Study on the Characteristics of Local Bentonite in Upper Myanmar

Naw Zar Htwe*, Than Than Kyi**

Abstract

Bentonite is specialized clay composed mainly of the clay mineral montmorillinite and formed by the alteration of volcanic ash. It has three principal properties that are widely used in industry: swelling, adsorbing and binding. The properties of bentonite are widely used in a number of industrial applications. The chemical compositions of collected bentonite clay were analyzed by Energy Dispersive X–ray Fluorescence (EDXRF) and compared with Wyoming bentonite. After that 2 g of dry bentonite samples were slowly added to the measuring cylinder containing 100 ml of 1% sodium lauryl sulphate solution for measuring the swelling capacity and 25 g of bentonite clay samples were also added to 500 ml of collected water sample for measuring the water softening activities by using EDTA titration method at different time intervals. It was found that Kyunhla bentonite clay is more powerful water softener than Tada U bentonite at time intervals of 36 hr.

Key words: bentonite, montmorillinite, volcanic ash, swelling, water softening,

Introduction

Bentonite is a naturally formed volcanic material that is mined for commercial use around the world. The bentonite have formed in the course of several millions years though alteration i.e. weathering of volcano ash. As this ash only settles in valleys and small bentonite deposits develop. In the older days, there were volcanic eruption in Myanmar, especially in the middle and north western part of the country. Thus, bentonite occurrence had been found in those of places in Myanmar, KyunhlaTownship (Shwebo District, Sagaing Division),which is famous for first grade quality bentonite.

Bentonite clay is being won by open cast mining. The main constituent, which is the determinant factor in the clay´s properties, is the clay mineral montmorillonite. Bentonite is distinguished from other clays by its extremely fineness, highly adsorbent nature and curious properties of swelling in water. All bentonites contain a percentage of other minerals; aluminium oxide, potassium oxide, magnesium oxide, small percentage of sand and silt. The process of removing the sand and slit from the bentonite that will produce a higher quality products. It is either sieved (granular form) or milled (into powder and super fine powder). Bentonite is electrostatic, meaning that naturally has an electric charge. It is

* Lecturer, Department of Industrial Chemistry, Yadanabon University.

** Professor and Head (Rtd), Dr., Department of Industrial Chemistry, Yadanabon University.

also swelling clay. When it mixed with water it rapidly swells open like a highly porous sponge. From here, the toxins are drawn into sponges through electrical attraction and once there, they are bond. Two types of bentonite are generally identified. One is called the swelling type or sodium bentonite, which contains Na^+ as the exchangeable ion. The other has particles with Ca^{2+} as the exchangeable ion. It is called calcium bentonite or non–swelling types. The swelling type bentonite when dispersed in water, separates into suspendible flake which are all finer than 0.5 micron. The swollen volume is the indication of the swelling characteristics of bentonite in water.

The reduction of hardness or softening is a process commonly practiced in water treatment. Chemical precipitation and ion exchange are two softening processes most commonly used. For example, hard water containing a significant loading of soluble calcium and magnesium compound. In ion exchange replaces calcium and magnesium with non– hardness cation, usually sodium.Calcium and magnesium in solution are removed by interchange with sodium within a solid interface (matrix) through which the flow. The exchange media include greensand, aluminium silicates, synthetic sillicious gels, bentonite clay, sulfonated coal and synthetic organic reasins and are generally in partical form, usually ranging up to a diameter of 0.5 mm. In this research, the focus relates to the application of natural bentonite as water softener. Bentonite clay has united composition and can absorb negatively charged toxins.

Because of its peculiar physical properties bentonite is extensively used in wide variety of many other industrial applications. Hence, Bentonite is used in number of industrial application due to its excellent adsorption and absorption properties. The properties of bentonite are largely depended on the type and amount of montmorillonite. Bentonite/montmorillonite is used to seal dams, in bonding foundry sands, asbestos, drilling muds for petroleum industries, as water softener to remove calcium and magnesium from hard water, removing color from mineral and vegetable oils and as an adsorbent in many processes. For special applications, bentonite is purified by removing the associated gangue minerals, or treated with acid to produce acid activated bentonite (bleaching earth).

The aims of this research were to study the chemical compositions, the swelling volume and water softening capacity of collected bentonite from Kyunhla and Tada–U Township.

Materials and Methods

Collection of Sample

Two different clay samples were collected from Mogyotwin area, Tada–U Township, Mandalay Division and Myahint area, Kyunhla Township, Sagaing Division. Location Maps of Bentonite Clay Deposits are shown in Figure (1). Natural and prepared of Kyunhla and Tada–U bentonite clays are shown in Figure (2).

Sample Preparation

Bentonite clay lump samples were dried under sun drying at the temperature of 36°–40°C for about two days. The dried samples were then ground into fine powder by using grinder. Then it was sieved with vibrating sieve shaker of 200 mesh screen to obtained powder form.

Chemical Composition of Bentonite by EDXRF

Chemical compositions of bentonite clay powder were analyzed by Energy Dispersive X–ray Fluorescence (EDXRF). The results are shown in Table (1).

Determination of the Type of Bentonite by Swelling Test

100 ml of 1 % solution of sodium lauryl sulphate was put into measuring cylinder and then 2 g of bentonite clay powder was slowly sprayed into it. After spraying, the solution was settled. Swollen volume between clay suspension and clear water were visually determined for (24) hours. The results of swollen volume are shown in Table (2).

Determination of Water Softening Capacities of Bentonite

25 g of bentonite clay was added into beaker containing 500 ml of hard water. After the addition of clay, the mixture was gently stirred with magnetic stirrer and then settled at different time intervals (0hr, 4hr, 8hr, 12hr, 16hr, 20hr, 24hr, 28hr,32hr and 36hr) respectively. After settling, the supernatant solution was alternatively taken and titrated with EDTA solution. Water softening capacity was calculated as follow:

$$W.S.C = \frac{H_B - H_A}{H_B} \times 100$$

Where, W.S.C = Water Softening Capacity

H_B= Hardness of water before treatment

H_A= Hardness of water after treatment

The results are shown in Tables (3) and (4).

Determination of Hardness of Supernatant Solution

25 ml of supernatant solution was placed in 250 ml conical flask and 1 ml of buffer solution and 2 drops of EBT indicator was added and mixed. After that, the solution will appear wine red colour. This solution was immediately titrated with 0.01 M EDTA solution and shake well until the color change to blue. Total hardness was calculated as follows:

$$\text{Total Hardness (as } CaCO_3\text{) mg/L} = \frac{\text{ml of Titrant volume x } 1000}{\text{ml of Sample}}$$

Results and Discussion

Significant efforts have been made for the development of technological processes as the consumption of natural resources in food, cosmetics, pharmaceutical and other industries are increasing day by day, so demand and supply of natural resources should be maintained. In this research work, the ability of local bentonite clays as water softener was studied.

The major elements of bentonite clays were determined by EDXRF. Table (1) showed that the relatively abundances were presented by oxide form of Si, Al, Na, Ca, Mg, K, Ti, Fe and compared with Wyoming bentonite clay. From the analyzed collected bentonite clay, it was observed that the chemical composition of bentonite clays was agreed with the data of Wyoming bentonite clay.

The swelling power of clay samples were determined by swelling test according to British Pharmaceutical Codex and Indian Standard. (IS;6186 –1971). In this standard, when the clay of montmorillonite group swells in water, this clay contained cations such as Ca^{2+} and Na^{+} etc. Non–swelling type (calcium bentonite) have a swollen volume less than about 5 ml/2g , moderately swelling type (sodium bentonite) have of about 15–20 ml/2g, a good variety sodium bentonite have 25 ml/2g and an excellent grade sodium bentonite have a swollen volume of about 30ml/2g or more.

From Table (2), it was found that Kyunhla bentonite clay had 25 ml/2g swollen volume and is a good variety of sodium bentonite but Tada–U bentonite had 12.6 ml/2g and its swollen volume is weak.

Effect of treating time intervals on hardness reduction of collected water treated with natural Kyunhla and Tada–U bentonite clay were shown in Tables (3) and (4) and Figure (3). It was observed that the hardness of collected water were reduced from 1087 ppm to 40 ppm for Kyunhla bentonite but the hardness of collected water were decreased from 1087 to 60 ppm for Tada–U bentonite clay within the time of 0 hour to 36 hour

contact time. Therefore the reduction of hardness indicated that it had good efficiency of water softening. It could be seen that Kyunhla bentonite clay had higher softening capacity than Tada–U bentonite clay.

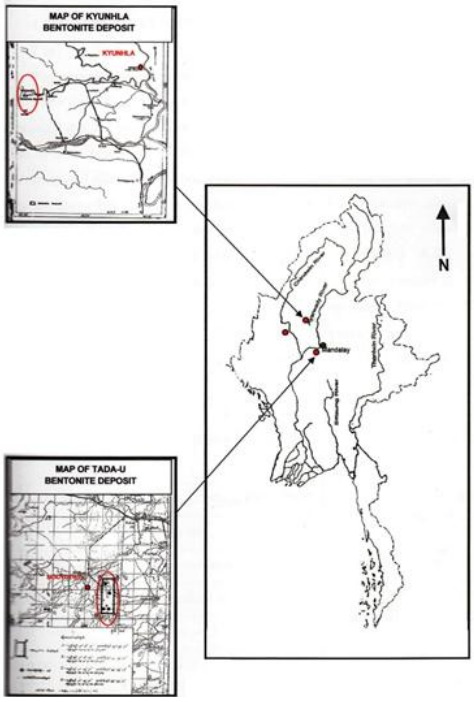


Figure (1) Location Maps of Bentonite Clay Deposits

Natural Kyun Hla Bentonite Clay

Natural Tada U Bentonite Clay

Figure (2) Natural and Prepared Bentonite Clays

Table (1) Analysis of Chemical Composition for Tada–U and Kyunhla bentonite by Using EDXRF

Sr No.	Element	Tada–U %	Kyun Hla %	*Wyoming Bentonite
1	SiO_2	51.43	41.03	41–64
2	Al_2O_3	14.23	11.69	11–21
3	Fe_2O_3	5.35	7.6	4–8
4	Na_2O	2.94	2.9	0.1–15
5	CaO	5.594	6.19	2.5–7.2
6	MgO	2.42	4.85	2–5
7	K_2O	1.433	1.13	0.2–2.4
8	TiO_2	0.63	0.861	0.1–0.9

Sr No. 1 to 8 was carried out at the laboratory of Department of Physics, Mandalay University.

* Literature value

Table (2) Effect of Swelling Volume with respect to Kyunhla and Tada–U Bentonite

Amount of Clay Sample = 2 g

Experiment No.	Clay Sample	Colour	Swelling volume (ml)
1.	Tada–U	Yellow(Raw)	11.3
2.	Tada–U	Yellow(wash)	12.6
3.	Kyunhla	Red (Raw)	24
4.	Kyunhla	Red(Wash)	25

Sodium Lauryl Sulphate Solution = 1% (w/v)

All experiments were carried out at the laboratory of Industrial Chemistry Department, Yadanabon University.

Table (3) Effect of Treating Time Intervals on Hardness Reduction of Water Treated with Natural Kyunhla Bentonite Clay

Amount of hard water = 500ml

Clay Dosage = 25g (5%w/v)

Experiment	Contact Time/hr	Total Hardness mg/l	W.S.C %
1	0	1087	_
2	4	400	63.20
3	8	380	65.04
4	12	320	70.56
5	16	220	79.76
6	20	160	85.28
7	24	80	92.64
8	28	60	94.48
9	32	40	96.92
10	36	40	96.92

All experiments were carried out at the laboratory of Industrial Chemistry Department, Yadanabon University.

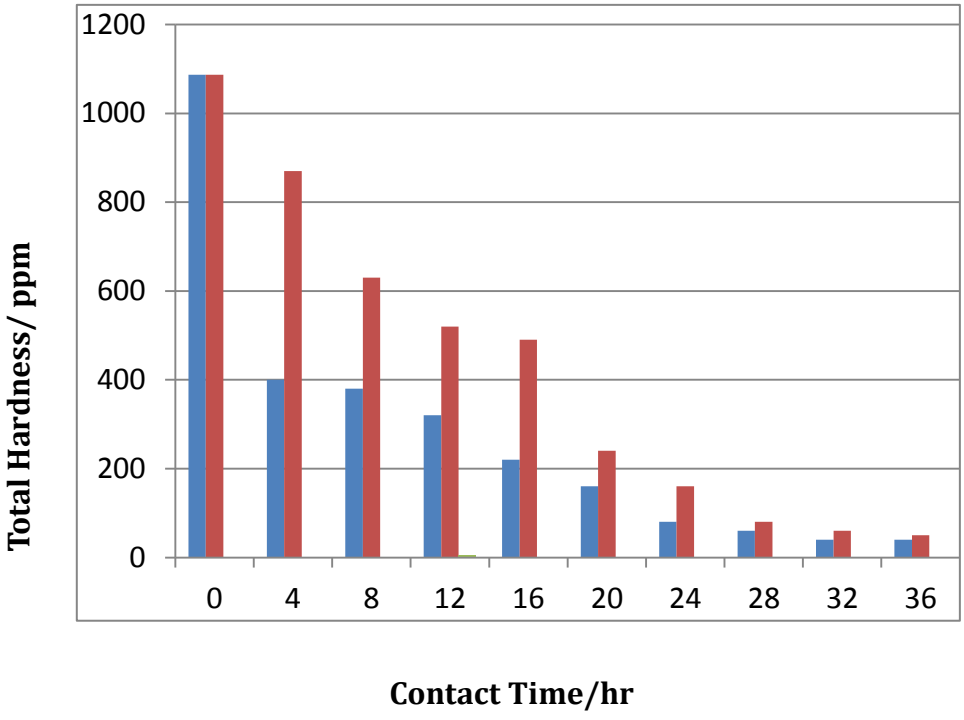
Table (4) Effect of Treating Time Intervals on Hardness Reduction of Water Treated with Natural Tada U Bentonite Clay

Amount of hard water = 500ml

Clay Dosage = 25g (5%w/v)

Experiment	Contact Time/hr	Total Hardness mg/l	W.S.C%
1	0	1087	_
2	4	870	19.96
3	8	630	42.04
4	12	520	52.16
5	16	490	54.92
6	20	240	77.79
7	24	160	85.28
8	28	60	94.48
9	32	50	95.94
10	36	50	95.94

All experiments were carried out at the laboratory of Industrial Chemistry Department, Yadanabon University.



Figure(3) Effect of Treating Time Intervals on Hardness Reduction of Water Treated with Natural Kyunhla and Tada–U Bentonite Clay

Conclusion

The present research was carried out on two different Myanmar bentonite clays that contain different percentages of clay mineral montmorillonite. It was also found that Kyunhla bentonite clay was rich in montmorillonite because it possessed high swelling properties and water softening properties than Thada–U bentonit clay.

Suggestions for Future Work

The prepared bentonite clay will be analyzed by the modern techniques such as XRD, XRF SEM, and FT–IR and compared with Wyoming bentonite and will be utilized in the formulation of cosmetic products. Edible oil will also be bleached after activation of prepared bentonite with acid and ammonium chloride.

Acknowledgements

First of all, the authors wish to acknowledge our gratitude to Rector Dr Maung Maung Naing and Pro–rectors, Yadanabon University, for their permission to submit this article. We would like to express our appreciation to Dr Khin Hnin Aye, Professor and Head, Department of Industrial Chemistry, Yadanabon University for her encouragement and permission to present this paper. I also wish to acknowledge to my teacher U Soe Myint , Associate Professor, Industrial Chemistry Department, Yadanabon University for his invaluable help in preparing this research.

References

Chisholm,F (1960), "Bentonite in industry",Mines Magazine, July.

Dana,J.D and Hurlbut,C.S,(1959), "Manual of Mineralogy" ,John Wiley and Sons, Inc.Landon.

Holmes,G.G (1983), " Bentonite and fuller Earth in New South Wales",Geological Survey of New South Wales, Mineral Resources,No.45, 9–20 ,127–128.

IS:6186(1971), "Indian Standard,Specification for bentonite", Indian Standards Institution,New Delhi.

Than Than kyi (2010), "Study on Bentonite Clays from Different Localities in upper Myanmar",Ph.D (Disseration),Department of Industrial Chemistry, University of Yangon ,Myanmar.

Websites

http;//www.triganic.com/Monymorillonite–Bentonite clay –htm.

http;//www.New Myanmar Pioneerstar.com/bentonite.htm.

http://www.en wikipeda.org/wiki/Bentonite.

http://www.eytogerchth.org/bentonite–montmorillonite–php.

http://www.E/ Sevier.com.

http://www. Cyber–nook.com/water/solutions.html.