Characterization of the Oils of some Non-Edible Seeds as Biodiesel

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ABSTRACT

In this study, oils of the seeds of Azadirachta indica(Neem), Mangnifera indica(Mango), Thevetia peruviana, Jatropha curcas and Hervia Brasilensis(Rubber) were extracted and transesterified. The oil and biodiesel yields were; Neem, 97%, Mango, 90%, Thevetia 98%, Jatropha, 95% and Rubber, 92%. Analysis of the biodiesel and their blends showed that Neem oil biodiesel (NOB) had highest Cetane number of 66 at 20% blend, among the biodiesel, ROB 65 at 100% blend, JOB 60 at 10% blend, MOB 60% at 100% blend, TOB 60 at 100% blend, while petrol diesel had 50 at 100% blend and it's the lowest. Analysis of other parameters shows that the Biodiesels and their blends displayed encouraging results as energy resources. Thus the investigation shows that biodiesel and its blends can be a good alternative energy source to petroleum diesel, technically and environmentally.

Keywords: Biodiesel, Emission, Non-Edible Oil, Transesterification,

INTRODUCTION

The emission of greenhouse gasses such CO, NO_2, CO_2, NO, SO_2, and SO_3 are majorly believed to be responsible for the environmental problems associated with the urban and industrial areas and their entire surrounding by depleting the ozone layer resulting in global warming (Turner, 2005). Also, the energy generated from fossil fuel is no longer sufficient for our consumption and this is causing a serious negative impact on the economy of the nations knowing that, all nations rely on energy, which is the most fundamental requirement for human existence and activities (Ribeiro el al., 2011). Unfortunately, the non-renewable energy sources which presently contribute over 86% to the global energy pool (Atadashi et al., 2011) are depleting. As a consequence of the depleting natural petroleum based products as well as greenhouse gas emission resulting from their use, a serious search for alternative feedstock and sustainable technology that can counter the shortcomings of this natural energy sources became necessary. Among the alternative energy sources considered to replace the dwindling convectional transportation fuels are bio-diesels, straight-chain vegetable oil, and bio-ethanol, bio-oil, among other forms of bio-fuels that can be utilized as electricity and transportation fuel. Presently, agronomic efforts are being made on increasing feedstocks supply. Alternative feedstocks normally arise out of necessity from regions of the world, where the materials are not locally available or as part of concerted effort to reduce dependence on imported petroleum products (Moser, 2009). Jatropha, rubber and mango plants are majorly found and grown in Nigeria, predominantly in the southern part of Nigeria where rainfall is prominent throughout the year.

MATERIALS AND METHODS

Jatropha curcas seeds and rubber seeds were collected from Okpara Water side in Ethiope East Local Government Area of Delta State. Neem seeds(azadirachta indica) were collected from Gwadangaji Area, Birnin Kebbi, Kebbi State. Thevatia Peruviena and mango seeds were collected in Idumebo Ekpoma in Edo State. The seeds were respectively sorted, cleaned and air-dried at ambient temperature of 25^0C for a month after which they were packaged in clean polythene bags and kept in a safe cool place. Other processes carried out prior to extraction includes; depulping, dehusking, drying and grinding. The seeds were pulverized to powdery mass, using a mill, after which a known mass (1kg) each, was soaked in an extraction jar with hexane solvent for 24hours. The filtrates were carefully decanted and the oils recovered using the vacuum rotary evaporator. The oils were then dried using air oven at 70^0C until the moisture content was reduced to 0.2%(Liauw et al., 2008).

The biodiesels gotten from the processes were bended with 10%, 20% and 50% natural diesel. From the blend Cetane number, flash point, cloud point and density were determined.

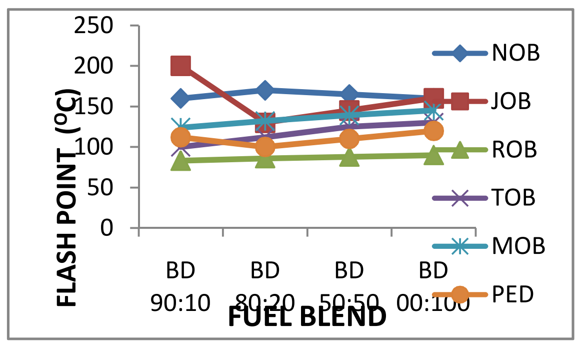

Fig. 1 Graph showing comparison of cetane numbers at different blends

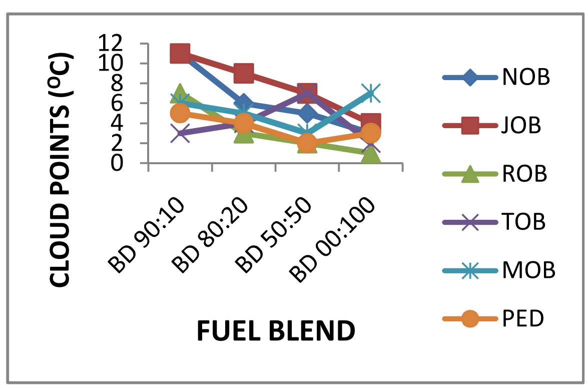

Fig. 2 Graph showing comparison of flash points at different blend

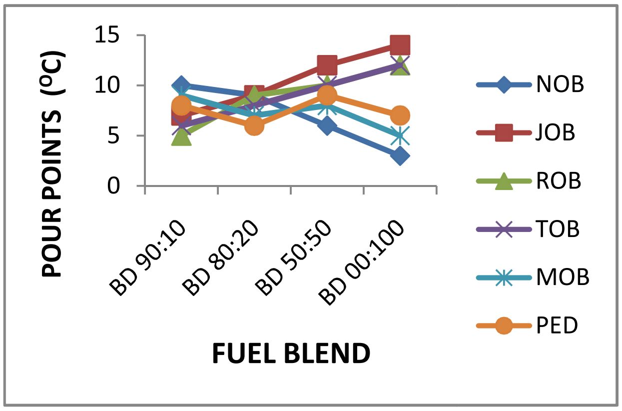

Fig.3 Graph showing comparison of cloud points at different blends

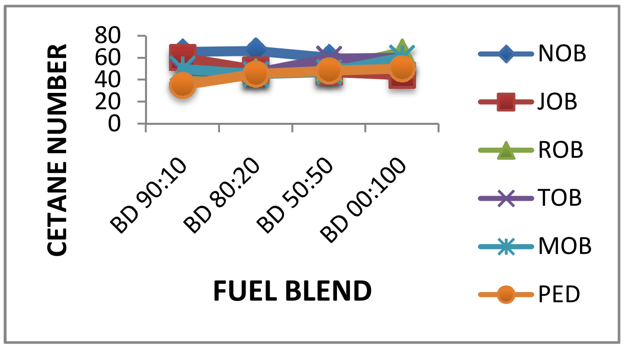

Fig. 4 Graph showing comparison of pour points at different blends

Jatropha oil Biodiesel (JOB) , Rubber oil Biodiesel (ROB), Neem oil biodiesel (NOB), Mango oil Biodiesel (MOB) and Thevetia peruviana oil Biodiesel were used. A high cetane fuel will have a short ignition delay period than lower cetane fuel also with increase in cetane number, a reduction of carbon monoxide (CO), hydrocarbon (HC), the volatile particulate fractions and even the noise could be achieved. High cetane number in the range of 49 to 52 can reduce particulate emissions by up to 0.01g/kW(Lorga and Ostonia, 2002). The results of cetane number of biodiesel, petrol diesel and their blends in Fig. 1 above shows that Neem oil biodiesel (NOB) has the highest cetane number of 66 at 20% blend, among the biodiesel produced in this study while petroleum diesel has the lowest cetane number among the fuels. The flash point was determined according to ASTM D6751, using the Kehler Model K-16270 flash point apparatus. Results of the experiment on flash points as depicted in Fig. 2 shows that JOB has the highest flash point of 200^{o}C at 10% blend. The cloud point is the temperature at which wax first becomes visible when the fuel is cold. The crystal formation is treated as a solid equilibrium of paraffins between a solution and a solid (No SY, 2011). The cloud point is determined with Herzog HCP852 (ASTM D2500) at specific rate. The result of the cloud point in the study as depicted in Fig.3 shows that NOB, JOB had highest cloud point 11^{o}C at 10% blends, ROB, TOB, MOB had 7^{o}C at 10%, 50%, and MOB 100% blends, respectively, while petroleum diesel (PED) 5^{o}C at 10% blend which is the lowest. The pour point is the temperature at which the amount of wax, out of the solution, is sufficient to gel the fuel (Saloua et al, 2010). The standards pour point for biodiesel is between -15^{o}C and 16^{o}C as shown in ASTM D6751. Fig 4. shows that Jatropha biodiesel (JOB) had 14^{o}C at 100% blend, ROB, TOB 12^{o}C at 100% blend respectively, while that of MOB and PED had 9^{o}C at 10% and 50% blends. The pour points are within the acceptable range of the ASTM D6751.

CONCLUSION

From the evaluation of the five non-edible seeds of Jatropha curcas, Neem, Rubber, Thevetia peruviana and Mango, it can be seen that they can favourably compete with petroleum diesel as fuel. The results suggest that these non-edible oils can be exploited as an alternative source of fuel as they are even more environmentally friendly than the present conventional petroleum diesel. Mango seed considered for this experiment for the first time also shows very good prospects as an alternative source of fuel.

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