IMPACT: International Journal of Research in Engineering & Technology (IMPACT: IJRET)
ISSN(E): 2321-8843; ISSN(P): 2347-4599
Vol. 2, Issue 5, May 2014, 117-124

PERFORMANCE & EMISSION ANALYSIS OF BIODIESEL USING VARIOUS BLENDS (CASTOR OIL+ NEEM OIL BIODIESEL)

DAINGADE AJIT SAMPATRAO, METKARI GANESH SUNIL & P. D. KULKARNI

Department of Mechanical Engineering, ADCET, Ashta, Maharashtra, India

ABSTRACT

Major need of energy generation is fulfilled by fossil fuels which are used for worldwide transportation. In recent year India need sources of an alternative fuel as a biodiesel and its major potential can be generated in India almost 10-30% of diesel can be replaced with blending of biodiesel. This biodiesel can reduce major Burdon on the import as well as reduction in pollution level. For India maximum wasteland can be utilized for plantation of sources as a seed base like caster seed, Neem trees and biodiesel can be produced and make it available as alternative fuel.

The focus of this paper is to conduct study of biodiesel properties (castor oil + Neem oil) and its performance with various blends. For diesel engine the performance and emission is almost increasing by 2-5 % and emission level are quiet lower than present fuel. This will be the major sources in the generation of energy for the replacement of diesel.

So that we are interested in biodiesel for a variety of reasons, but most importantly, it's potential to reduce total lifetime carbon dioxide emissions, as well as reduction in other pollutants.

KEYWORDS: Diesel Engine Performances, Biodiesel Blends, Biodiesel Castor Oil/Neem Oils, Performance Analysis

INTRODUCTION

Biodiesel is the name of a clean burning alternative fuel produced from domestic, renewable resources. Biodiesel contains no petroleum, but it can be blended at any level with petroleum diesel to create a biodiesel blend. It can be used in compression ignition (diesel) engines with no major modifications. Biodiesel is simple to use, biodegradable, nontoxic, and essentially free of sulphur and aromatics. In this study, "Castor oil and Neem oil" were used as they are not part of food menu.

Now a day's increases in price and non-renewability of petroleum products, which are obtained from finite sources, alternative resources of energy have started gaining attention. The alternative sources of energy especially for automobile fuel that are gaining popularity today are biofuel. [5]

The biodiesel is a methyl or ethyl ester of mainly vegetable oils. Biodiesel readily with diesel fuels in any %. The blend level is the function of economics the desired emission profile, material compatibility and combustion characteristics. Methyl or ethyl ester can be produced from vegetable & tree oils, animal's fats are used oils & fats. For vegetable oils to be used as fuels as fuels for conventional diesel engine the oil must be further processed primarily because of its high viscosity. [4] Transesterification of vegetable oil or animal fats, using alcohol in the presence of catalyst, is the more popular process. However, for every 100 units of glycerin by-product, Glycerin is used in such product as hand creams, toothpaste and lubricants.

Biodiesel fuel derived from petroleum crude oil, Vegetable oil as a biomass-based energy can be considered as possible alternative fuels. Neat vegetable oil is too viscous, has poor volatility. So that it is blended with diesel.

Biodiesel has similar characteristics to petroleum diesel fuel (petro-diesel), and therefore requires no modification to existing fuel storage, delivery and engine systems. It is non-toxic, biodegradable and less flammable than petroleum diesel. The benefits also include reduced particulate in Emissions, and longer engine life, due to increased lubricity.

POTENTIAL RESOURCE IN INDIA

Neem Oil in India

The Neem trees occurring throughout India represent a large, although very scattered, resource. Already, Neem oil is a common commodity traded freely in the markets, but much more could be produced. It has been estimated that India's Neem trees bear about 3.5 million tones of kernels each year and that, in principle, about 700 000 tons of oil might be recoverable. The annual production in the late 1980s was only around 150 000 tons. (About 34 tones of Neem oil were exported in 1990 valued at 300000 rupees, worth about 21000 US dollars.)[1][3]

Castor Oil in India

The castor plant grows in the wild in large quantities in most tropical and sub-tropical countries. It is available at low cost and the plant is known to tolerate varying weather conditions. Specifically, castor plant requires a temperature of between 20 and 26 _C with low humidity throughout the growing season in order to obtain maximum yields.

Blending

Biodiesel can be used as B100 (neat) or in a blend with fossil diesel. Blends only refer to FAME and are designated as ‘B’ followed by a number, E.g.- B5- In this blend 95% is diesel and remaining 5% consists of 2.5% castor biodiesel & 2.5% Neem biodiesel. Blending of HDRD has no legal restrictions due to its chemical resemblance to fossil diesel. [12]

Even in very low concentrations, FAME improves fuel lubricity and raises the cetane number. Blending of biodiesel with fossil diesel in small proportions (B2, B5) is already apart of renewable energy policy in some countries. [10]

In Europe a biodiesel share of up to 5% in fossil diesel does not have to be labeled, according to norm EN590. In some countries, like France, B5 is already an obligatory blend. This Test have been conducted in a single-cylinder, four-stroke, naturally aspirated, direct injection Diesel engine.

BIODIESEL PROPERTIES TEST

Filter: Feedstock Oil (Not Required for Virgin Oils)

- Gather castor oils from seed sources around town.
- Filter it through cotton fabric & bucket.
- Heat oil to 100 Celsius and kept it at that temperature until it developed a glassy surface to evaporate any water particles.
- Filter hot oil through a paper coffee filter.

Titration: Determine the Amount of Catalyst

- Measure 1 gram of NaOH and 1 liter of de-ionized water
- Fully dissolve NaOH into liter of de-ionized water
- Measure 10 ml of isopropyl alcohol and mix with 1 ml of waste vegetable oil
- Use syringe to drop 1 ml of NaOH/water mixture into oil/alcohol mixture and stir the mixture
- Check pH using litmus paper
- Continue until mixture reaches a pH between 8-9, to determine X amount
- (X+3.5 = grams of NaOH needed per liter of feedstock oil) varying levels of NaOH required per batch

Transesterification: Biodiesel Making

- Measure 1000 ml of feedstock oil; 200 ml of methanol; X grams NaOH
- Fully dissolve catalyst into alcohol
- Pour in 1000 ml of feedstock oil
- Blend for 20 minutes
- Allow glycerin to settle for over 8 hours 6. Biodiesel should separate and leave about 15% glycerin on the bottom.

Biodiesel Quality Testing Process

Specific Gravity Test

- Poured biodiesel into graduated cylinder, so that hydrometer was able to float (quantity is not important, just enough to register a reading on the hydrometer)
- Placed hydrometer into biodiesel, verified it was afloat
- Then Recorded the specific gravity measurement from the hydrometer at the surface level of the biodiesel
- Repeated for our 5 completed batches

Gel Point Test

- Measured 10 mL of biodiesel and put into a 20 mL beaker
- Placed all batches into a freezer
- Returned after five minutes and removed one batch, verifying that it had gelled
- Placed thermometer in batch and let it warm into a liquid
- Observed temperature at which biodiesel gel melted (Melting is indicated by biodiesel changing state from solid to liquid)
- Repeated and recorded for each biodiesel batch

pH Test

- Used pH paper to determine the approximate pH of each batch and the oil.
- The paper was immersed in the batch and determined through consensus the approximate value based on the chart provided with the paper.

EXPERIMENTAL SET-UP AND PROCEDURE

Performance Testing of C.I. Engine with Biodiesel Blends

Experiments conducted in a single-cylinder, four-stroke, naturally aspirated, direct injection Diesel engine.

Table 1: Specification of Engine

Particulars	Specifications
Make & Model	Field marshal
Power	8HP/5.9 kW
Type of Engine	Direct Injection & 4-Stroke
Compression Ratio	16:01
Bore & Stroke	114.30 mm & 139.7 mm
Type of Loading	Rope Brake Dynamometer
Lubrication	SAE 36/W
Fuel Tank Capacity	8.5 LTR
Method of Cooling	Water Cooled

Procedure

The castor oil and Neem oil are mixed together to prepare a mixture. The proportion of mixing the two oils are 50% and 50%. Then 10% of the mixture is taken and 90% of diesel is taken to prepare the blend. This is the first fuel to be tested. Then 20% of the mixture is taken and 80%diesel is mixed to prepare the second blending. likewise 30% blend is taken and tested. The blend oil is put in the fuel tank, the engine is started first we have to take the reading for 0 load and time taken to consume 20ml of oil is noted down. Afterwards load is increased gradually as 1, 25Kg and 32Kg.

PERFORMANCE ANALYSIS

Break Thermal Efficiency vs. Load for B30 Blends

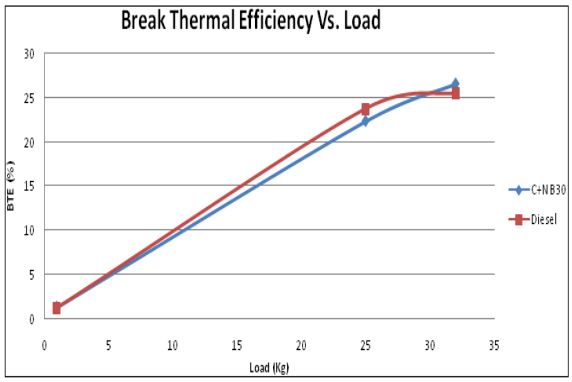

Figure 1: Break Thermal Efficiency vs. Load for B30 Blends

- Break thermal efficiency ofB30 blend at part load is quite lower than that of diesel.
- Break thermal efficiency of B30 blend is higher than diesel at full load as shown in Figure 1.

Break Thermal Efficiency vs. Load for B100 Blends

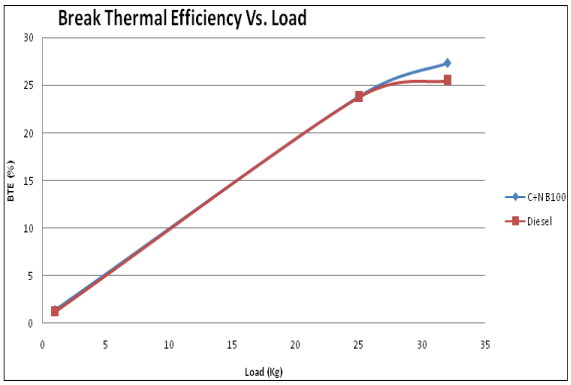

Figure 2: Break Thermal Efficiency vs. Load for B100 Blends

- Break thermal efficiency of B100 biodiesel at part load is nearly equal to that of diesel.
- Break thermal efficiency of B100 biodiesel is higher than diesel at full load as shown in Figure 2.

EMISSION ANALYSIS

CO Analysis

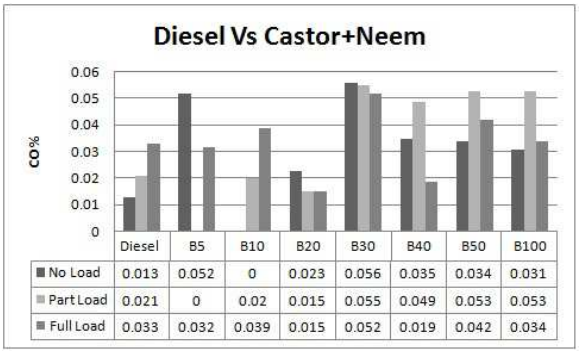

Figure 3: CO Analysis

- CO emission of B20 and B40 blends is less as compared to the diesel at full load.
- CO emission of B100 biodiesel is quite equal to that of diesel at full load as shown in Figure 3.

HC Analysis

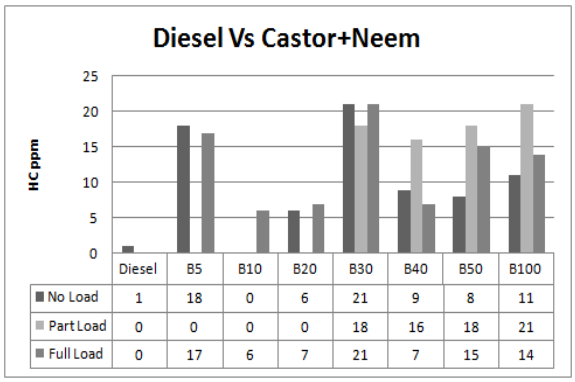

Figure 4: HC Analysis

- HC emission of B10 blend is comparatively less than that of diesel for no load condition.
- HC emission slightly increases as the blend percentage increases as shown in Figure 4.

ADVANTAGES IN I.C. ENGINE

- Vegetable oil is produced domestically which helps to reduce costly petroleum imports;
- Development of the bio-diesel industry would strengthen the domestic, and particularly the rural, agricultural economy of agricultural based countries like India; (iii)It is biodegradable and non-toxic;
- It is a renewable fuel that can be made from agricultural crops and or other feed stocks that are considered as waste;
- It has 80% heating value compared to that of diesel;
- It contains low aromatics;
- It has a reasonable cetane number and hence possesses less knocking tendency.
- Low sulphur content and hence environment friendly.
- Enhanced lubricity, thereby no major modification is required in the engine.
- Personal safety is improved (flash point is 100 °C higher than that of diesel).
- It is usable within the existing petroleum diesel infrastructure (with minor or no modification in the engine).[8][9]

SCOPE FOR IMPROVEMENT

- The price of vegetable oil is dependent on the feed stock price;
- Feed stock homogeneity, consistency and reliability are questionable;
- Homogeneity of the product depends on the supplier, feed stocks and production methods;

CONCLUSIONS

- As the above graphs shows that 30% blending gives us optimum values of performance and emission characteristics
- Blends have lower value of Co, Unburnt hydrocarbon than diesel. This is due to better combustion of fuel inside the cylinder than diesel.
- The Brake thermal efficiency of blends (B30) is lower and higher part load & full load respectively than diesel.
- Emission of biodiesel is comparatively lower than diesel. Also CO is least.

REFERENCES

1. The Neem Tree, available at: http://www.neem-tree.com. The Economics of Neem Production

2. Patel, P., Suthar, B., 1988. Interpenetrating polymer network from castor oil-based polyurethanes. Polym. Eng. Sci. 28, 901–905.
3. Biodiesel standard EN 14214. European Standard Organization; 2003.
4. Kumar Tiwari A, Kumar A, Raheman H. Biodiesel production from jatropha oil (Jatrophacurcas) with high free fatty acids: an optimized process. Biomass and Bioenergy 2007; 31: 569–75.
5. MNRE (Ministry of New and Renewable Energy). Annual report 2009–10 chapter 3: renewable energy for rural applications; 2010.
6. Biodiesel standards. Biofuel Systems. [Online] [Cited: 1 11, 2009.]
7. National Renewable Energy Laboratory. Biodiesel handling and use guide. Fourth edition. 2008. pp. 8-29.
8. Effect of biodiesel on diesel engine performance, lubricants and emissions -a review rajendra v. pethkar, sachin urunkar & prasadd kulkarni International Journal of Automobile Engineering Research and Development (IJAuERD) ISSN 2277-4785Vol. 3, Issue 2, Jun 2013, 43-50© TJPRC Pvt. Ltd.
9. Aydin H, Bayindir H. Performance and emission analysis of cotton seed oil methyl ester in a diesel engine. Renew Energy 2010; 35:588–92.
10. Utlu Z, Koc¸ ak MS. The effect of biodiesel fuel obtained from waste frying oil on direct injection diesel engine performance and exhaust emissions. Renew Energy 2008; 33:1936–41.
11. Biodiesel processing and production Jon Van Gerpen* University of Idaho, Moscow, ID 83844, USA
12. Effect of Biodiesel Blends on Diesel Particulate Filter Performance Aaron Williams, Robert L. McCormick. Robert Hayes, John Ireland National Renewable Energy Laboratory 2006-01-3280