

THE COMPARATIVE CHEMICAL COMPOSITION AND STRUCTURES OF LOCAL SAND IN NAKHON PATHOM

Watcharin Rachniyom^{1,2*}, Teardsak Sakunsuk², Suwimol Rueangsri² and Jakrapong Kaewkhao^{1,2}

Received: May 2, 2018; Revised: August 18, 2018; Accepted: August 29, 2018

Abstract

In this work, sand samples from sand mining in Nakhon Pathom Province were investigated chemical compositions and structures. The difference between land sand in Mueang and Kamphaeng Saen district were measured by the energy dispersive X-ray fluorescence (EDXRF) and X-ray diffractometer (XRD) in various condition. These samples were cleaned by water rinsing from 30-60 min. Samples were separated grain size to 250, 180, and 150 μm . The results of chemical compositions of sand in Mueang district (SM) were rich in SiO_2 , K_2O , Al_2O_3 and Fe_2O_3 around 67.91, 12.28, 10.35, and 6.30 wt%, respectively. While, the results of sand in Kamphaeng Saen district (SK) were found SiO_2 , K_2O , Al_2O_3 , and Fe_2O_3 around 64.67, 14.06, 9.61, and 7.17 wt%, respectively. It clearly that SM has more SiO_2 than SK. However, the results of SEM and XRD were not different. The crystal structures of SM and SK were appeared as quartz phase commonly.

Keywords: Dihydroxyacetone, Glycerol, *Gluconobacter*, *Acetobacter*

Introduction

Sand is an important mineral resource of Nakhon Pathom Province. Sand mining are widely distributed in Nakhon Pathom Province. They are located in Kamphaeng Saen, Bang Len and Nakhon Chai Si district (Doksaiyud *et al.*, 2014). Sand production of

Nakhon Pathom were utilized in constructions, building, road and land field. The values of local sand in Nakhon Pathom are low price because they are considered low grade. In fact, local sand can be added values if it could be used in other industries such as glasses,

¹ Center of Excellence in Glass Technology and Materials Science (CEGM), Nakhon Pathom Rajabhat University, Nakhon Pathom, 73000, Thailand. E-mail: watcharinratniyom601@hotmail.com

² Science Program, Faculty of Science and Technology, Nakhon Pathom Rajabhat University, Nakhon Pathom 73000, Thailand.

* Corresponding author

ceramics, optic fibers and refractory materials (Taxiarchou *et al.*, 1997). However, there is no research that recognizes the value of sand in these aspects. So, this research may be the starting point for improving the quality of local sand for the local economy.

Natural sands exhibit a variety of minerals and chemical compositions (Hasdemir *et al.*, 2016). The minerals in sands may be composed of quartz, mica, feldspar, etc. While, chemical compositions in sands show a variety of oxides such as SiO_2 , Al_2O_3 , TiO , K_2O , CaO , MnO , etc. in different proportions (Ekpunobi *et al.*, 2013). The physical and chemical properties of sands were depended on minerals and composition of them. So, it is divided into several grades to suit the requirements of different industries. The value of sand is very different according to each industry sector such as; the high price of sand which high purity silicon and low iron oxide shades to glass (Levitskii, 2003).

This work, we analyzed sand samples from two different areas in Nakhon Pathom Province. The samples were investigated in chemical composition and minelological by X-ray fluorescence (XRF) and X-ray diffractometer (XRD). The compositions of sand in this experiment were focused on proportion between SiO_2 and Fe_2O_3 . The simple and low price techniques to increased purity of silicon were washed and sieve shaker separated particle size.

Experiment

Local Sands were procured from two different sandpits in Nakhon Pathom Province. The first sample was collected from sandpit in Tambol Baan yang, Mueang district (SM). The second sand was procured from a sandpit in Tambol Sapattana, Kamphaeng Saen district (SK). The experiment procedure is shown in Figure 1. The both samples were indentified the chemical compositions and crystal structures. The energy dispersive X-ray fluorescence (EDXRF), model Panalytical Minipal-4 spectrometer was investigated the chemical compositions in sand samples. The crystal

structures of sand were analyzed by X-ray Diffractometer, model Shimadzu 6100 with CuK_α radiation ($\lambda = 1.5406 \text{ \AA}$) over the 2 theta range 10° - 80° . After that, a method to treated samples was washed with water in different time from 30 to 60 min. The samples were dried at 100°C in an electrical furnace for 3 h and slow cooled down to room temperature in furnace. These samples were investigated in chemical composition and crystal structures again. Finally, treatment method of sand sample was separated size by sieves shaker. The sieves were selected standard of ASTM E11 sieve NO. 60, 80, and 100. The samples were re-examined in chemical composition to compare with raw samples.

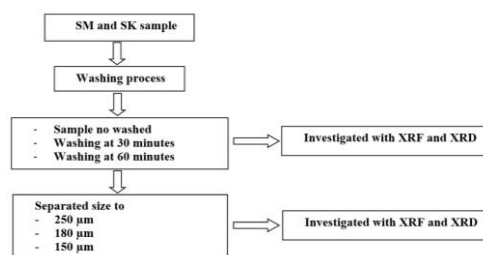


Figure 1. diagram of experimental

Results and Discussion

The chemical compositions of samples from both sand mines have been shown in table 1. It can observe that, before washing, SiO_2 of SM is higher than SK around 3.24 wt%, but Al_2O_3 and K_2O of SK are higher than SM about 0.74 wt% and 1.78 wt%. While, the other components of both are slightly different. However, the samples were contained large amount of Fe_2O_3 around 6.30-7.71 wt%. The results demonstrated why the sands in Nakhon Pathom Province unsuitable for raw material in industrial such as; glasses, ceramics and optic fibers (Taxiarchou *et al.*, 1997). The silicon content of them have low proportion and large iron content in them is influential to reduced transmission property in optic fibers and the transparency of glasses with ferric oxide (Eberhard, 2013).

The simple methods and low cost to treat the impurity sand in this experiment were washed with rinsing water. The results of varied washed times are shown in table 1. The both sample were increased silicon content with increasing washed times. While, iron content was reduced proportion to 3.11 wt% in SM and 3.95 wt% in SK with 60 min of washed time. However, the samples were still impurity grade of sand. In the second experiment, the samples were separated size by put in the Sieve Shaker No. 60 (250 μm), 80 (180 μm), and 100 (150 μm) before washed with various time from 0-60 min. The results of them are shown in Table 2. It can observe that the SM 250 μm were higher silicon and lower iron contents than raw SM. While, the SM size 180 and 150 μm have lower silicon than 250 μm . While, iron was increased to 4.40 wt% and 6.04 wt%

at particle size 180 and 150 μm , respectively. The washing process were increased purify of silicon and reduced iron in SM sample for all particle size. For the SK results, silicon and iron contents were same trend with the SM results. The proportion of silicon content was increased with reduction of sand particle size, but iron contents cannot find the relation in this experiment. In water washing process, the chemical compositions of SK samples unable to determined the relationship of this experiment.

X-ray diffraction analysis is acceptable and easily technique to identified minerals present in the sand. The XRD patterns of SM and SK are shown in Figures 2-3. The modern software and mineral data are available for investigation of crystal structure in sand. The diffraction lines were compared with the standard line pattern for various compounds in

Table 1. Chemical composition of samples before and after washing process

Sample	Washed time (min)	Compositions (wt%)							
		SiO ₂	Al ₂ O ₃	K ₂ O	CaO	Fe ₂ O ₃	TiO	MnO	Rb ₂ O
SM	0	67.91	10.35	12.28	1.88	6.30	0.97	0.10	0.15
	30	69.50	10.35	12.79	1.71	5.85	0.98	0.07	0.09
	60	73.46	13.95	8.83	1.67	3.11	0.05	0.03	0.09
SK	0	64.67	9.61	14.06	2.90	7.17	1.14	0.11	0.27
	30	68.79	11.61	9.59	2.37	6.00	1.35	0.11	0.13
	60	70.71	11.26	11.19	1.78	3.95	0.66	0.05	0.13

Table 2. Chemical composition of samples in various particle size before and after washing process

Sample	Sieve size	Washed time (min)	Compositions (wt%)							
			SiO ₂	Al ₂ O ₃	K ₂ O	CaO	Fe ₂ O ₃	TiO	MnO	Rb ₂ O
SM	60	0	73.22	11.99	5.60	1.05	4.01	0.59	0.04	0.02
		30	74.10	14.06	8.79	0.87	2.15	0.40	0.04	0.08
		60	74.44	13.53	9.62	0.87	1.91	0.34	0.04	0.06
	80	0	70.11	12.34	10.97	1.24	4.40	0.61	0.16	0.12
		30	72.66	14.89	8.64	0.88	3.11	0.54	0.04	0.08
		60	75.17	13.39	7.16	0.80	2.87	0.44	0.05	0.06
	100	0	71.37	11.60	8.52	1.24	6.04	0.95	0.13	0.09
		30	71.62	14.62	7.37	0.86	4.59	0.67	0.13	0.07
		60	74.77	12.92	6.19	0.75	4.28	0.87	0.08	0.06
SK	60	0	66.87	11.88	12.84	1.85	4.63	0.85	0.10	0.15
		30	64.28	9.34	16.69	3.08	5.46	0.79	0.06	0.24
		60	64.96	9.42	16.30	2.41	4.74	0.79	0.07	0.24
	80	0	68.37	11.99	11.11	1.79	5.09	1.06	0.11	0.14
		30	63.88	9.79	16.21	2.75	6.03	0.85	0.09	0.95
		60	66.34	9.19	15.85	2.32	5.19	0.76	0.06	0.76
	100	0	69.52	11.73	9.39	1.69	5.44	0.89	0.10	0.10
		30	65.28	10.00	12.10	2.79	7.98	1.49	0.13	0.16
		60	67.62	8.83	12.89	2.30	6.71	1.32	0.08	0.19

the Powder Diffraction File (PDF) database (Bahoria *et al.*, 2016). In Figure 2, the SM structure general defines quartz phase (SiO_2 , Quartz, PDF 00-046-1045). The mineralogy of SM was commonly of natural sand (Hasdemir *et al.*, 2016). The XRD pattern of SK is the same with SM pattern, but intensities of the diffraction lines are lower than SM. Figures 4-5 have been shown the XRD pattern of SM and SK after water washing process. They can observe that the mainly crystalline structures were commonly of quartz phase. The diffraction lines were same with raw SM and SK samples. However, the crystalline were occurred smooth lines and higher intensity than raw samples. While, The process of water

wash can't found the relation between washed time and crystalline structures.

Conclusions

The SM sample has more purity of SiO_2 and lower Fe_2O_3 than SK sample. The both samples are classified in low purity sands and not suitable for raw material in industrial. Especially, glasses and optic fibers were affected by iron oxide which reduce transmission property and imparted various shades to glass. The water washing treatment methods were increased purity of silicon. The sample show high silicon contents when

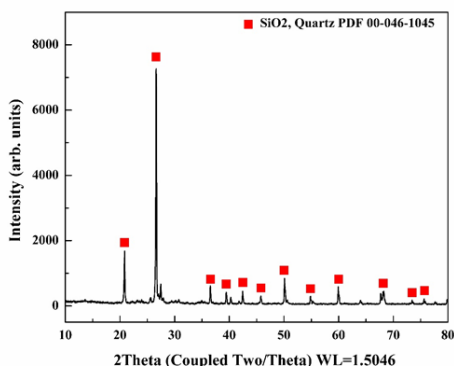


Figure 2. XRD pattern of SM sample

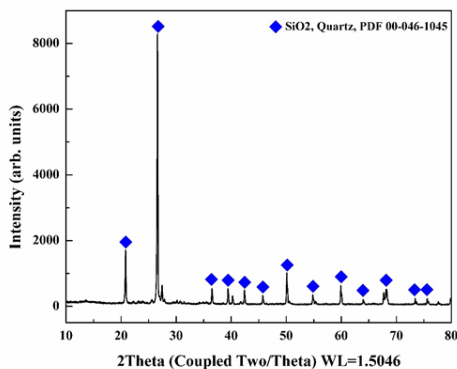


Figure 3. XRD pattern of SM sample

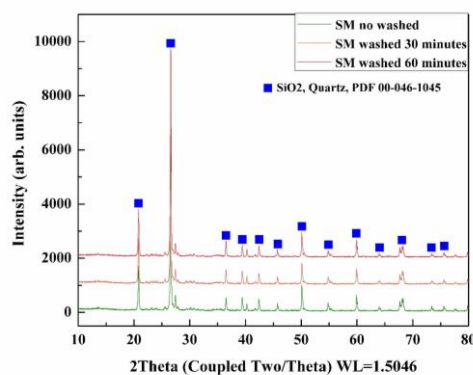


Figure 4. The XRD patterns of SM before and after washing process

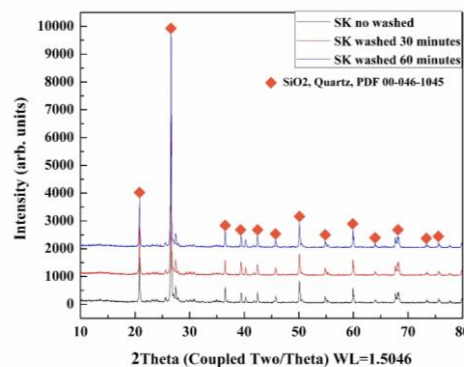


Figure 5. The XRD patterns of SK before and after washing process

increasing time to wash. However, sieve shaker separation cannot find the clear relative in this experiment. Finally, mineralogy of both samples was commonly of natural sand which rich in quartz.

Acknowledgements

The authors would like to thank National Research Council of Thailand (NRCT) and Nakhon Pathom Rajabhat University for supporting this research.

References

- Bahoria, B.V., Parbat, D.K. and Nagarnaik, P.B. (2016). XRD analysis of natural sand, quarry dust, waste plastic (ldpe) to be used as a fine aggregate in concrete. International Conference on Processing of Materials, Minerals and Energy, 29-30th July 2016 Ongole, Andhra Pradesh, India, p. 1,432-1,438.
- Doksaiyud, A., Lamyai, W., and Lakananuruk, S. (2014). Utilization of the unused sanfield areas: a case study of nakhon pathom province. J. Soc. Sci. Res., 5(1):147-169.
- Eberhard, Z. (2013). Chemical technology of glass, Society of Glass Technology. The Royal Society of Chemistry.
- Ekpunobi, U.E., Duru, C.B., and Obumselu, F. (2013). Xrd characterization of sand deposit in river niger (south eastern nigeria). American Chem. Sci. J., 3(3):287-293.
- Hasdemir, S., Tugrul, A., and Yilmaz, M. (2016). The effect of natural sand composition on concrete strength. Construc. Build. Mat., 112:940-948.
- Levitskii, A. (2003). The effect of iron oxides on the properties and structure of glazed glasses. Glass Ceram., 60(3):111-114.
- Taxiarchou, M., Panias, D., Douni, I., Paspaloaris, I., and Kontopoulos, A. (1997). Removal of iron from silica sand by leaching with oxalic acid. Hydrometallurgy, 46:215-227.