International Journal of Engineering, Science and Mathematics
Vol. 9 Issue 10, October 2020,
ISSN: 2320-0294 Impact Factor: 6.765
Journal Homepage: http://www.ijmra.us, Email: editorijmie@gmail.com
Double-Blind Peer Reviewed Refereed Open Access International Journal - Included in the International Serial Directories Indexed & Listed at: Ulrich's Periodicals Directory ©, U.S.A., Open J-Gage as well as in Cabell's Directories of Publishing Opportunities, U.S.A

INVESTIGATING THE IMPACT OF CHEMICAL COMPOSITION ON THE CONDUCTIVITY OF SOAPS

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Abstract
For the purposes of this study, two distinct sets of liquid soaps were formulated. Anionic surfactant (SLES), amphoteric surfactant (BETAIN), and nonionic surfactant (DEA) made up the initial batch of samples that were analyzed. The second group of samples included an anionic surfactant as well as two different nonionic surfactants. The purpose of this study is to evaluate the effect on the physicochemical characteristics of liquid soap that can be attributed to the kind of surfactant as well as the mass fraction of surfactants that are present. In addition to the critical micelle concentration (CMC), the values for surface tension, electrical conductivity, and density at a range of concentrations for each kind of surfactant that was investigated were also analyzed and determined. In addition, the research has demonstrated that a little reduction in pH value and an increase in viscosity took place as a consequence of an increase in the concentration of zwitterionic (amphoteric) surfactant and a decrease in the concentration of nonionic surfactant, respectively. In contrast, a rise in the concentration of polyglycolide was found to be associated with a little elevation in pH, and a reduction in DEA concentration was shown to be associated with a drop in viscosity.
Keywords: Liquid soap, Surfactants, pH, Viscosity, Surface tension, Electrical conductivity, Critical micelle concentration, Stability

INTRODUCTION

There is always a need for a decent and quality handwashing agent, particularly for the health reasons that follow a person who is exposed to a variety of different pollutants and bacteria. As a result of this, we are faced with the difficulty of manufacturing liquid soap that will fulfill the requirements of our clients with regard to its quality, color, aroma, look, and consistency. Washing agents are known as soaps, and they are composed of synthetic surface-active agents (also known as surfactants) as well as supplementary components. A hydrophilic head and a hydrophobic tail are the two components that make up a surfactant molecule. In general, surfactants are categorized as anionic, cationic, or non-ionic surfactants based on the nature and type of the surface-active moiety group that is present in the molecule. If both cationic and anionic centers are present in the same molecules, then the molecules are referred to as zwitterionic (amphoteric) surfactants.

The chemical definition of soap is the sodium or potassium (alkali) salts of fatty acids or similar products formed by the saponification or neutralization process. This is the process by which triglycerides (fats and oils) or fatty acids are transformed with organic or inorganic bases into the corresponding alkali salt mixtures of fatty acids. Soap can also be defined as the sodium or potassium (alkali) salts of fatty acids.

Approximately 6000 years ago, someone first discovered how to make soap. Inscriptions for the production of soap were discovered on cylinders that were unearthed in ancient Babylon around the year 2800 B.C.E.1 Records that were kept in ancient Egypt about the year 1500 B.C.E. documented the process of making soap by combining animal and vegetable oils with alkaline salts. According to a myth that originated in Roman times, soap gained its name from Mount Sapo, which was the site of animal sacrifices. The fat from the animals that were sacrificed was washed into the Tiber River by rain, together with the alkaline ashes of the wood that had been burned during the rituals, and the people realized that the mixture was useful for washing their clothing. The American colonists gathered animal tallow (rendered fat), cooked it down, and then mixed it with an alkali potash solution that they collected from the accumulated hardwood ashes from their winter fires. This method for creating soap stayed the same for generations. Likewise, Europeans used olive oil in the production of castile soap. Since the middle of the nineteenth century, the technique has been commercialized, and soap has become readily accessible at the markets around the country.1 To this day, the majority of individuals produce their own soaps at home using procedures that are quite comparable.

The Basic Ingredients for Liquid Soaps

Surfactants, namely those of the anionic kind (sodium laureate sulfate, sodium lauryl sulfate, and other sulfates), are the fundamental components of liquid soaps. Liquid soaps are often used for hand washing. The primary factor contributing to the cheap cost of sodium salts and surfactants is that they are frequently utilized in the production of liquid detergents. In addition to this, chemicals of this sort have a significant potential to raise the viscosity of cleaning solutions. Surfactants have a wide range of applications and may be found in a variety of products including topical medicinal formulations, cosmetics, antiseptics, shampoos, detergents, creams, and lotions. Due to the amphiphilic qualities that they possess, surface active products are put to use as emulsifiers, suspending agents, wetting agents, solubilizing agents, and stabilizing agents.

Micelle and Critical Micelle Concentration

Micelles in solution was a notion that was created in the early 20th century by James William Mc Bain and his coworkers at the University of Bristol in Bristol, England [11]. Micelles are aggregates that are generated when surfactants are present in concentrations that are higher than their critical micelle concentration (CMC). Micelles have a hydrophilic surface and a hydrophobic center. Because of their unique shape, micelles are able to form chemical and physical interactions with both hydrophilic and lipophilic molecules. These interactions can be beneficial to both types of substances.

lution is the capacity of the particles to self-aggregate into association colloids known as micelles, which is followed with a general decrease in the system's free energy [14]. When the concentration of surfactant molecules in the bulk of the solution reaches or surpasses a limiting value, the surfactant molecules will self-aggregate to form micelles. This will result in a sudden shift in many of the solution's physicochemical properties.

The small concentration range over which these changes occur is referred to as the critical micelle concentration (CMC), and it is possibly the most essential trait that a surfactant possesses [16]. The kind of surfactant and the nature of the surfactant both have a significant role in determining the surfactant's propensity to form micelles in solution. In general, surfactants that have a longer hydrophobic tail (which indicates a higher level of hydrophobicity) have a stronger predisposition toward the production of micelles. The hydrophobic effect becomes more pronounced as the length of the hydrophobic tail increases, and as a consequence, the critical micelle concentration (CMC) falls, resulting in the formation of bigger micelles.

OBJECTIVE

1. To research and investigate the impact of different chemical compositions on the electrical conductivity of soaps

2. To conduct research about micelles and the critical micelle concentration

MATERIALS AND METHODS

Materials

The saw dusts derived from soft wood are the primary raw material that go into the creation of this soap. It was obtained from a saw mill that was situated at the sand fill at Iwabuchi Port Harcourt, which is located in the state of Rivers. In addition, materials can be broken down further into apparatus and reagents.

The Various Applications of the Apparatus:

There is a laboratory in the Department of Chemical and Petrochemical Engineering at Rivers State University in Port Harcourt that houses the various pieces of equipment that were utilized in this study.

Density Determination

In order to arrive at a conclusion on density, the following methods were applied;

- Empty weight of pyrometer (W1) was measured
- The Pyrometer was filled to the brim and covered with the lye
- Weight of the Pyrometer and then the lye sample (W3) was measured
- Volume of the Sample was (50m) W4

$$\text{Density } (g/cl) = \frac{W_3 - W_1}{W_4}$$

pH Determination

The decision-making process ultimately settled on the following procedures of pH;

- pH A buffer 7 solution was used to standardize the meter.
- 150ml of The sample was poured into a beaker with a capacity of 250 milliliters.
- pH The sample that was in the beaker received an electrode that was placed into it.
- pH reading was recorded.

Viscosity Determination

- During the process of determining the viscosity, the following procedures were utilized: • Samples were analyzed using a capillary viscosity instrument with a size of 150 ASTM.
- The samples included in the apparatus were pumped to the highest possible point

on the viscosity scale.

- The samples were allowed to fall to the lower mark of the apparatus at the same time, and time changes were observed on the stop clock.
- We recorded the amount of time it took for samples to flow from the upper mark to the lower mark.
- Time were converted to second and multiply by the ASTM size No: (0.025)
- Viscosity in Centistokes was recorded

Moisture Content or Water Content

- The weight of the crucible when it was empty, designated as W1, was determined.
- Ten grams of the material were weighed out and placed inside the crucible (W2).
- The weight of the Crucible as well as the sample (W3) was noted down.
- At 105 degrees Fahrenheit, the crucible was used to dry the samples until they were completely dry.
- The weight of the crucible and the dry sample, denoted by the symbol W4, was determined.
- Next, the weight of the dried sample, designated as W5, was noted down.

However,

$$\%\ \text{moisture} = \frac{W_4 - W_1}{W_2} \times 100$$

Metal

- All samples were permitted to go through the acid extraction operations, and they were also digested.
- A spectrophotometer was used to examine the metal elements, with each wavelength being used for a specific element.

Lye Extraction

- An ash sample weighing one kilogram was first measured, and then it was rehydrated in warm distilled water of various volumes, each of which was labeled A, B, C, D, E, and F.
- After allowing each solution to settle for a period of forty-eight hours, the results were recorded.
- After that, it was filtered, and the components that remained after that step were collected as extracts.
- The extract indicates alkalinity (an alkaline extract);
- This particular alkaline extract is referred to as the lye

RESULTS AND DISCUSSION

The tables and figures that follow describe the findings that were produced as a result of the research activity:

Table 1: Parameters showing the Physicochemical Properties of the Lye Extracts

Parameter	Unit	Soft Wood Saw dust
pH		5.5
Density	kg/m3	1.00
Viscosity	cSt	2.650

Water Content	%	58.7

Lye that was extracted from a wide variety of sawdust components was subjected to tests to determine its pH, density, viscosity, and total water content. The results of these tests are presented in Table 1, along with any other relevant information.

Table 2: In comparison to the Canadian standard, the amount of metal present in the alkaline and lye extracts of the various saw dust components was found to be as follows.

Sample (mg/l)	Soft Wood Ash (mg/l)	Canadian Limit (mg/l)
Pb	0.31283	10-20
Fe	4.65741	19-60
Mg	0.53927	0.7-2.2
Ca	8.13065	7.4-33.1
Na	6.52849	24.4
K	4.93404	126.1
P	2.42784	0.3-1.4
Hg	0.00135	Nil

The findings that were obtained after conducting an investigation into the metal content of the lye that was obtained by extracting it from the various sawdust ash components are summarized in Table 2. After comparing the data that were obtained with the legal limit in Canada, it was discovered that there was a significant difference in concentration. This demonstrated that the lye in its current state is not appropriate for soap manufacture and calls for the inclusion of additional components in order to increase the constituent concentration of the lye.

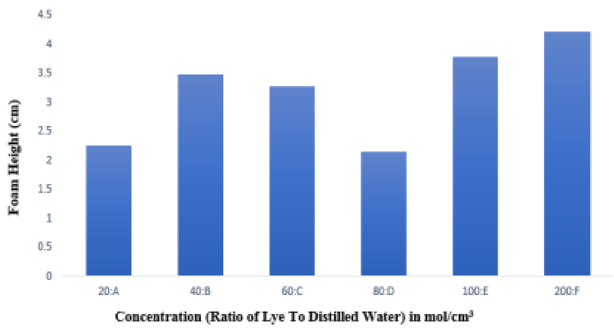

Figure 1: The height of the foam as a function of the concentration of the lye to distilled water mixture is plotted here.

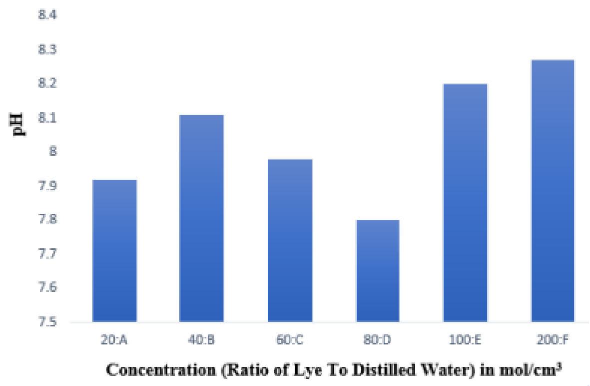

Figure 2: Diagram depicting the relationship between pH and the concentration of the lye to water ratio in the mixture

The correlation between the effects of lye concentration and the foamability height of liquid soaps made from soft wood saw dust is illustrated in Figure 1. The following magnitude order was noticed with regard to the increase in foam height: 200:F > 40:B > 60: C > 80:D > 100:E > 20:A. The change in the concentration of the lye was observed to be correlated with the observed variation in the foamability heights of the liquid soaps. This difference could be related to a shift in the lye's concentration, which is measured as the ratio of lye to distilled water in the mixture.

The influence that the concentration of lye has on the pH value of the liquid soaps that are made from soft wood is seen in Figure 2. The degree of the difference in the pH value of the liquid soaps grew as follows: 200:F > 100:E > 40: B > 60:C > 20: A >80:D. The different pH values of the liquid soaps that were made using the soft wood saw dust could be related to differences in the concentration of the lye used in the production process.

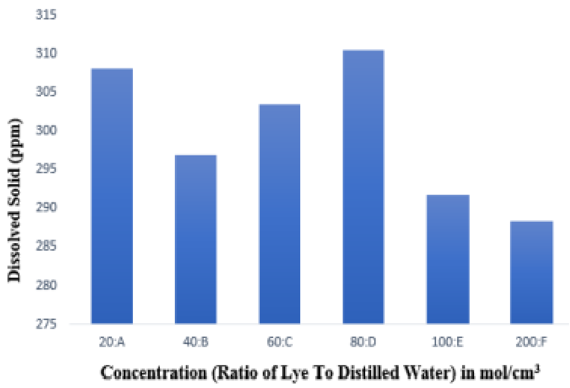

Figure 3: Graph showing the concentration of dissolved solids vs the percentage of lye to distilled water in the mixture

The effects of concentration on the dissolved solids of the liquid soaps derived from the soft wood saw dust are illustrated in Figure 3. The amplitude of the difference in the dissolved solids increased as follows: 80:D > 20:A > 60:C > 40:B > 100:E >200:F. One possible explanation for the disparity in the amount of solids that have been dissolved in the liquid soaps is that the concentration of lye that was used to make them has been altered.

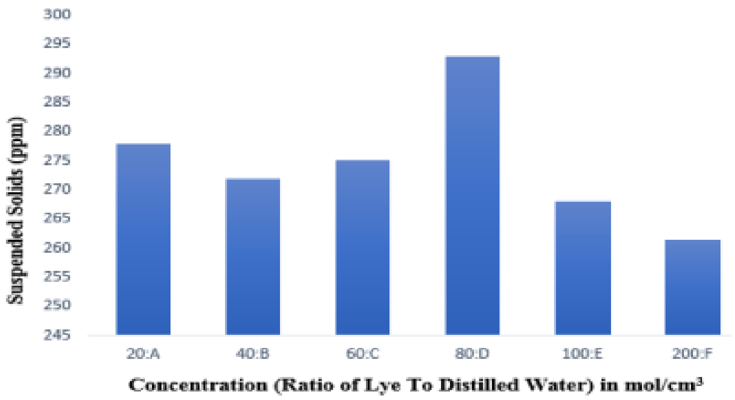

Figure 4: Graph showing the concentration of suspended solids vs the percentage of lye to distilled water in the mixture

As shown in Figure 4, the concentration of lye may have an effect on the solids that are suspended in the liquid soaps that are made from soft wood sawdust. The degree of the difference in the suspended particles found in the liquid soaps rose as follows: 80:D > 20:A > 60:C > 40:B > 100:E > 200:F. The fluctuation in the concentrations of lye could be responsible for the shift in the suspended particles that were found in the liquid soaps.

CONCLUSION

The viscosity of made liquid soaps was analyzed initially in order to have a better understanding of the physiochemical processes at play. Following that, an investigation into every single surfactant was carried out in order to locate the crucial micelle concentration. This was done with the intention of determining how the type of surfactant and its mass concentration impacted the outcome of the experiment. Every single physicochemical parameter is subject to change during the course of this concentration range. The outcomes of the computations that were done based on the surface tension and conductivity of soaps came out exactly the same. In comparison to the other soaps that were examined, the CMC has a lower value of surface tension and fits more neatly into the LX category. This result indicates that the CMC is the superior product. When the CMC is higher and the surface tension of LX is lower, this results in the production of a greater number of micelles. Due to the larger concentration of micelles, the solution of LX soap is the most effective cleaning solution. As a consequence. In a similar vein, it was shown that LFBY had an antibacterial effectiveness that was superior to that of other soaps. On the basis of these studies, it is reasonable to infer that LFBY now occupies the number one slot. The current investigation has shown the existence of a solution property research that controls the cleansing and elimination of germs and dirt. -The antibacterial activity that is provided by the bioactive components that are contained within them is capable of treating a wide variety of skin diseases that are brought on by bacterial infections.

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