 95% confidence level (Ott, 1993; Barnes, 1994). The letters in parentheses in table show the Tukey grouping analysis for the BSFC. If the variables in the Tukey grouping have the same letter, then the differences between those variables are not statistically significant. There was no significant difference between the BSFC of the engine operating on SME and YGME, or between the 20% blend of SME and the 20% blend of YGME. However, both biodiesels and their blends have a significant effect on the BSFC compared with the diesel fuel.[20]

The brake thermal efficiencies of the engine when operating on the different fuels and blends are also shown in table 4. Brake thermal efficiency is defined as the actual brake work per cycle divided by the amount of fuel chemical energy as indicated by the fuel's lower heating value. As the table shows, the thermal efficiency of the SME, YGME, and their blends were almost the same as for diesel fuel. This means that the engine converts the chemical energy of the fuel to mechanical energy with the same efficiency for all the fuels used in the test. This was confirmed by the Tukey grouping test, which indicates that there is no significant difference between any of the fuels.[8]

flow are measured by thermometer 14 and pressure gauge 17 respectively. [6] Volume flow rate of cold and hot streams is determined by two rotameters 13 and 15 respectively.

High pressure inlet flow is directed to the main pipe by two tangential nozzles such that vortex flow is generated. The vortex generator and the configuration of tangential inlet nozzle which are illustrated .are made similarly for all three vortex tubes. The main pipe and cold flow orifice are fitted to the vortex generator at section3 and section 2 respectively as indicated. The main tube is made of copper with different turning angle and curvature radius for all vortex tubes; however the axial curvature is uniform. For each tube, Inner surface is perfectly smooth and their inner diameters are kept completely constant. Length (L) and inside diameter (D) of main tubes are the same for all three vortex tubes; however their curvature radiuses and their turning angles are different as indicated. [6]

Conclusion

Biodiesel produced from vegetable oil or animal fats by transesterification with alcohol like methanol and ethanol is recommended for use as a substitute for petroleum-based diesel mainly because biodiesel is an oxygenated, renewable, biodegradable and environmentally friendly bio-fuel. From this seminar summaries that

1. The results shown in different paper that engine performance when fuelled with the biodiesel is compared to that when fuelled with petroleum diesel is shown in the form of tables and graphs.
2. The result shown in different paper that engine emission is compared with diesel is calculated in form tables and graphs.

Acknowledgment (Heading 5)

With a firm belief that a guide in a project is one who holds the candle in the maze of darkness. I take this opportunity to express my profound gratitude to **Prof. M.P. Nagarkar** who as guider, have enacted the role of a torch in their endeavor.

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