Preparation of Natural Soap from Carbonate Containing Soapy Sand

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Abstract

In Myanmar, sand soap "Thae-Suppya" is found in many places, especially in the dry zone. It is used for manufacture of caustic soda and suppya. This sample was collected from Myinthi village in Tada U Township, Mandalay Region. Physical properties such as moisture, pH, bulk density and texture were examined. In addition, the major components such as chloride, sulphate, carbonate, bicarbonate, sodium, potassium, organic matter, exchangeable calcium and magnesium in this sample were also determined by using recommended standard methods. The water soluble carbonate salts were prepared from sand soap. The carbonate salt was converted to caustic soda crystal by using commercial quick lime. Finally, Natural soap was produced by a basic hydrolysis reaction on a mixture of palm oil.

Keywords: soapy sand, commercial quick lime, caustic soda crystal, palm oil, natural soap

1. Introduction

Natural soda locally called "sand soap" is an impure efflorescent salt of sodium mostly the carbonate with a large amount of intermixed and sand. The deposit occurs mainly in the tertiary rock of the dry zone. Sand soap usually forms on a sandy surface. Due to its detergent property, the crude product is used as cleansing and washing agent for kitchen utensil, laundering

clothes and also by silk merchants for rinsing purposes [4]. Sand soap including sodium carbonate, sodium hydrogen carbonate, sodium sulphate, magnesium and calcium salt is found as crystal or flake in the upper layer of soapy sand soil. In the middle and bottom of the layer round about three to four feet depth, soapy sand was found as a mixture with clay. As distinct nature of environmental characteristics, a kind of grass is grown to the sand soap area. The aim of the research work is to prepare the natural soap from soapy sand. The objectives are to dry the sample, to examine the elemental contents of sand soap by using EDXRF technique, to determine the physicochemical properties and to prepare the caustic soda in this sample.

2. Materials and Methods

2.1. Sample Collection and Preparation

In December 2019, sand soap sample was collected from Myinthi village in Tada U Township, Mandalay Region. This sample was spread out in the shade for air dry. After drying, the sample was sieved through a 2mm sieve to remove gravel, roots etc, which have to be discarded. And then, it can be used for analysis. Moreover, palm oil was purchased from the shop of Zegyo market, Chanayetharsan Township, Mandalay Region.



Figure 1. The Map of Myinthi village in Tada U Township, Mandalay Region



Figure 2. Soapy-sand found near the Myinthi village

2.2. Preparation of 1:5 Water Extract

About 120 g of sample was weighed accurately and placed in a 1000mL volumetric flask and 600mL of distilled water was added (the ratio of sample to water was 1:5) and shaken for three minutes vigorously and filtered.

2.3. Determination of Physical Properties of Sand Soap Soil

2.3.1. Estimation of Moisture

Moisture content of sand soap soil sample was estimated by oven drying method [2].

2.4. Estimation of Total Dissolved Solids

Constant weight of the porcelain basin was first determined. The 50mL of the sample was taken in the basin and it was evaporated on sand bath. After complete evaporation of the water from the residue, the basin was transferred to in oven maintained at $103 - 105^{\circ}$ C. Then it was dried to constant weight which is considered when not more than a 0.5mg weight change occurs between two successive series of operations consisting of heating, cooling in a desiccator and weighing. Increase in weight over empty dish was reported as total dissolved residue on drying at $103 - 105^{\circ}$ C.

2.5. Estimation of Hydrogen Ion Concentration (pH)

The pH value of sand soap soil sample was measured by pH meter.

2.6. Determination of Chemical Properties of the Sand Soap Soil

Chemical Properties such as chloride, sulphate, carbonate and bicarbonate were determined by using titration method.

2.7. Estimation of Exchangeable Calcium and Magnesium

Exchangeable calcium and magnesium were determined by using titration method.

2.8. Estimation of Exchangeable sodium and Potassium

Exchangeable sodium and potassium were also determined by using titration method.

2.9. Determination of Elemental Contents of Sand Soap Soil Sample by Energy Dispersive X-Ray Fluorescence (EDXRF)

This experiment was carried out by using EDXRF technique at department of chemistry in Monywa University.

2.10. Preparation of Water Soluble Salts from Soapy Sand

The pure and dried soapy sand (about 0.5kg) was immersed in 2L of water and stirred with wood rod thoroughly for 5min, then kept on overnight. The clear supernatant solution was decanted through a nylon colander. This supernatant liquid was transferred to iron pan and heated until boiling. The boiling was continued to obtain solid mass and the solid mass was scratched out from the wall of iron pan. The weight of the water soluble carbonate salt was accurately weighed by analytical balance. The yield was found to be 0.7g.This experiment was being done until required amount.

2.11. Preparation of Caustic soda (NaOH) by using Commercial Quick Lime (CaO)

Step I

The commercial quick lime powder 5kg which was purchased from the shop of Amarapura Township. It was meshed by bamboo screen and removed some lime stone that left on the screen.

The fine quick lime powder 0.5kg was then immersed in 10L of pure water and stirred with wood rod thoroughly for about 15 min, and then it was kept overnight. The clear supernatant liquid was decanted through a nylon colander. 6L of clear supernatant liquid was obtained (about 2.673%).

2.12. The Mixture of Carbonate and Hydroxide

About 25mL of clear solution obtained from above experiment was added into conical flask and then followed by addition of a few drops of methyl orange as an indicator. The solution was titrated with 0.1M hydrochloric acid until yellow color of the solution change into orange color. This titration was carried out at least three times. This gives total alkalinity (hydroxide and carbonate). The amount of a mixture of calcium hydroxide and carbonate containing in solution described in Experiment 2.11 as found to be about 2.673% by weight. 6L of clear supernatant solution was reduced to half volume (about 3L) by heating gently.

Step II

About 3L of calcium hydroxide solution was then treated with 38g of Na₂CO₃ with constant stirring on warming for 30min, and kept to cool to room temperature. White precipitate of calcium carbonate was filtered out. The filtrate that contains sodium hydroxide (caustic soda) was then heated to boil until platelet crystal was obtained. The NaOH platelet crystal was accurately weighed and stored in air tight container.



Figure 3. Preparation of Caustic soda

2.13. Physicochemical Properties of Palm Oil

2.13.1 Determination of Saponification Value

About 2g of oil sample was weighed in a roundbottomed flask provided and 25mL of 0.5M ethanolic potassium hydroxide was added. The flask was connected with air condenser and was then boiled under reflux until the sample was completely saponified. The reflux time was about 1hr. The solution was then cooled and 4 to 5 drops of phenolphthalein indicator was added and titrated with 0.5M hydrochloric acid until pink color just appeared. A blank titration was carried out without sample under the same condition [2].

2.13.2. Determination of Acid Value

About 1g of oil sample was dissolved in 25mL of ethanol and benzene mixture (1:1). A few drops of phenolphthalein indicator was added and titrated with 0.1M potassium hydroxide solution, until the color of the indicator changed from colorless to pink[2].

2.13.3. Determination of Iodine Value

About 1g of oil sample was weighed in a conical flask provided with a stopper. 10mL of concentrated hydrochloric acid and 10mL chloroform were added to dissolve the sample. 15mL of 15% potassium iodide solution and exact amount of 25mL of Wiji's solution were mixed together. It was shaken for a minute and placed in the dark for 1hr. The solution then was titrated with 0.1N sodium thiosulphate by using starch indicator. The end point was indicated by a change in color from blue to colorless. A blank titration was carried out without sample under the same condition [2].

2.13.4. Determination of the Density

The specific gravity bottle and its stopper were cleaned, dried and weighed. The sample was filtered through filter paper. The bottle was filled with the oil and the stopper was interested in it. The excess oil was wiped. The bottle with its contents was weighed. The volume of the specific gravity bottle is 25mL.

2.13.5. Determination of Free Fatty Acid

The free fatty acid of an oil (or fat) is the percentage by weight of fatty acids of a specified molecular weight, present in the type of fat (or oil) under investigation. Free fatty acid is numerically approximately half of the acid value.

2.13.6. Determination of Specific Gravity

Oil sample was maintained at room temperature and filled into the specific bottle until it overflowed and the stopper was inserted. Then, the bottle and content were weighed. Next, the bottle was cleaned and dried thoroughly. After that the bottle was filled with distilled water and maintained at room temperature and weighed again [1].

2.13.7. Determination of Peroxide Value

About 5g of oil sample was weighed into a 300mL glass-stoppered flask and then 30mL of acetic acid and chloroform (3:2) were added. The flask was swirled until the sample was dissolved in the solution. 0.5mL of saturated potassium iodide was added and the solution was allowed to stand with occasional shaking for exactly 1 minute and left in the dark for 5 minutes. Then, 30mL of distilled water was added and titrated with 0.01N sodium thiosulphate solution with constant and vigorous shaking. 0.5mL of starch indicator solution was added when the yellow color had almost disappeared. A blank titration was carried out without sample and must not exceed 0.1N sodium thiosulphate_solution [2].

2.14. Preparation of Natural Soap

In making natural soap, 100mL of palm oil was placed in a steel container and then heated to $70 - 80^{\circ}$ C. The molten fat was saponified with 50mL of caustic soda (10% w/v) solution accompanied by agitation with continuous stirring until soap appeared for about 10 min. Then the soap mass was transferred into the frame.



Figure 4. Natural Soap Sample

2.15 Analysis of Natural Soap

Physico-chemical characteristic of prepared soap was analyzed by using AOCS (American Oil Chemists' Society) methods and the results are recorded in Table 5.

2.15.1. Determination of pH of Natural Soap

About 1g of the soap sample was weighed in a clean, dry and previously weighed 250mL beaker and 100mL of boiled distilled water was added. The beaker was boiled vigorously for 15 min just prior to use. The pH value of the natural soap was measured by using pH meter.

2.15.2. Determination of Total Fatty Matter (TFM) in Natural Soap

Soap was dissolved in hot water and decomposed by adding a slight excess of standard sulphuric acid which liberate the fatty acid according to the equation.

$$2RCOONa + H_2SO_4$$

The fatty acid separated in this way was collected for actual weighing by was cake method. About 10g of soap sample was placed in a 250mL beaker. Then 150mL of hot distilled water was added and heated in a water bath until all the soap was dissolved. 0.1N sulphuric acid containing a few drops of methyl orange were added to the solution until the soap was completely decomposed, as shown by the development of a permanent red color. The solution was stirred continuously by means of a glass rod and boiled until the fatty acid formed clear oil. Bee wax 5g added and when this was completely melted, the beaker was placed in cold water until the mixture of acids and wax had solidified to a cake, leaving the glass stirring rod in the beaker. The solid cake was withdraw by means of glass rod and placed on a pad of filter paper and its surface dried by pressing with another filter paper. From the weight of cake, the percentage of fatty matter in the soap was readily calculated.

 $T.F.M = \frac{\text{Weight of Total Fatty Matter} \times 100}{\text{Weight of Sample}}$

2.15.3 Determination of Free Alkalinity in Soap

About 150mL of methylated spirit was placed in a 500mL conical flask and 0.5mL of phenolphthalein indicator solution was added. This solution was neutralized with 0.1N sodium hydroxide. Then 5g of the soap sample was placed in a conical flask and the soap dissolved as quickly as possible by heating on boiling water bath. This solution was titrated rapidly with 0.05M sulphuric acid solution until the pink color just disappeared.

Free Alkalinity (Na₂O%) = $\frac{\text{Volume of H}_2\text{SO}_4 \times \text{strength of H}_2\text{SO}_4 \times 0.31}{\text{Weight of sample}}$

2.15.4 Determination of Unsaponified Fat in Soap

The soap was dissolved in neutralized alcohol and a known quality of standard alkali was added to it. The solution was boiled under reflux and the excess of alkali titrated with standard acid. The difference between the volume of alkali added and the acid used for titration was a measure of unsaponified fat present expressed in terms of Na₂O.

3. Results and Discussion

Analysis was done on natural sand soap taken from Myinthi village in Tada U Township, Mandalay Region in December 2019. Characteristic studies are moisture, pH, bulk density, Texture and Total dissolved solids as physical determination. The experimental results are tabulated in Table 1. And then chemical characteristics were carried out. The results of chemical characteristics are shown in Table 2.

Table	1.	Results	of Phys	sical (Characteristics	of	Sand
		Soap So	oil Samp	ole			

No	Parameters	Results
1.	Moisture (%)	5.43
2.	pН	10.89
3.	Total dissolved solids (%)	3.218
4.	Sand Texture (%) Silt	76.19 19.05
	Clay	4.760
	Total	100
5.	Bulk Density (g/cm ³)	2.941

The pH value of this sample was 10.89. It was found that this sample was highly alkaline condition. Alkaline soils have pH 7.5 to 8.5 and acidic soils have 4 to 6.5. Soils with pH values outside these ranges are usually toxic to most plants. Texture percent of the sample was found to be loamy sand (76.19% sand, 19.05% silt and 4.76% clay). Loamy sand soil is usually not as fertile. So, this sand soap area does not grow any plant.

 Table 2.Results of Chemical Characteristics of Sand

 Soap Soil Sample

No	Parameters	Results
1.	Chloride as Cl ⁻ (mg/100g)	1.14
2.	Sulphate as SO ₄ ²⁻ (mg/100g)	0.143
3.	Exchangeable Calcium (meq/100g)	7.4
4.	Exchangeable Magnesium (meq/100g)	1.06
5.	Exchangeable Sodium (meq/100g)	217.39
6.	Exchangeable Potassium (meq/100g)	0.23
7.	Carbonate as Na ₂ CO ₃ (mg/dm ³)	230
8.	Bicarbonate as NaHCO ₃ (mg/dm^3)	87

From this table, it was found that the contents of carbonate, bicarbonate and sodium were found to be greater than the contents of other constituents in this sand soap soil sample.

The elemental contents of sand soap soil sample were determined by EDXRF spectrometer. The results are shown in Table 3.

Soap Son Sample					
Oxide	Measuring Value (%)	Element	Measuring Value (%)		
SiO ₂	64.998	Si	30.333		
CaO	12.989	Ca	9.271		
SO_3	10.903	S	4.361		
Fe_2O_3	6.0470	Fe	2.120		
K ₂ O	3.3320	Κ	1.388		
TiO ₂	1.0160	Ti	0.609		
SrO	0.2510	Sr	0.212		
MnO	0.118	Mn	0.091		
ZrO_2	0.0820	Zr	0.061		
CuO	0.0620	Cu	0.049		
V_2O_5	0.0590	V	0.017		
Cr_2O_3	0.0480	Cr	0.016		
Rb ₂ O	0.0320	Rb	0.015		
ZnO	0.0190	Zn	0.015		

Table 3.	Results of Elemental Contents of Sand
	Soan Soil Sample

The general characteristics of palm oil such as saponification value, acid value, iodine value, free fatty acid, specific gravity, density and peroxide value were determined. These results are indicated in Table 4.

 Table 4. Results of Characteristics of Palm Oil

No	Characteristics	Respective Value
1.	Saponification value	192.13 mgKOH/g
2.	Acid value	1.0090 mgKOH/g
3.	Iodine value	$228.42\ mgI_2/g$
4.	Free fatty acid	0.5079 mgKOH/g
5.	Specific gravity	0.7500
6.	Density	0.8100g/mL
7.	Peroxide value	20.18 meq/g

According to this table, these data are very important and essential for the quality of soap.

 Table 5. Comparison of Characteristics of Natural

 Soap and Shwe-war-soap

No	Sample	pН	Total	Free	Unsaponi
			fatty	Alalinit	fied Fat
			matter	у	(%w/w)
			(%w/w)	(%w/w)	
1.	Natural	10.0	70.9	0.05	1.07
	Soap				
2.	Shwe-	9.5	71.0	0.002	0.03
	warsoap				

According to this table, it was found that natural soap has fair foaming and shwe-war soap has good foaming. But, the cleansing properties of both soaps have the same.

4. Conclusion

The soil rich in natural deposit is an invaluable gift of the nature. It is a good source to produce chemicals and so it needs to analyze to know what kinds of constituents are present in it.

In accordance with the data as shown in Table 2, the content of sodium carbonate percentage in this sample collected in winter season was 230mg/dm⁻³. Thus, some local people from the village around Tada U Township collect this soil deposit in the winter season and sell as sand soap for cleansing utensils and for washing rough blankets.

Since the sand soap taken from this village contains large amount of Na_2CO_3 , it could be used as a possible source for the production of sodium carbonate. According to this research, the production of natural soap was described by using carbonate produced from sand soap.

The water soluble carbonate salts could be obtained from soapy sand. The caustic soda could be obtained from carbonate salt by using commercial quick lime. Therefore, natural soap could be produced from palm oil and caustic soda obtained from this sand soap sample.

In Myanmar, soapy sand was used for hundreds of years as a cleansing product for both the home and body. The villagers said that undiluted soapy sand was used to clean for the teeth and an early mouthwash before the toothpaste was not produced. Moreover, this sample can be used to dry and preserve fish and meat. The properties of caustic soda from soapy sand and marketable caustic were found to be the same. But the color of prepared caustic soda has pale yellow and marketable caustic soda has white color. The characteristic of natural sand soap sample was found to be no itching sensation for body skin and cleansing activity of oily skin, clothes, rugs and dishes. Some marketable soap has felt an itching sensation for body skin.

Finally, the author would like to give an advice for the villagers in Myinthi village is that instead of selling as the sand soap from which by producing the caustic soda and which is combined with oil or fat to produce as a natural soap. So, if they do that they can get more income and more effective for their profit.

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