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Correlation between Biodiesel Percentage and Flash Point of Diesel & Biodiesel Blends

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Abstract—*Biodiesel is a biomass-based renewable fuel. It can be used either fully or in blends of diesel/biodiesel as an alternative to standard diesel in compression ignition engine. In the current study, biodiesel or methyl ester of cottonseed oil (Gossypiumhirsutum) has been prepared through a base-catalyzed transesterification process. The physical & chemical properties of the biodiesel have been determined. The biodiesel is mixed with diesel to produce blends. The objective of the study is to determine how the percentage of biodiesel in blends impacts the flashpoint of diesel/biodiesel blends. A polynomial of the second order has been developed to estimate the flashpoint based on biodiesel percentage in the blends.*

Introduction

Petroleum resources in the world are dwindling day by day. Still, the transport sector and the power sector mostly rely on petroleum fuels. India imports 70% of consumed petroleum fuels from countries such as Saudi Arabia, Iran, Iraq, and Venezuela. Recently, the US government has put oil embargo on Iran for export. This has negatively affected the economy as India has to import petroleum oils from far distant countries like Venezuela and the USA. In addition, the widespread war-like situation in most of the Middle Eastern states has made the issue far more serious. Therefore, the time has come for development of a new and renewable source of energy for our transport sector. Biodiesel is increasingly being used as alternative fuel for CI engines rather than diesel [1, 2]. Biodiesel is defined as methyl ester or ethyl esters from vegetable oils or animal fats. Biodiesel has become an effective way to address the issue of petroleum scarcity and its effect on the environment [3, 4]. The recent studies have pointed out that the on utilization of biodiesel in CI engines; the engines emit less carbon dioxide, carbon monoxide and no sulfur dioxide at all [5,6]. Having its biomass-based origin, biodiesel is free from sulfur. Sulfur dioxides are considered very harmful [7]. Biodiesel can cut down dependence on oil import and can promote the economy. Developing biodiesel as a fuel, it can put significant impetus in energy crop cultivation, processing, production, and distribution. This will ultimately contribute to the economy in various capacities. The aim of current research is to synthesize biodiesel or methyl ester from cottonseed oil. Then, biodiesel blends have been prepared from B10 to B100 with standard diesel in volume by volume basis. The present work tries to correlate the effect of biodiesel blending percentage on flashpoint of the biodiesel.

Materials and Method

Cottonseed oil (*Gossypiumhirsutum)* is considered for biodiesel production by a transesterification reaction. The transesterification process is simple. In this process the seed oil is reacted with alcohol either methanol or ethanol in presence of base catalyst mostly potassium hydroxide (KOH). In the present study, methanol is used for the reaction and it is 20% of the seed oil or excess. The amount of potassium hydroxide is determined by titration. One liter of cottonseed oil requires 8 gm of potassium hydroxide (KOH). The potassium hydroxide pallets are dissolved in the methanol in a flask. This potassium methoxide solution is added to seed oil at 60 ℃ which is being previously heated to 100℃ to remove moisture. The mixture is transferred to a chemical reaction reactor. The temperature in the reactor is maintained at 60 ℃ and stirred at 300 rpm for one and half hour. After completion, the mixture is poured in a separating flask and mixture is rested for 12 hours or more. After 12 hours, two distinct layers of biodiesel and glycerin can be seen in the flask. Biodiesel is light yellow and it floats over glycerin having lighter in density while glycerin is dark brown in color and separated out by gravity separation method. The biodiesel

is washed with warm water. This removes the impurities in the form of catalyst and dissolved alcohol. The physical and chemical properties of cottonseed oil biodiesel have been determined in accordance with ASTM standards. The biodiesel is now blended with diesel in volume by volume basis from B10 to B100. The flashpoints of the biodiesel blends have been determined according to ASTM standards.

Table 1: Properties of biodiesel

Property	Methyl ester of Cottonseed oil (Gossypiumhirsutum)	Diesel
Density (kg/cm3)	855	833
Kinematic viscosity(cSt)	4	2.6
Calorific Value (MJ/kg)	34.8	53.54
Cetane Number	48	46
Pour point (℃)	-15	-16
Cloud Point (℃)	-	-4
Fire point (℃)	-	64
Flashpoint (℃)	142	66

Results and Discussions

The current study involves biodiesel production from cottonseed oil (*Gossypiumhirsutum*) in laboratory scale. The biodiesel is blended with diesel in volume by volume basis from B10 to B100. The flashpoints of the blends have been determined according to ASTM D675 norms. Figure 1 shows the flashpoints of various blends and pure biodiesel. A second-order polynomial has been developed to estimate the flashpoint of biodiesel at various biodiesel percentages. The polynomial is $FP=0.012x^2-0.374x+59.78$ ($R^2=0.989$) where 'x' is the blending percentage. Therefore, the flashpoint can be estimated easily based on its blending percentages.

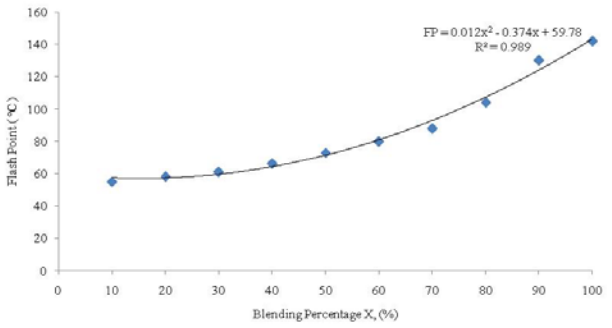

Figure 1: Flashpoints at various blending percentages.

Conclusions

The cottonseed biodiesel (*Gossypiumhirsutum)*is successfully prepared in the present study. The physical and chemical properties have also been derived for the biodiesel. The flashpoints of cottonseed oil biodiesel blends have been prepared from B10-B100. The correlation between flash point and blending percentage has been developed. The correlation developed is observed to be second-order polynomial. This will help estimation of flashpoint of biodiesel blends mathematically on blending percentage basis.

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References

[1] Faham M., "*Green fuel as an alternative fuel for diesel engine: A review*", Renewable & Sustainable Reviews, 2017, pp. 694-709

[2] Yeom J.K., "*The study of emission characteristics of biodiesel fuel for diesel engines*", Journal of Korea Society for Power System Engineering, 2015, pp. 234-50.

[3] Keven A., "*Investigation of alternative fuel for diesel engine*", Acta Physica Polonica Series A, 2018, pp. 280-282.

[4] Scholl K.W., Sorenson S.C., "*Combustion of soybean oil methyl ester in a direct injection diesel engine*", SAE, 2008, pp. 930934.

[5] Kalligeros S., "*An investigation of using biodiesel /marine diesel blends on the performance of a stationary diesel engine*", Biomass and Bio-energy, 2003, pp. 141-9.

[6] Dorado M.P., "*Exhaust emissions from a diesel engine fueled with transesterified waste olive oil*", Fuel, 2003, pp. 1311-15.

[7] Raheman H., "*Diesel engine emissions and performance from blends of karanja methyl ester and diesel*", Biomass and Bio-energy, 2004, pp.393-7.