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EVALUATION OF THERMAL PROPERTIES OF RAPESEED - BIOFUEL

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ABSTRACT

Rapeseed which is primarily cultivated for the rich oil content is the third largest producer of vegetable oil in the world. It is rich in protein and therefore also finds its applications as a suitable animal feed. An exhaustive study on Rapeseed derived Biofuel reveals its various properties which are found to be in close proximity to the properties of petroleum based fuels, hence indicating it as a suitable candidate for substituting the petroleum based fuels at different blend ratios. The study also highlights the various advantages of Rapeseed Biofuel over the conventional petroleum based fuels.

Keywords - Rapeseed Biofuels, Properties, Transesterification, Vegetable Oils, Biomass, Feedstock

I. INTRODUCTION

Rapeseed is grown mainly for animal feed, oil extraction through their oil rich seeds and for biodiesel production. It is one of the largest source of vegetable oil in the world and a leading source of protein rich meal. It produces much more oil for the same land occupancy, and therefore is a preferred oil stock for the production of biodiesel. Rapeseed derived Biodiesel can be used straight in diesel engines with few modifications. It can also be blended in various proportions with Petroleum derived diesel fuels. However, the production of rapeseed biodiesel requires excessive steps involving cultivating, crushing and refining which result in an overall increase in the cost of production. Also extra care must be taken to during their long term storage to avoid the problems of oxidation stability which renders the fuel unfit for usage. This additional set up requirements increases the cost per liter fuel produced. Therefore, on monetarily basis rapeseed derived biodiesel does not seem competent enough to replace the existing exponential demand of petroleum derived diesel fuels.

The study carried out reflects the comparison between the properties of petrodiesel and rapeseed biodiesel. A similarity in properties enables its usage on a large scale.

II. METHODOLOGY

This section discusses the production procedure for the rapeseed derived biodiesel.

Oil Extraction

1) Clean the rapeseeds by removing any plant material and dirt still attached to the seeds.
2) Place the rapeseeds in a flaking mill and turn on the mill. The mill has cylindrical rolls that turn in opposite directions to crush or flatten the seeds.
3) Heat the seeds. Pour the flaked seeds into a multistage cooker. Heat the seeds to 68 to 122 degrees Fahrenheit for preheating. Within five minutes steam heat to 248 degrees Fahrenheit.
4) Place the seeds into the oil extractor immediately after heating. The heat will make the oil separate easily from the seeds. Turn on the extractor. The machine crushes the oils out of the seed flakes until there is nothing left coming out of the seeds.

Transesterification

In organic chemistry, transesterification is the process of exchanging the alkoxy group of an ester compound by another alcohol. These reactions are often catalyzed by the addition of an acid or base.

The transesterification of vegetable oils, animal fats or waste cooking oils is the process behind conventional biodiesel. In the transesterification process a glyceride reacts with an alcohol (typically methanol or ethanol) in the presence of a catalyst forming fatty acid alkyl esters and an alcohol.

Blending and Testing

The transesterified oil was then used to prepare different blends with diesel in the ratios of 1:9 and 1:4. Hence obtaining the biofuel of required blends.

Figure 1. Different blends of rapeseed biofuel with traditional diesel

The above figure shows the blending of rapeseed derived bodiesel fuel in various proportions of petrodiesel. The mixture was blended for 15 minutes prior to testing using a magnetic stirrer set to 600 rpm. This was done to ensure completing mixing of both the fuels, and thus obtain a homogeneous mixture of the two.

III. STUDIES AND FINDINGS

Properties of diesel with rapeseed biodiesel:

The properties of the biodiesel give an indication of whether it would be suitable or not for the performance, life and emission of the engine. So, the main properties of biodiesel such as the pH number, calorific value, viscosity, density, flash point and fire point were studied using standard methods. Three replications were done for all the tests, and their means were calculated.

Combustion Properties

Combustion Properties of different blends

BLENDS	FLASH POINT (K)	FIRE POINT (K)	CALORIFIC VALUE (MJ/kg)
DIESEL	343	353	45.5
B10	326	333	45.418
B20	323	330	45.380

From the above tabular column diesel has the highest combustion properties as compared to B10 and B20, but the values of B10 and B20 are not significantly low.

Physical Properties of different blends

BLENDS	VISCOSITY (cm^2/sec)	DENSITY (Kg/cm^3)
DIESEL	2.3	815
B10	2.89	842.7
B20	2.92	859.122

It is evident from the table that diesel has lower viscosity and density compared to the biofuel blends.

Chemical Properties

BLENDS	pH NUMBER
DIESEL	5.5-8
B10	5.3-8.7
B20	5.2-8.5

Chemical Properties of different blends

It is visible B20 is acidic compared to B10 and diesel.

IV. CONCLUSION

It was observed that with increase in blend percentage of rapeseed oil with diesel, the calorific value of the mixture does not vary adversely and the flash and fire point of the mixture reduces significantly, hence facilitating the ignition of the fuel to take place at lower temperatures. Further studies were conducted on physical properties, the

parameters which were considered were Viscosity and Density. It was observed that viscosity and density increase with increase in blend quantity. We also note that an increase in viscosity produces a detrimental effect on the performance of the engine however an increase in density of the fuel will further reduce the volume occupied by the fuel thus enabling us to optimize the storage capacity of the fuel tank.

With the depletion of fossil fuels, it is important that we develop alternative fuels and technologies that will enable us to reduce the carbon footprints and move towards the greener future. This project aims at contributing to this cause through the blending of organic oil with diesel to produce a petroleum hybrid. In this study we worked with different blends of rapeseed based biodiesel and the results can be used to increase the efficiency of the fuel and reduce the emission characteristics. Using this biodiesel engine performance can be obtained through various tests. Therefore, to summarize it is observed that biodiesel fuel tend to improve the overall properties of fuel.

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