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PROPERTY EVALUATION OF VARIOUS BIODIESEL-H¬2O2 BLENDS

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ABSTRACT

An attempt has been made to evaluate the properties of biodiesel-Hydrogen Peroxide blends in various proportions. Jatropha, Surahonne, Pongomia and Neem are the biodiesel oils whose blends with diesel and H2O2 are evaluated. Density, Viscosity, Flash and fire point and calorific value are the values evaluated. These properties play a vital role in deciding the atomization of fuel, flow through the manifolds, combustion, energy release etc of the fuel blends.

***Keywords*:** *Biodiesel, Hydrogen Peroxide, properties*

INTRODUCTION

With the rapid depletion of mineral diesel, there is a need of finding out an alternative fuel for the mineral diesel which is a replacement to diesel in all regards. Biodiesel is the alternative towards which a lot of research is going on, the major disadvantage of blending biodiesel is that the properties of diesel is adversely affected like calorific value, increase in NO_x emissions, etc. In order to overcome this is an attempt has been made to introduce additives which can overcome these adverse effects; here Hydrogen Peroxide is used as an additive. The major reason being that Hydrogen has the maximum calorific value, high latent heat of vaporization etc., so an attempt has been made to blend diesel-biodiesel-H_2O_2 on volume basis and Flash point, fire point, density, viscosity and calorific value of these blends are evaluated.

HYDROGEN PEROXIDE AND BIODIESEL

1. Hydrogen Peroxide

Hydrogen Peroxide is a colorless fluid, pure hydrogen peroxide is highly inflammable, so aqueous solution of Hydrogen Peroxide is used. It is used as liquid propellant in jet engines. Main idea to use this fluid is, its Boiling Point (150.2^oC[2]), once hydrogen peroxide reaches its boiling point, it starts decomposing in to water molecule i.e. H_2O(steam) and O_2.

$$2H_2O_2 \rightarrow 2H_2O + O_2$$

It is found that as the concentration of H_2O_2 is increased the brake thermal efficiency of the engine has increased. This is due to the presence of H_2O_2 in the fuel, which starts decomposing and releasing a large amount of oxygen. This oxygen helps in assisting complete combustion of the fuel.

2. Jatropha Curcas

Jatropha is a non-edible, oil seed producing plant. It grows in infertile and semiarid land and each jatropha seeds contain 28% to 35% oil[1], 3kg of seeds gives one litre jatropha oil. Each tree has a yield of 1 to 25 kg/year[1].

3. Calophyllum Inophyllum

Calophylum inophylum Linn is botanical name of surahonne. It is an Indian Laurel tree with awesome potential for biodiesel. Calophylum inophylum Linn is a medium-sized to expansive evergreen tree that midpoints 8.5–20.5 m in stature with a wide spreading crown of unpredictable branches. Calophylum inophylum is a helpful tree for seaside shelterbelts, windbreaks, and strand reforestation.

4. Pongamia Pinnata

Commonly known as Karanga or Honge. It grows about 16-22 meters in height with a large canopy which spreads equally wide. Pongamia seeds have 27% to 39% oil, each tree has an average yield of 20 to 25 kgs/year[1].

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5. Neem

Neem is a fast growing tree that can reach a height of 15–20 metres (49–66 ft).It is evergreen, but in severe drought it may shed most or nearly all of its leaves. The branches are wide and spreading. Neem seeds have 45% oil, each tree has a yield of 15 kg/year[1].

BLEND PREPARATION

The blends are prepared on volume basis with 60% of diesel and the remaining 40% proportion is varied as follows:

38%Biodiesel+ 2%H_2O_2 is represented as *38H2

Where * represents the type of biodiesel oil used-

J stands for Jatropha

S stands for Surahonne

P stands for Pongomia

N stands for Neem

PROPERTIES OF BLENDS

Properties Of 2% Additive Blends

Property / Blends	Density (Kg/m^3)	Viscosity (CST)	Flash Point (^oC)	Fire Point (^oC)	Calorific Value (KJ/Kg)
J38H2	855	3.321	84	106	40746
S38H2	860	3.72	84	98	37061
P38H2	840	3.321	83	88	39268
N38H2	840	3.321	85	88	44723
Diesel	835	3.2736	56	58	44800

PROPERTIES OF BIODIESEL

Property / Blends	Density (Kg/m^3)	Viscosity (CST)	Flash Point (^oC)	Fire Point (^oC)	Calorific Value (KJ/Kg)
J100	879	4.84	130	137	39600
S100	920	6	165	175	34200
P100	890	5.82	132	140	36120
N100	880	6	143	163	38150
Diesel	835	3.2736	56	58	44800

PROPERTIES OF BIODIESEL BLENDS

Property / Blends	Density (Kg/m^3)	Viscosity (CST)	Flash Point (^oC)	Fire Point (^oC)	Calorific Value (KJ/Kg)
J40	850	3.024	90	105	42659
S40	855	3.696	89	110	38653
P40	860	3.024	82	90	42483
N40	860	3.532	94	112	40629
Diesel	835	3.2736	56	58	44800

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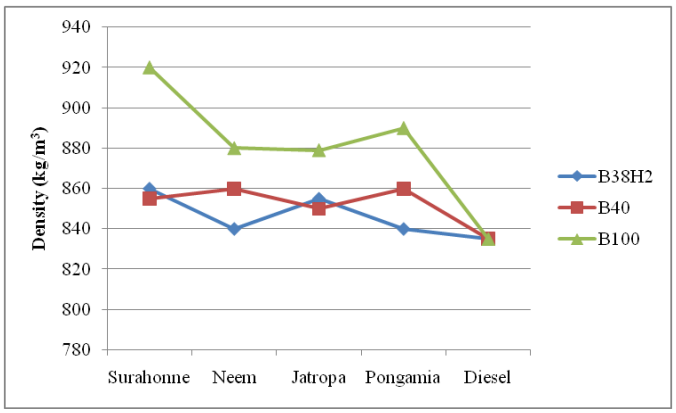

Fig 1. Variation of Density

Density is defined as mass per unit volume. It enhances the energy density of the fuel drops. Increased Density will lead to larger fuel droplets. It is seen from figure 1 that the densities of biodiesel-H_2O_2 are higher than Diesel, this is because the density of Hydrogen peroxide is more and when it is blended with biodiesel mixture it increases its density but it is at a range very near to the density of mineral diesel.

The density of diesel fuel generally varies between 810 and 890 kg/m^3 and the densities of prepared fuel blend are also varied between these values. Hydrogen peroxide having a density of 1130 kg/m^3 and it is higher value than the pure diesel. The values of the density can be observed in figure1 that as the addition of H_2O_2 density of fuel blends will come to a range approximate to that of mineral diesel oil.

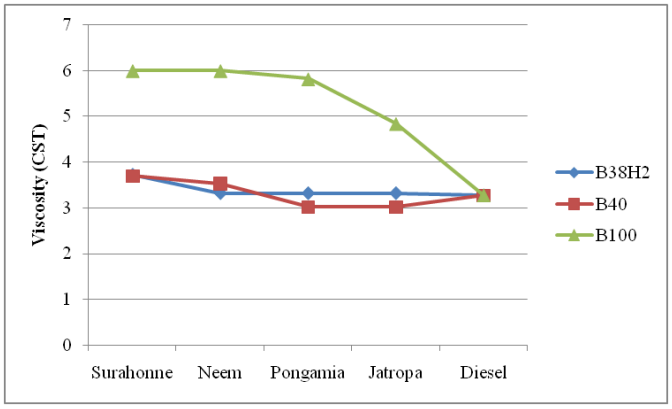

Fig 2. Variation of Viscosity.

Viscosity is defined as resistance offered to the fluid flow. It enhances the adhesive, cohesive and frictional characteristics of the fuel. It is seen from figure 2 that the viscosities of biodiesel-H_2O_2 are varying with the type of biofuel used, but it stays well within the range of viscosity of mineral diesel.

The Viscosity of diesel fuel generally varies between 1.8 to 4.9 CST and the viscosities of prepared fuel blend are also varied between these values. Hydrogen peroxide having a viscosity of 1.245 CST and it is a lower value than the pure diesel. The values of the viscosity can be observed in figure 2 that as the additive content increases correspondingly viscosity of fuel blends also decreased, but the viscosities of the prepared blends depend too much upon the type of biodiesel used, Jatropha and Pongamia are less viscus where as Surahonne and Neem are more viscus when compared to mineral diesel oil.

Lower viscosities are preferred because high viscosities may contribute to the formation of carbon deposits in the engines, incomplete fuel combustion, larger fuel droplets and results in reducing the life of an engine

Viscosity is a standout amongst the most imperative fuel properties. The viscosity has consequences for the atomization quality, the measure of fuel drop, the plane infiltration and it affects the nature of ignition

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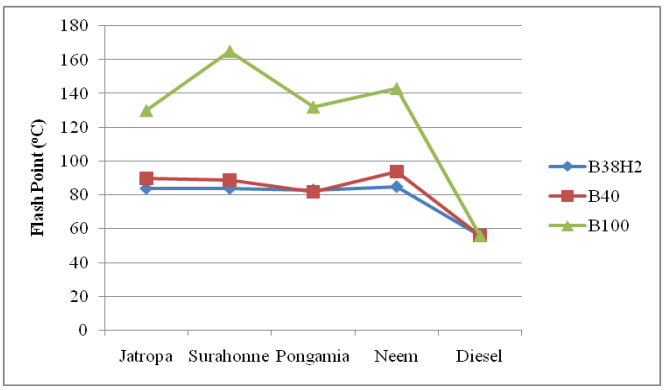

Fig 3. Variation of Flash Point.

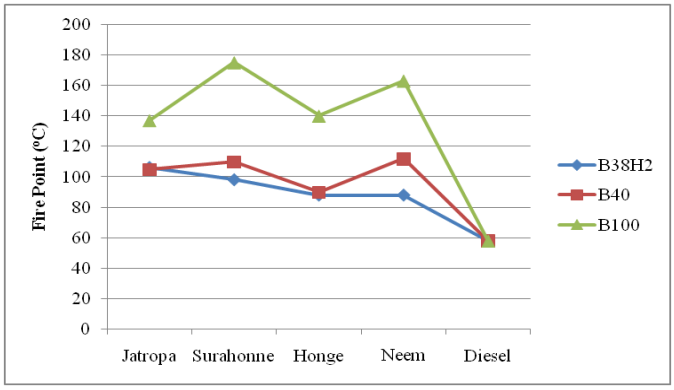

Fig 4. Variation of Fire Point.

Flash Point is the least temperature at which the fuel gives off sufficient vapours when a trial flame is brought over the fuel surface without catching fine.

Fire point is the temperature at which it will start to burn continuously when flame is held on plane of surface of the fuel blends.The figures 3 and 4 shows the flash and fire points of the blended fuels. It shows that adding of H_2O_2 to the fuel has very less influence on the flash & fire point of the fuel. Flash and fire points are very important from the point of view of storage, transportation and ignition of the fuel. Since there is a very little effect of the additive, it can be used as a safe fuel. It also helps to determine the operating and storage range of the fuel.

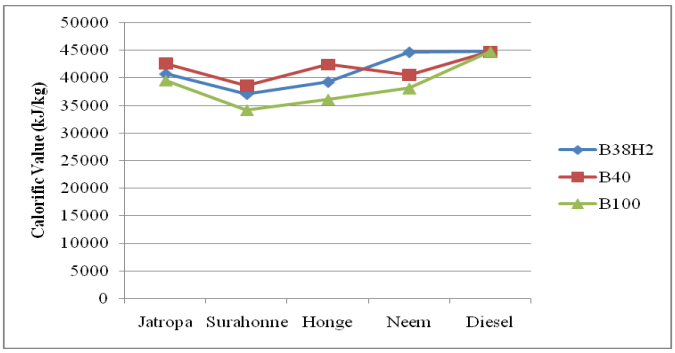

Fig 5. Variation of Calorific Value.

Calorific value is the amount of heat released during complete combustion of unit mass of fuel. It is the measure of energy content of the fuel.

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It is evident from the figure 5 that the calorific value is slightly reduced, because Hydrogen Peroxide does not contain any Calorific value as such it means to say that it does not have any heat content as such, therefore it reduces the Calorific value which is a measure per unit mass.

But at elevated temperatures Hydrogen Peroxide decomposes into water and oxygen. This oxygen helps as assisting complete combustion of the fuel[4]. Hence hydrogen peroxide is used as additive.

CONCLUSIONS

Biodiesel emerges to to be a clear substitute to diesel with repsect to combustion properties. But, when it comes to physical properties that are refere to here there is a slight deviation of the property values from that of mineral diesel, these properties are also equally important when it comes to fuel handling, flow, storage and ignition. This can be overcome by adding additives like Hydrogen Peroxide which will bring the property values very close to that of diesel, thereby helping to improve the overall performance of the engine.

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