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Production of Shoe Polish From Polyethylene Sachet Waste

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Abstract:

The water sachet waste in the surroundings have destroyed the aesthetics of the environment. A laboratory production of shoe polish from water sachets (Polyethylene waste) was investigated. The sachet waste were pyrolysed at various temperatures to obtain polyethylene wax with good melting point and yield. This was produced between 100 °C-200 °C and used to produce shoe polish. Three different formulations of shoe polish were prepared from polyethylene wax and the properties were compared with the paraffin wax based control. The density, melting point, physical testing of shoe polish and viscosity of the polish formulated using different percentages of used polyethylene wax compared favourably with the paraffin wax based control. The effects of temperature and pyrolysis time were significant in the yield and melting point of polyethylene wax produced. The sachet wax obtained has a melting point of 104 °C while the yield of polyethylene wax was 35.4%. Waste sachets pyrolysed at 100 °C for 45 minutes produced polyethylene wax which was used in the formulation of shoe polish, a way of converting waste to wealth. This gives room for job creation.

Keywords:

Water Sachets Waste, Polyethylene Wax, Pyrolysis, Shoe Polish

1. Introduction

Polyethylene products are used world over with varied applications. There are strings of application which include bags, plastic bottles, insulation cables, intravenous infusion sachets and water sachets. Unfortunately and many a time, people litter the environment with used polyethylene products after use without civic concern. This habit may go on uninhibited for a long period of time within a locality where lax work ethic thrive on the part of government agencies entrusted with the evacuation of domestic waste. These litters dropped haphazardly eventually breed into waste. The most typical description defines waste as unwanted substances or material remaining from any production or consumption process [1]. Going by the definition, polyethylene wastes generated from drinking water stored in sachets need to be treated as special wastes so as to rid the environment of its ugly sight. According to Verma, (2002) the debate on the use and abuse of the water sachets vis-à-vis environmental protection can go on in an endless stream without yielding results until practical steps are taken by everyone who is in position to do something about it. It is impossible for government to stamp out environmental pollution caused by water sachet waste without providing mechanisms or alternative ways of utilization of the water sachet waste [1,2,3,4].

1.1. Shoe Polish

Shoe polish is a waxy paste or cream used to restore the original lustre, finish, shine, waterproof and the appearance of leather footwear and leather products. It exists in both liquid and semi-solid forms. All leather surfaces and leather shoes require a good polishing to prolong their lives and keep them looking new.

1.2. Composition

Shoe polish consists of a waxy colloidal emulsion, a substance composed of a number of partially immiscible liquids and solids mixed together. It is usually made from ingredients including some or all of naphtha, lanolin, olive oil, or paraffin oil, turpentine oil, wax (Bee wax), gum Arabic, ethylene glycol, and if required, colorants such as carbon black or an azo dye [1,5,6].

1.3. Wax

The term wax can be defined as a variety of organic substances which exists as solids at ambient temperature but at slightly higher temperature become free flowing liquids [7,8]. The composition of wax chemically is quite complex, but normal alkanes are constantly present in high proportions and molecular weight profiles are wide. In commercial quantities, wax are derivatives of refinery process in principle but in practice not all petroleum refiners produce wax. For the most part, lignite is the source of mineral wax. This research was hinged on the production of polyethylene wax which belongs to synthetic wax family. Wax can be got from petroleum, minerals, synthesis, animal and vegetable based sources:

Petroleum: Paraffin wax and microcrystalline wax.

Mineral: Montan, ozokerite, lignite, ceresin and peat wax.

Synthesis: Alpha-olefin, fischer-tropsch, fatty acid amide and polyethylene wax.

Animal based source: Ambergris, spermaceti, bees wax, lanolin and tallow.

Plant based source: Carnauba, candelilla, japan wax, ouricury, rice bran wax, jojoba and soy wax.

Table 1. *Materials used for Shoe Polish Production.*

Raw materials	Source	Comment	Status
Stearic acid	Imported	No production in the country at the moment	100%
Paraffin wax	Imported	No production at the various Nigeria refineries	100%
Polyethylene	Local	Readily available	100%

2. Materials and Method

Sample Collection: The water sachet waste (LDPE) for this research were collected from eatery and along the streets of Enugwu-ukwu, Anambra State. The water sachets were washed with water and detergent to remove dust and other debris and were dried under the sun. The print ink on the water sachets were removed with acetone, then rewashed with water and detergent and dried under the sun. The clean sachets were shredded in a plastic laboratory. The shredded water sachets (LDPE) waste was sieved with a 4.75 mm mesh sieve (N0 5 of ASTM sieve). All particles retained above the mesh were taken out for regrind. This was done to attain the same particle size.

Preparation of polyethylene wax: Several proportions of stearic acid and polyethylene were mixed until the most acceptable ratio of 10:2 was obtained, which is 10g stearic acid and 2g polyethylene. The temperature was regulated by using a sand bath and varied through pyrolysis temperatures of 100 °C, 150 °C and 200 °C. Also corresponding pyrolysis time of 30 mins, 45mins and 60 mins were noted also.

Preparation of shoe polish from polyethylene wax: Water sachet waste were collected, washed, dried, bleached and shredded. It was weighed into a sample of 2g. 10g of stearic acid was also measured out. The weighed stearic acid was placed in a batch pyrolytic reactor over a steady source of heat energy at controlled temperature. When slight melting was observed, then shredded water sachet waste were added and stirred continually. Thereafter, paraffin oil, turpentine and colour were added while still being stirred to ensure even mix. The mixture was poured into a storage container and allowed to set.

Table 2. *Equipment Used for the Experiment.*

Equipment	Models	Comments
Weighing balance or scale	METTLER pm 2000 made in England	Measures mass/weight
Thermometer	Duran, Germany	Measures temperature
Scissors	-	For cutting
Spoon	-	For stirring
Steel conta1iner/reactor	-	For heating wax on a source of heat.

3. Results and Discussion

The materials used for shoe polish production such as stearic acid, paraffin wax, and polyethylene and their source are shown in Table 1. Equipment used for the experiment and the model including the purpose of using them is depicted in Table 2. The properties of shoe polish formulated from polyethylene wax produced from water sachet waste studied show that pyrolysis temperatures between 100 °C – 200 °C was required to produce polyethylene wax from water sachet waste used in the formulation of shoe polish. The melting points, densities and viscosities of shoe polish samples showed that Sample A compared favourably with the Control. The practical significance of this study is that the viscosity and yield of the polyethylene wax are essential to the processors as they cascade down the flow chart of the value chain.

More importantly, the use of water sachet waste (LDPE) in the mix ratio of polyethylene wax with shoe polish as end product will create demand for the used water sachet thereby drawing it out from the environment and rid the environment of its ugly sight as this is best strategy to mop it up from the environment. The above characteristics is the advantage of this procedure compared to the conventional thermochemical recycling in which the recycled products find their way back to the waste bin / landfill after few days of recycle.

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It is established from the above that water sachet waste can be used for production of shoe and leather polish. Utilization of the water sachet (LDPE) waste in the environment will drastically reduce the environmental menace posed by water sachet waste and its associated low density polyethylene waste. It will also generate jobs for the growing number of unemployed youths [9,10,11,12,13].

Table 3 gives the effects of pyrolysis temperature and time on the yield of polyethylene wax. At high pyrolysis temperature, there is a decrease in the yield of wax obtained. It can be seen from the Table 3 and Figure 1 that the yield range is 8-35.4%, at the pyrolysis temperature range of 100 °C- 200 °C.

Table 3. *Highlights pyrolysis temperature, pyrolysis time and yield of polyethylene wax.*

S/No	Pyrolysis Temperature (°C)	Pyrolysis Time (min)	Yield of sachet Wax (%)
1	100	30	31.50
2	100	45	35.40
3	100	60	32.80
4	150	30	29.40
5	150	45	23.60
6	150	60	19.75
7	200	30	16.00
8	200	45	12.00
9	200	60	8.00

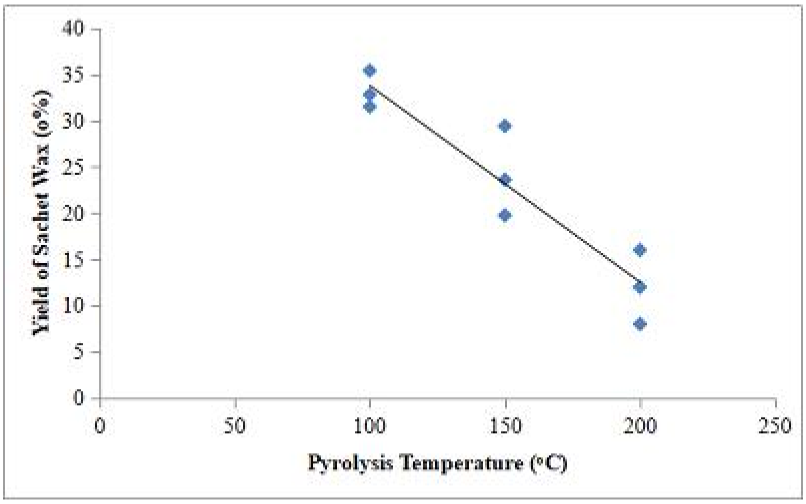

Figure 1. *Illustrates the pyrolysis temperature, pyrolysis time and yield of polyethylene wax.*

Table 4 gives the effect of temperature on the viscosity of shoe polish. It shows the viscosity of shoe polish formulated; A,B,C and the control polish D at different temperatures. The increase in temperature affects the viscosity of the sample's viscosity, value decreased with increase in temperature for all the samples as Figure 2 deplicts. Polish labeled B formulated using 30% water sachet wax was the hardest compared to sample A and sample C at 40 °C and 60°C respectively. Generally, viscosity values of the polish produced using sample A compared favorably with control at 50 °C.

Table 4. *Showing viscosities of formulated shoe polishes and control at different temperatures.*

Temperature (°C)	Viscosities of formulated and control shoe polishes at different temperatures			
	A	B	C	Control
40	2.20	7.24	6.45	1.88
50	1.44	3.96	3.15	1.02
60	0.64	2.09	1.35	0.20

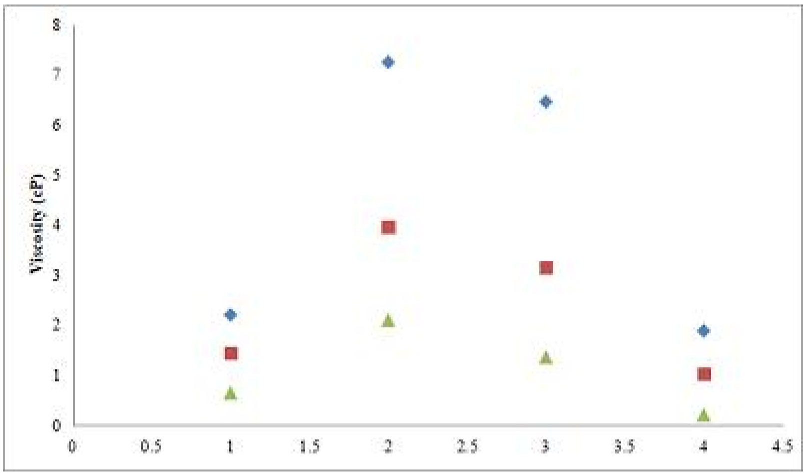

Figure 2. *Plot of viscosities of formulated shoe polishes and control at different temperatures.*

4. Conclusion

This research demonstrates that there is great potential for the utilization of low density polyethylene waste in preparing shoe and leather polish. The effective management of the polyethylene waste through conversion into further usable products from the surrounding to an environmental friendly one has been established. There is a likelihood of reduced disease outbreak and can as well generate employment for both skilled and unskilled labour.

5. Recommendation

Waste disposals on landfills would be no longer tenable due to the pronouncements made that waste landfill be reduced by 35% spanning over the period from 1995 to 2020 [9,10,11]. Tied to it are rising costs by way of its impact on our lives and its poor biodegradability especially the commonly used polymers [14,15,16,17,18].

We strongly recommend that;

The use of shredded LDPE waste and stearic acid as an alternative or replacement for wax in the production of shoe polish and leather surface enhancer. This is the best option for the disposal of water sachet waste as it will ultimately reduce the plastic pollution in our environment.

Finally, we recommend that chemical society of Nigeria, Nigeria society of Engineers, other relevant local industries and international associations to tap from this initiative.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this article.

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