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Study On The Performance And Emission Charecteristics Of Preheated Higher Blends Of Uto And Waste Plastic Oil With Diesel In Single Cylinder 4 Stroke Ci Engine

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Abstract:

Biodiesel is a non-toxic, biodegradable and renewable alternative fuel that can be used with little or no engine modifications. Biodiesel is currently expensive but would be more cost effective if it could be produced from low-cost non-edible oils. The objective of this study was to investigate the effect of Bio fuel produced from non-edible oils on engine performance and emissions. Biodiesel was prepared from non-edible oil such as UTO and WASTE PLASTIC OIL by Transesterification method. After Transesterification process, the properties of UTO biodiesel and Diesel was compared. From this comparison, it is observed that properties of UTO Biodiesel are better than the raw oils. Tests were carried out on 4- S CI Diesel engine without any modification in the fuel injection system. From the results, it is observed that the Neem oil Biodiesel performance results comparable to Diesel fuel. Also Biodiesel fuel results in significant reductions in carbon monoxide and un burnt hydrocarbons. Using of this non-edible oil as an alternative fuel will be a good substitute for Diesel oil and will conserve India’s foreign exchange.

1. INTRODUCTION:

What is biodiesel?

Bio diesel is defined as the mono-alkyl esters of fatty acids derived from vegetable oils or animal fats. In simple terms, bio diesel is the product you get when a vegetable oil or animal fat is chemically reacted with an alcohol to produce a new compound that is known as a fatty acid alkyl ester. A catalyst such as sodium or potassium hydroxide is required. Glycerol is produced as a by-product.

Bio diesel fuels are oxygenated organic compounds methyl or ethyl esters derived from a variety of renewable sources such as vegetable oil, animal fat and cooking oil.

Bio diesel can also be made from other feed stocks:

1. Other vegetable oils such as corn oil, canola oil, cotton seed oil, mustard oil, palm oil etc.
2. Restaurant waste oils such as frying oils
3. Animal fats such as beef tallow or pork lard.
4. Trap grease, float grease.

Why biodiesel?

Proponents of bio diesel as a substitute for diesel fuel (neat or in blends) point to its advantages:

- It can reduce our dependence on foreign petroleum imports are at record levels in the United States, and will continue to rise as domestic oil supplies shrink. Our transportation sector, with its great demand for gasoline and diesel fuel, relies almost exclusively on petroleum for energy. Bio diesel can be produced domestically from agricultural oils and from waste fats and oils. Because it can be used directly in diesel engines, bio diesel offers the immediate potential to reduce our demand for petroleum.
- It can leverage limited supplies of fossil fuels. Regardless of whose perspective we choose to believe in the future of coal, oil and natural gas, their supply is, ultimately, limited. Bio diesel can help us leverage our use of these oils.
- It can help reduce greenhouse effect; the burning of fossil fuels during the past century has dramatically increased the levels of carbon dioxide (CO_2) and other green house gases. Their implications are hotly debated, but the levels of these gases have unquestionably risen at unprecedented rates in the context of geological time. To the extent that bio diesel is truly renewable, it could help reduce greenhouse gas emissions from the transportation sector.
- It can help reduce air pollution and related public health risks, one of the U.S. Environmental Protection Agency’s primary charges is to reduce public health risks associated with environmental pollution. Bio diesel can play a role in reducing emissions of many air pollutants, especially those targeted by EPA in urban areas. These include Particulate Matter (PM), Carbon monoxide (CO), Hydrocarbons (HC), Sulphur oxides (SO_X), Nitrogen oxides (NOx) and air toxics.

- It can benefit our domestic economy spending on foreign imports of petroleum takes dollars away from our economy. Biodiesel can help us shift this spending to domestically produced energy, and offers new energy-related markets to farmers.
- Because the tailpipe emissions of bio diesel vary linearly with the blend level, the benefit of any blend level of bio diesel can be estimated by using the following formula: % Bio diesel multiplied by bio diesel life cycle inventory plus % diesel fuel multiplied by diesel fuel life cycle inventory.
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Literature Review:

Prajapti Jaivik and R.J.Jani,June(2013).[1]They studied the characteristics and performance of the 4-stroke diesel engine, and they verify that NOME biodiesel and its blends was only poorer performance than diesel at full load condition .They carried out 4-stroke ,4-cylinder,diesel engine operated on methyl ester of neem oil blend like pure diesel and biodiesel B05(Biodiesel 5% and Diesel 95%) up to B100(Biodiesel 100%).They concluded ,the brake thermal efficiency decreased with increase of NOME in the blend on full condition i.e. B100 gives the lowest brake thermal efficiency of 14.02% at output of 18.50kw. The HC emission is increased with increased the proportion of NOME in the blend. Emission of CO and CO2 is increased with increased in the proportion of NOME in the blend. Emission of O2 is decreased with increase in the proportion of NOME in the blend. Emission of NOX is also decreased with increase in the proportion of NOME in the blend. These all emission test is conducted using B100.

L.Prabhu andS.Sathish kumar (2013).[2]According to this paper, they used a single cylinder engine for conducting the experiment on diesel and NOME diesel blends. They studied that the brake thermal efficiency and basic specific fuel consumption for 20%,40% and 100% NOME are lower than that of diesel fuel at full load .They conducted emission NO emission ,and the CO emission are decreased by 20%,30% and 40% for 20%,40% and 100% NOME at full load condition as compared to diesel fuel, the smoke emission from 20%,40% and 100% NOME blends decreased by 25% and 30% for full load condition and also they concluded that 20% NOME is better when compared to diesel, thus the neem oil is suitable for alternative to the diesel fuel.

Vikas Kumar and Anuprasad S G (2013).[4]According to this paper, they deal with production of biodiesel from neem oil using Trans esterification process. Initially they purchased neem oil from the market as raw product, and they removed the moisture content by heating 100% before to use for Trans esterification process. After that catalyst is dissolved in the alcohol with the help of mixer and neem oil is added to it, then the system is closed to the atmosphere because to prevent the loss of alcohol. They added 200ml of methanol for 100ml of oil and keep on stirred up to 45min and maintaining the temperature between the range of 400 to 500.After stirring process is completed they kept the mixture about 24hrs,the thick layer of the glycerine id settled down at the bottom and the bottom glycerine is removed by using separating funnel. After preparation of biodiesel they checked all the properties, they found that NOX emission found increasing for the same load for diesel this is the major drawback of using the biodiesel. Finally they concluded that the rate of fuel consumption lowers for B20, B10 and overall to keep environment greener we can use biodiesel.

K Anumani and Ajit Pal Singh (2010). [5]According to their study, they used two edible oil i.e. mustard (Brassica nigra; Family; Cruciferae) and neem (Azadirachita indica; Family; Meliaceae) as diesel oil substitute and studied their condition characteristics. According to study, on blending vegetable oil with diesel oil remarkable improvement in the properties were observed, and they carried out the experiment at different load (0,4,8,16 and 20kg) at constant speed of (1500rpm) separately and on pure diesel. Result indicated that using 20% blend of oil to run the engine shows the closer performance to pure diesel, however the mustard oil at 20% blend with diesel gives the better results compared to neem blend oil, in terms of low smoke intensity emission of HC and NOX. All the characteristics were tested viz total fuel consumption, specific fuel consumption, specific energy consumption, brake thermal efficiency, cylinder peak pressure were improved. Further trans esterificated mustard oil at 20% blend satisfy the important fuel properties as per standard specification of biodiesel and it leads to an better improvement in engine performance and emission characteristics without changing the modification of the engine.

S Prabhakar and K.Annamalai (2011). [6]The main objective of this paper is to evaluate the sound, exhaust emission, gas temperature and smoke characteristics of single cylinder. They carried out the experiment five type of vegetable oil viz Nerium (nerium olender), Jetropa (jetropa cusas), Pongamia (pongamia pinnata), Mahua (madhuca indica) and Neem (Azadirchta indica). They conducted different fuel blends i.e. 20%, 40%, 60% up to 80% with standard diesel, maintaining engine speed up to 1800rpm. They took three way flasks in that 1000ml of vegetable oil, 12gms of sodium hydroxide (NaOH) and 200ml of methanol (CH3OH), the vegetable oil in three way flasks and it is stirred properly. The methoxide solution is heated 600 and it is stirred for 1hour continuously and the mixture is poured in the separating beaker after 24hours the glycerine is settled down at the bottom and the pure biodiesel is floating upper portion. After the experiment conducted that kinematic viscosity and density of the vegetable oil is reduced and parallel the calorific value in increased, and also the results obtained for sound, exhaust emission, gas temperature of vegetable oil blends are almost comparable with diesel oil.

B Keshava Rao,P Srinivasa Rao and []G Venkateshwara Rao (2014).[3] According to their work extracting the biodiesel from Lin seed oil (LSO) and neem oil (NO) with the help of Trans etherification process. Initially they optimized the different characteristics of biodiesel and analysed different properties like density, specific gravity, flash point, heating value, kinematic viscosity and carbon %.they used 4stroke, vertical, single cylinder, water cooled engine which is coupled to rope brake drum arrangement to absorb the power produced. When they engine started respective dead weight is applied on the brake drum and provided suitable cooling. Thermal couples where fitted to the arrangement for measuring the temperature. The system includes measuring instrument for fuel consumption consisting of fuel tank, burette, three way cock, stop watch U-tube differential manometer and a governor is provided to maintain the constant speed. They tested initially by allowing the engine for 10minutes on load condition and readings are noted down and they carried out the experiment for different load condition. They conducted blends B10, B20 and pure diesel at constant speed 1500rpm.After conducting the experiment they concluded that L30 has given better performance in the sense of brake thermal efficiency.

Nomenclature:

1. Cylinder bore D : 80 mm
2. Stroke length L : 110 mm
3. Water density R : 1000 kg/m3
4. Calorific value of diesel CV : 43,000 KJ/kg
5. Acceleration due to gravity g : 9.81 m/sec^2
6. Diesel density ρ_f : 0.83 Kg/lit
7. Airdensity ρ_a : 1.2 kg/m^3

Formulae used:

1. Air fuel ratio: A/F

$$A/F = \frac{m_a}{m_f}$$

2. Volumetric efficiency, η_v

$$\eta_v = \frac{V_a}{V_s} \times 100$$

a) Swept volume

$$V_s = \left(\frac{\pi D^2}{4}\right) \times L \times \left(\frac{N}{2}\right) m^3/\min$$

b) Actual volume

$$V_a = \frac{m_a}{\rho_a} \quad m^3/\min$$

3. Heat supplied Q_i in KW

$$Q_i = \frac{(m_f \times CV)}{3600} \quad KW$$

4. Brake power (BP)

$$BP = \frac{2\pi NT}{60000} \text{ in } KW$$

5. Indicated power (IP)

IP = BP + FP in kW

6. Mechanical efficiency η_{mech} in %

$$\eta_{mech} = \frac{BP}{IP} \times 100$$

7. Brake thermal efficiency: η_{bth} in %

$$\eta_{Bth} = \frac{BP}{Q_i} \times 100$$

8. Indicated thermal efficiency: η_{ith} in %

$$\eta_{Ith} = \frac{IP}{Q_i} \times 100$$

9. Specific fuel consumption on BP basis:

$$BSFC = \frac{m_f}{BP} \quad Kg/KWH$$

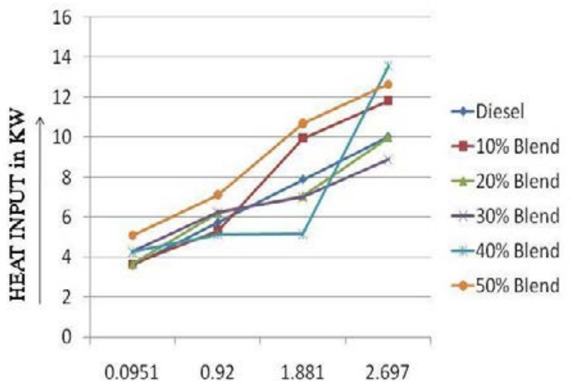
10. Specific fuel consumption on IP basis:

$$ISFC = \frac{m_f}{IP} \quad Kg/KWH$$

Results

Esterification is the process, which brings about a change in the molecular structure of the UTO molecules, thus bringing down the levels of viscosity and unsaturation of UTO. The viscosity of vegetable oils reduces substantially after esterification. The density and viscosity of the UTO formed after esterification were found to be very close to petroleum diesel oil. The flash point of UTO was higher than that of diesel oil. The 20% bio diesel blend also demonstrate comparatively higher flash point than the diesel oil and was in range of safe fuel. The cetane number of diesel oil obtained by this method is 50 and cetane number of UTO was 53. A 20% blending of UTO with diesel oil improved the cetane number of diesel oil, the calorific value of UTO was found to be slightly lower than diesel oil. All these tests for characterization of biodiesel oil demonstrated that almost all the important properties of biodiesel are in very close with the petroleum diesel oil.

Graphs



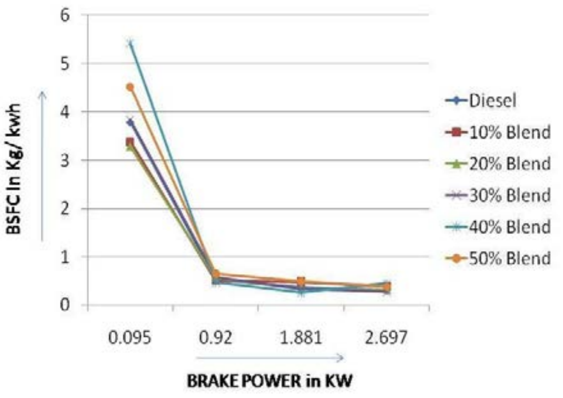


Fig 8.2 : BSFC v/s BP

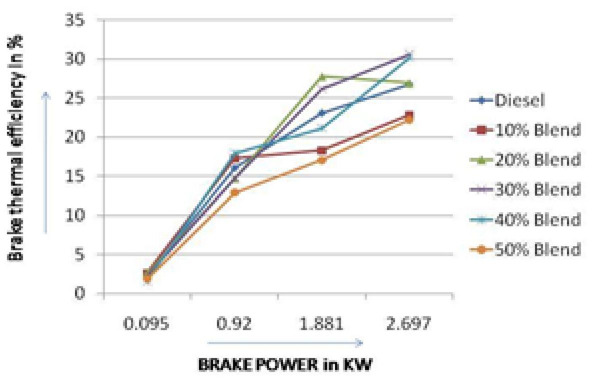


Fig 8.4: Brake thermal efficiency v/s BP

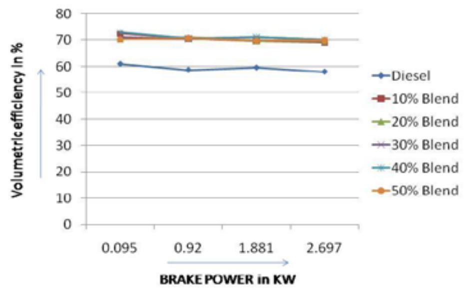


Fig 8.6 : Volumetric efficiency v/s BP

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