DIESEL FUEL ABILITY OF VEGETABLE OIL – PETROLEUM FUEL BLENDS

Supported by tetfund

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Received: May 23, 2019 **Accepted:** September 18, 2019

Abstract: Ternary blends of palm kernel oil (PKO), kerosene (DPK) and petroleum diesel (AGO) were prepared in different proportion of eight. The percentage of the PKO in the blends ranges from 20 to 80%. ASTM standard methods were used to check the fuel properties of the sample blends. The analyzed properties include specific gravity, kinematic viscosity, cetane number, flash point, water content, sulphur content, ash content and acid number. The result reveals that, in terms of critical fuel characteristics, the sample blends apparently complied with the biodiesel standards which signify that blending of PKO/DPK/AGO would serve a useful cost-effective pathway to producing more environmentally friendly fuel for diesel engines.
Keywords: AGO, ASTM, DPK, PKO, blends, fuel

Introduction

In the last decades, full scale commercial production of biodiesel has come on stream and biodiesel is available in the open market in Europe and United State of America. The current global production of biodiesel exceeds 300 million litres/year (Gerpen, 2005). The use of vegetable oil as fuel for diesel engine is not a new concept; more than 100 years ago Rudolf Diesel tested vegetable oil as fuel for tractor engine (Peterson *et al*., 1983). Periodically, the vegetable oil-fuel concept has been reintroduced particularly during periods of petroleum shortages.

The current low price of crude oil in the global market may alter the cost benefits of biodiesel vis-a-viz fossil diesel and stall, if not reverse the growing trend of biodiesel in the energy sector. There is therefore the need to seek and develop more cost effective technology for biodiesel production in order to sustain its niche in the renewable energy subsector. The reaction conditions of transesterification generally involve a tradeoff between reaction time and temperature as reaction completeness is a critical fuel quality parameter. Much of the process complexity originates from contaminants in the feedstock; water, free glycerol, methanol and soap (Ma and Hanna, 1999). Blending of vegetable oil with other petroleum derived fuels will preclude most of these impurities and may lead to diesel fuel that may meet the requisite Biodiesel Standards.

Generally, biodiesel fuel properties may be distinguished into those that are determined by the structure if the component fatty acids; number of double bonds, length of fatty acids chains, average molecular weight, presence of non hydrocarbon moieties; and quality parameters, e.g. free fatty acid, peroxide value, phosphorus content, etc which relate to post-treatment/processing quality of vegetable oil. On the basis of fundamental principles, the fuel properties of biodiesel correlate well with structure of the component fatty acids of the vegetable oil from which it is derived (Knoth, 2001).

Materials and Methods

Ternary blends of palm kernel oil (PKO), kerosene (DPK) and petroleum diesel (AGO) were prepared to contain 20 to 80% PKO. The formulation of the ternary blends used is shown in Table 1. The PKO used in this study was obtained from the popular Okene central market in Kogi State. Standard methods as given in Table 2 were used to determine the fuel properties of the sample blends.

Table 1: Formulations for PKO/DPK/AGO blends

Samples	DPK:AGO (Mixture)	PKO:Mixture	% PKO
A	1:9	1:4	20%
B	1:4	1:3	25%
C	2:3	2:3	40%
D	1:1	1:1	50%
E	3:2	3:2	60%
F	9:1	4:1	80%

Table 2: Standard methods for the determination of fuel properties of biodiesel

Fuel properties	Test methods
Specific gravity (g/ml)	ASTM D1298
Kinematic viscosity at 40°C (CST)	ASTM D445
Flash point (°C)	ASTM D93
Cetane number	ASTM D976
Poor point (°C)	ASTM D97
Water content (%)	ASTM D96
Sulphur content (%)	ASTM D129
Ash content (%)	ASTM D482
Acid number (mgKOH/g)	IP-139

The samples were prepared according to the formulations as shown in Table 1; the analysis of the fuel properties were conducted at Petroleum Analysis Laboratory, Petroleum Training Institute, Effurun, Delta State.

Results and Discussion

From table 3 above, the results shows consistency and are mostly within the permissible range for standard biodiesel properties. It can be seen that in terms of critical fuel characteristics, the blends of PKO/DPK/AGO apparently complied with the biodiesel standards. It thus appears that blending of PKO/DPK/AGO would serve a useful cost-effective pathway to producing green(er) fuel for diesel engines.

Table 3: Fuel properties of PKO/DPK/AGO blends

Fuel Properties	PKO/DPK/AGO blends						Biodiesel Standards	
	A	B	C	D	E	F	US	EN
Specific gravity(g/ml)	0.864	0.878	0.880	0.885	0.890	0.902	0.870-0.980	0.820-0.843
Kinematic viscosity	2.38	2.34	2.29	2.25	2.40	2.79	1.9-6.0	3.5-5.0
Cetane number	48.0	48.0	49.0	50.0	50.0	48.0	46-47	51
Flash point (^oC)	158	156	156	154	150	156	130 above	120 above
Water content (%)	0.04	0.04	0.04	0.03	0.04	0.04	0.05 less	0.03 less
Sulphur content (%)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	≤0.024	≤0.024
Ash content (%)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	≤0.02	≤0.01
Acid number (mgKOH/g)	0.38	0.40	0.38	0.37	0.42	0.42	≤0.80	≤0.50

The substantial replacement of petroleum-diesel with PKO without marked deleterious effect on the fuel characteristics of the blend should provide the impetus for further detailed studies into the use of fuel blends in diesel engines.

Conclusion

The sample blends were mixed to vary the ratio DPK:AGO of the blend and this would have significant effect on the measured fuel characteristics of the ternary PKO/DPK/AGO blends. Such effect should be examined in further studies. The problems which are often encountered in running direct injection diesel engines on vegetable oil; plugged orifices, carbon deposit formation, etc. may be obviated by scrupulous blend of vegetable oils with petroleum fuels.

Conflict of Interest

Authors declare that there is no conflict of interest.

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