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Biofuel Production Analysis Using Decay Plantain Fiber Extracts

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Abstract: *The production of biofuel using decay plantain fiber extract is experimental conducted research aimed to source for alternative renewable energy. This study became imperative due to the alarming catastrophe caused by the constant use of the black gold generated fuel in the environment. Therefore, a laydown experimental analysis was carried out with the study specimen to determine its physiochemical characteristics and properties to be compared with the same fossil fuel products. Obtained results for the decay plantain fiber extract in terms of flash, smoke and fire point temperatures are 45℃, 50℃ and 52℃ respectively which has close match range with kerosene at 38℃, 22℃ and 43℃ respectively and perhaps with diesel at 34℃ for flash point temperature and (60 – 105)℃ for its fire point temperature. This affirms that the decay plantain fiber extract fluid is highly and having promising potentials of flammable fuel. Therefore, this research opportunity is a creating link of the hidden and uncultivated biofuel resources from agricultural residual waste.*

Keywords—Biofuels, Decay fiber, Flash point temperature, fire point temperature, Physiochemical properties, Plantain, Smoke point temperature.

1. INTRODUCTION

One most cultivated and consumed natural food in West African countries like Nigeria is plantain. Plantain whose botanical name is Musa paradisiaca is a rich antioxidant vitamin/iron food which enhances the immune system and protects the body from damages such as cancer, heart diseases, etc. Plantain is usually a giant herbal plant that springs through an underground stem with conical trunk. A full-grown plantain is of 3 – 3.5m of length in the trunk which is capable of producing only but one bunch of edible plantain fruit; though, sometime with two bunches for very exceptional cases. The dead trunk after harvesting the matured plantain fruit becomes a significant component of biomass waste although, it looks very irritating, thus, feasted with inserts, worms, etc. [1]. This is a great limitation and possess major challenge to farmers [2]. The decay and rotten trunk over time is filled with fluid usually termed as plantain fiber extracts. This fluid is the focal point of the study due to its rich physio-chemical and thermodynamics properties.

However, research has great recognition for the predominant and essential benefits from waste plantain fibers in their diverse industrial applications. Thus, this waste has the potentials for alternative source to plantain fibrous materials-based industries. This is such as in the textiles and garment industries, paper production firms, herbal food supplement industries, etc [1]. A scholarly report described plantain Fiber as raw materials in fashion industries due to its abundant features such as its accessibility, availability in its quantity, durability with sufficient properties like twisting, braiding, weaving, etc [3]. Plantain fibers as shown below in figure 1 can be processed into splendor of lengthy threads with smooth shiny appearance which can be dyed to different colours of choice using its pseudo-stem sap as caustic harsh [3], [4].

Figure 1: Plantain Fibers used as Threads.
Source: [3]

Conversely, research has revealed that the plantain fibers used in the fashion industries are advantageous over the synthetic and conventional fashion materials because they are environmentally friendly with low density and cost [5], [6].

Likewise, in the medical industries; some herbal fluid medicines are produced from the stem's innermost part. It's also capable for candy and medicinal soft drink production [4]. Similarly, a reviewed literature reveals that plantains are rhizomatous herbs with terminal buds that produce inflorescence [7]. Consequently; upon the development of new concepts, plantain fibers are now been used as raw materials in paper manufacturing industries for the production of paper board, tissue, bloating, tracing, writing printing paper, etc. It is also an alternative source to polyethene production eventually reducing the harmful plastic products from fossil fuel [8], [9], [10].

Moreover, according to research, the use of plantain or banana fibers in paper industrials as raw materials will drastically reduce deforestation and environmental deterioration due to dependance on timber resources [11]. Furthermore, plantain fiber is classified among natural fibers being studied as reinforcement material in composite components and can be used as fabrication of shipping [12], [13].
The numerous benefits and sustainable attributes of plantain and banana fibers cannot be over emphasized. They are notable in biodegradability and reduction in ecological impact. These are few robust advantageous features of plantain and banana fibers. Meanwhile, the current study is to deeply investigate hidden features of plantain fiber extracts that will be useful in the practice of engineering.

2. Experimental Analysis

In line with the aim of the study, a laboratory experimental setup with plantain fiber extracts was carried in the Chemical Engineering Laboratory of the Niger Delta University, Wilberforce Island, Bayelsa State. The sample specimen for the practical is shown in figures 2 – 4.

Figure 2: Decayed Plantain Fiber

Figure 3: Squeezed Plantain Fibers

Figure 4: Plantain Fiber Extracts

The plantain fiber extracts which is the squeezed fluid from the decayed fiber is subjected to experimentation. The reason for this purpose is the explosive potentials this fluid has when preserved under high concentrated temperature. This is reported by local farmers the accidental explosions recorded with decayed fiber extracts of plantain at high concentrated temperature, hence this research.

3. Practical Test Beds

As a matter of investigating the physio-chemical properties and characteristics of the plantain fiber extracts, some laboratory test equipment was used in carrying out the flammable test analysis of the sample. They are such as pH meter, Viscosity test machine, flash point, smoke and fire point tester, etc as shown in figures 5 – 7.

Figure 5: pH – Meter

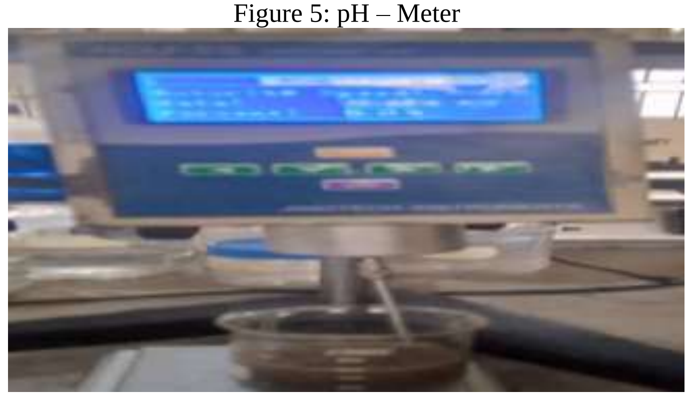

Figure 6: Viscosity test machine

Figure 7: Flash point, smoke and fire point tester

4. Presentation of Test Results and Discussion

The test analysis was conducted apparently with three (3) result samples of petroleum products such as gasoline, diesel and kerosene from established literatures. The purpose of this practical examination is for side-by-side comparison with the specimen considered for the investigation. This is in order to ascertain the real nature of the physiochemical properties of plantain fiber fluid. Hence, tables 1 and 2 are result presentation from experimentation and reviewed literatures respectively with corresponding graphical analysis as shown in figure 8.

Table 1: Practical Examination Results of Plantain Fiber Fluid Extracts

Sample	Viscosity $(kgm^{-1}s^{-1})$	Density, ρ (Kg/L)	Flash Point (℃)	Smoke Point (℃)	Fire Point (℃)	Pour Point (℃)	Cloud Point (℃)
Cool Fluid	2.67	1.8	-	-	-	70	12.7
Hot	2.43	1.8	45	50	52	-	-

Table 2: Physiochemical Characteristics of Petroleum Products

Sample of Petroleum Products	Viscosity $(kgm^{-1}s^{-1})$ @ 40℃	Density @ 15℃		Flash Point (℃)	Smoke Point (℃)	Fire Point (℃)	Auto-Ignition Temp. (℃)	Boiling Temp (℃)	FCV (MJ/KJ)	Molecular Weight (g/mol)
		Liquid Density (Kg/L)	Vpour Density, kgm^{-3})							
Gasoline	0.6 – 0.8	0.74	770	-43	-23	-17	257	79	38.9	104
Diesel	2.87	0.85	835	34	0.88	73	210	369.7	45.8	210
Kerosene	1.0 – 2.0	0.80	770	38	22	43	220	185	46.2	170

Source: [14]

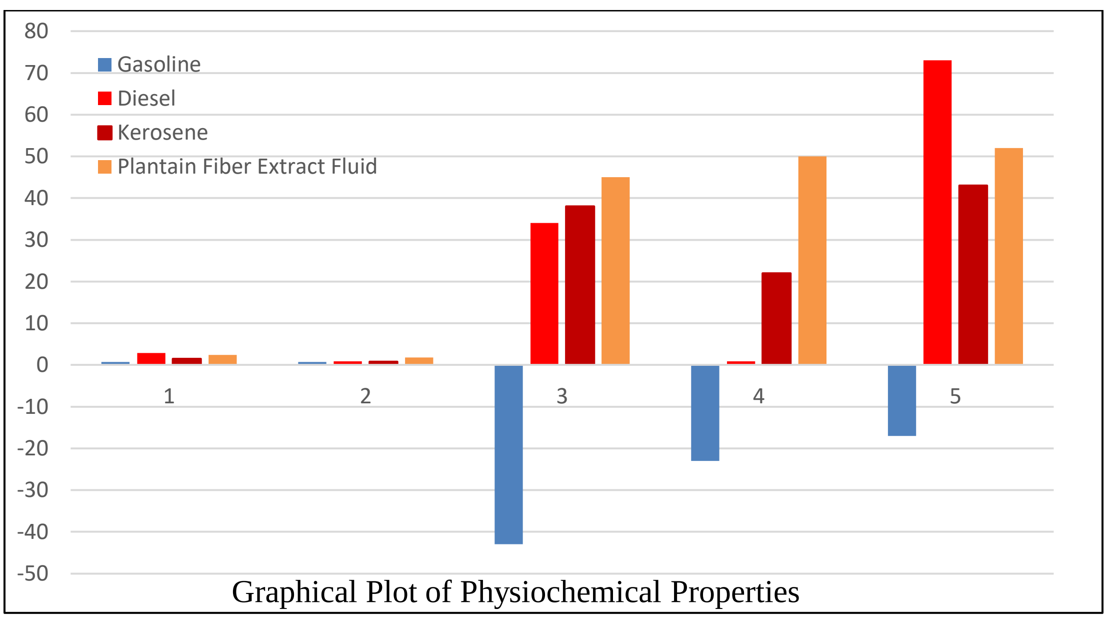

Figure 8: Presentation of Physiochemical Characteristics

The result analysis of the sampled specimen and the petroleum products describe their flammable thermo-fluid properties. The first category is the test of the viscous nature of the fluids under research. Viscosity as a thermodynamic property is a measure of fluid resistance test, perhaps defining its thickness. Hence, higher or more viscous fluid will retard a quick combustion process. Therefore, by the experimental data, the fiber extracts from plantain with viscosity value of $2.43kgm^{-1}s^{-1}$ is fairly lower than that of diesel but higher than gasoline and kerosene. Thus, this will be considered as a weak product to be used in engines because it will lead to incomplete combustion process which might produce emissions.

Meanwhile, the liquid density test result for the plantain fiber extract as obtained is 1.8kg/L, which is higher in rating than the petroleum product with 0.74Kg/L, 0.85Kg/L and 0.80kg/L for gasoline, diesel and kerosene respectively. However, the plantain fiber extract fluid is a natural mixture of water content in the decay fiber of plantain trunk. By distillation process of the water content from the specimen, the pure fiber extract fluid will be about 0.8kg/L since water has a standard density of 1kg/L. Thus, the real experimental density value for the specimen and kerosene will be the same.

Also, research affirms that the density of flammable liquid is slightly higher than air/mass density of $1.293kgm^{-3}$. This permits vapour dispersion along ground or floor where fluid may tend to sink at the surface of the ground and travels significant distances to ignition source. In consideration of flash point temperature of the products, the plantain fiber extract fluid, gasoline, diesel and kerosene had an experimental value of 45℃, -43℃, 34℃ and 38℃ respectively. These temperatures determine the standard condition for a fluid to form an ignitable vapour/air mixture. Amongst the products under study, it is observed that gasoline ignites at a very low temperature, followed by diesel, kerosene and the plantain fiber extract fluid. Conversely, the results for fire point temperature of the products as shown in tabular presentation are 52℃, (-13 to -23)℃, (60 – 105)℃ and 43℃ for the sampled fiber fluid, gasoline, diesel and kerosene respectively. Consequently, the fire point temperature signifies the least temperature range that keeps an effective combustion process at the removal of the ignition source. Finally, the last consideration is the smoke point temperature of the products which gives clear analysis of the fluid maintaining a continuous bluish flame as the combustion is in progress. 50℃ was observed from the practical analysis of the plantain fiber fluid, -23℃, 0.88℃ and 22℃ for gasoline, diesel and kerosene respectively.

At the peak fire and smoke temperatures of 52℃ and 50℃ of the studied plantain fiber extract fluid, a foaming nature was observed from the liquid under experiment. Thus, with these maintained temperatures, the sample was producing in quantity vapours that might lead to explosion and the practical was put to end. This should be provable evidence that the plantain fiber extract fluid is a liquid fuel having most likely properties with the existing fossil fuels.

5. Conclusion

The conducted experimental investigation of the decay plantain fiber extract fluid reveals some highly and promising potentials of flammable fuel. It almost has same physiochemical properties and characteristics of the conventional fuel. This research study also reveals hidden and uncultivated numerous biofuel source from agricultural residual waste. This energy source is a renewable and available not only from the plantain fiber but may also be possible with the banana decay fiber extracts, since the two editable fruit plant are of the same crop grouping. However, it is highly recommended that the same sample be conducted for engine performance test analysis for either with a petrol or diesel engine test beds. This will enhance the efficiency of the plantain fiber extract fluid.

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