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Effect of Marine Diesel and Biodiesel Blend on basic Fuel Properties: A Novel Study for Marine Diesel Engines

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ABSTRACT

Biodiesel has received increased attention due to higher cetane number, flash point, lesser exhaust emission compared to diesel fuel. Important correlation of density, viscosity and flash point with diesel fuel for spectrum blends are still lacking. Therefore, in this study, waste oil biodiesel (WOB) was procured and blended with diesel fuel (B0) at volume ratios of 25%, 50% and 75%, which are referred to as B25, B50 and B75. The important fuel properties of the biodiesel-diesel fuel blends were also analyzed and correlations were established for the WOB and B0 blends. The result obtained show that density and viscosity with flash point can be modelled with the fourth degree and second degrees equations respectively and can be useful for industrial applications of diesel and biodiesel blends.

Keywords-- Fuel, Diesel Engine, Biodiesel

I. INTRODUCTION

Biodiesel refers to a vegetable oil - or animal fat-based diesel fuel consisting of long-chain alkyl esters. And the alternative fuel is typically made by chemically reacting lipids (e.g., vegetable oil, soybean oil, animal fat (tallow)) with an alcohol in the presence of a catalyst and glycerol producing fatty acid esters and glycerol. Biodiesel is meant to be used in standard diesel engines and is thus distinct from the vegetable and compares favourably with diesel. Biodiesel can be used alone, or blended with petro diesel in any proportions (Samuel et al: 2016).

Marine diesel oil (MDO) is a heavy gas oil mostly adopted for marine diesel engines (www.etc-cte.ec. gc, 2015). The density of the MDO is higher than that of diesel.

The researchers are being motivated to search for alternate fuel such as biodiesel due to diminishing nature of fossil fuel and unfriendliness nature of the fusil fuel(Khan et al., 2017). Pure biodiesel has been indicated to impart the engine's warranty of diesel engines and biodiesel blends have been recommended by researchers (Mostafa and El-Gendy, 2017). The ever increasing energy demands in the power generation and transport sectors together with the limited availability of fossil fuels and the negative environmental effects resulting from their use have attracted researchers towards finding alternative fuels to progressively substitute conventional ones. Among the alternative fuels, biodiesel has received increasing attention due to their attractive characteristics of being renewable in nature and decreasing effect on HC and CO emissions. On the contrary, major problems associated with the use of biodiesel are lower engine. Exhaustive reviews conducted shows that most work have been reported in biodiesel and diesel blends. However, to the author's best knowledge, the impact of biodiesel and marine diesel fuel is absent in the literature. In order to add to the body of knowledge, this study is embarked to examine the effects of blending biodiesel and marine diesel on key fuel properties such as density, viscosity and flash point. Such properties have been reported (Benjumea et al., 2007) to be relevant for easy diagnosis of marine diesel engine and useful for predictive tools in marine engines.

II. MATERIAL AND METHOD

Pure biodiesel (B100) procured from Biotechnology Laboratory, Federal University of Agriculture, Abeokuta, Ogun State, Nigeria, was homogeneously mixed with B0 on the volume ratios of B25, B50and B75 for basic fuel properties test and analysis. The equipments employed for the analysis were mentioned in Table 1.

TABLE 1. Equipment used for the fuel property analysis

Property	**Standard**	**Equipment**	**Accuracy**
Density, 15^0c	ATM D1250	Density hygrometer	
Kinematic viscosity	ATM D445	Chongqing viscometer	0.1 mm^2/s
Flash Point(^{0}c)	ATM 1256	Cleveland open cup flash	0.1^0c

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2.1 Correlation development for the fuel types

The variation of density, kinematic viscosity and flash point of the waste oil biodiesel (WOB) with the fraction volume of WOB are presented in Figure 1, 2 and 3, respectively.

2.1.1 Correlation of density of WOB with its fractions

Density is highly relevant for diesel engines and heating elements. Fuel having higher density has been reported (Samuel et al; 2016) to compensate for lower calorific value. As depicted in figure 1, density increased with increasing biodiesel fraction. Hence, a fourth degree model is detected to correlate the variation of density (D) with respect to biodiesel fraction(n). the high regression co-efficient (R') of 1 of the model for all blends in figure 1 portrays that the model adequately fit the model presented in equation (1).

$$Y=0.0002xy-0.0021x^3+0.0073x^2-0.0054x+0.835 \quad (1)$$

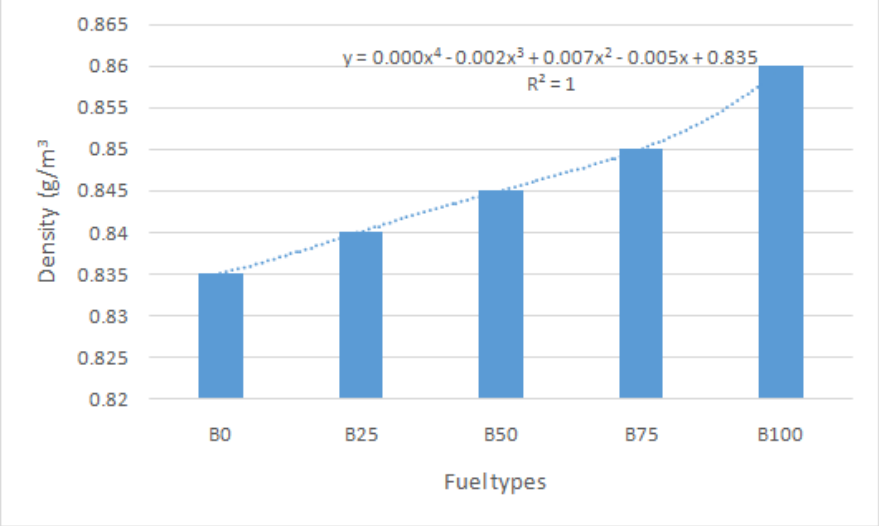

Figure 1. Graph of Density against Fuel Type

Viscosity is mostly employed to determine the flow behavior of fluid. Fuel having lower viscosity has been indicated (Samuel et al; 2016) to possess higher power loss for the diesel engine due to the leakage around injection pump. Figure 2 depicts the influence of biodiesel content in the blend with respect to kinematic viscosity (KV) of the blends. As noticed, the fourth degree order such as $(0.1708x^4 -2.25x^3+11.044x^2- 23.565x+20.8)$ is detected to be suitable for the changes of KV values vs. biodiesel fraction because of having high regression co-efficient (R') of 1.

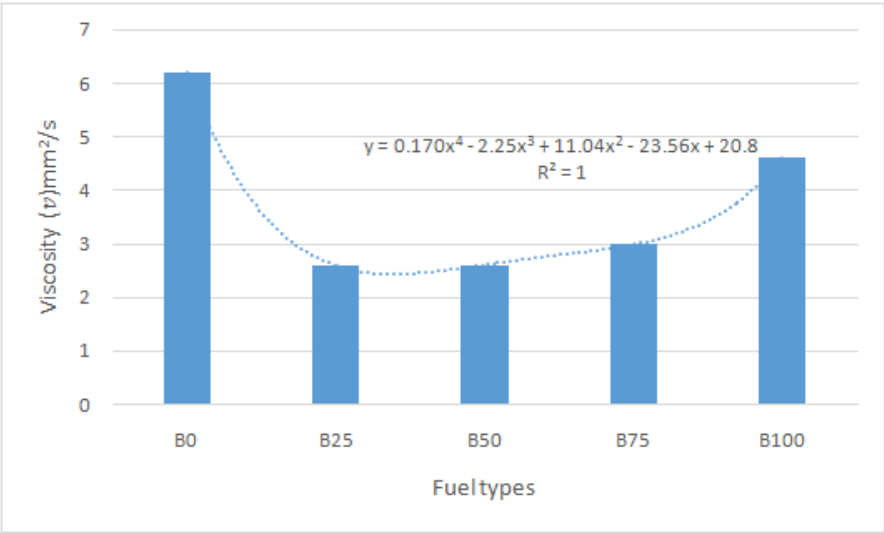

Figure 2. Variation of Viscosity with Biodiesel fractions

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The flash point is a measure of transportability and fuel's hazardousness (Samuel et al,). The effect of biodiesel blends on the Flash points (FP) is presented in figure 3. As shown, the quadratic model such as $(0.003x^2+0.177x+88.45)$ is determined to be adequate for the change in the FP values versus Biodiesel content and this is due to high regression coefficient (R') of 0.968.

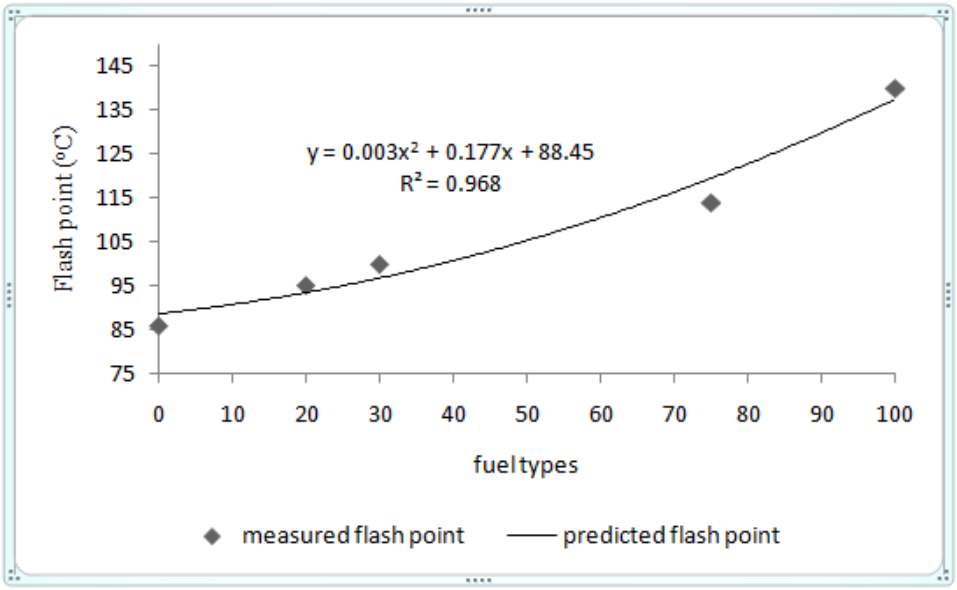

Figure 3. Variation of flash point with Biodiesel fractions

III. CONCLUSION

The respective models developed for the predication of density, kinematic viscosity and flash points for waste oil biodiesel- diesel blends were detected to have higher regression coefficient.

REFERENCES

[1] Benjumea P. et al. (2007). Basic properties of palm oil biodiesel diesel blends. *Fuel, 87*(10), 2069-2075.
[2] Khan S.et al (2017). Biodiesel production from algae to overcome the energy crisis. *HAYATI Journal of Biosciences, 24*(4), 163-167.
[3] Samuel O. et al. (2016). Optimization of coconut oil ethyl esters reaction variables and prediction models of its blends with diesel fuel for density and kinematic. *Biofuels, 7*(6), 7723-733
[4] Marine Diesel Fuel Oil. (2015). Environment Canada oil properties database. *Environment Canada, Emergencies Science and Technology Division.* Retrieved 23 April 2015
[5] Mostafa, S. S. & El-Gendy, N. S. (2017). Evaluation of fuel properties for microalgae Spirulina platensis bio-diesel and its blends with Egyptian petro-diesel. *Arabian Journal of Chemistry, 10*, S2040-S2050.

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