The study of the geological conditions of Kaolinite genesis in Jalisseh of Pirkoh and the determination of its practical properties for its uses in the porcelain Industry

Farzad Asadi [1], Prof. Ali Darvish Zadeh[2], Prof. Vassef Babazadeh[3], Majid Abrari[4], Ali Montezeri Gelsefidi[5]

1)The faculty member of Azad Islamic University of Lahijan, Islamic Republic of Iran, PhD student of mine exploration of Baku State University ,The republic of Azerbaijan

2) The faculty member & the Head of Department of Engineering Mine Exploration-Islamic Azad University of Lahijan, The Islamic Republic of Iran

3) The head of Department of useful Exploration, Baku State University, The Republic of Azerbaijan.

Abstract

Kaolin as clay has been known and used for years. The area under the study is located in the north of Iran with the latitude of 36° 47' and in the longitude of 50° 12' and at the distance of 15 Km from south-eastern part of Deilaman. Petrological study of Kaolin mother-rock, under the microscope shows that the rock is vitric Tuff with a Rhyolitic combination, having a falcated and embowed glass shards. The layer thickens is about 20 meters, being formed unconformably on a layer of Conglomerate with the thickens about 40 meters. Regarding the fact that shards have a falcated and embowed shape and that the percentage of reworked material within them is low, Tuff is thus a kind of Pyroclastic and airfall. According to the result of the study, it is proved that ash-falling has happened in the water. Strata-bound layers show that the syngenetic deposits can be the main factor in the formation of the clay bound as a result of alterations. Having conducted tests to determine physical properties such as : water absorption, baking temperature, shrinkage, the measurement of brightness was specified after baking and the clay formation for the use in the porcelain production. This mine having the deposit of over 8 million tons of kaolin will envisage good prospects.

Interduction

Kaolin as clay has been known and used for years. This group of minerals are made from the alteration of Feldspar. Kaolin, an Industrial mineral, has a particular importance among the valuable minerals because of its ever-increasing growth in the products produced by it at the global level. The demand for the mineral and the development of the users' industry especially in Guilan province and the supply of a major part of the clay industry of porcelain from the mines in the other provinces, cause the rise in the price of kaolinite products, as a result of which there will be a challenge in the competitive marketing. In this respect the exploring of kaolin deposits is of paramount importance.

Geographical location:

The area under the study is located in the north of Iran with the latitude of 36° 47' and in the longitude of 50° 12' and at the distance of 15 Km from south-eastern part of Deilaman. Its altitude from the sea level is about 1700 meters.(Figure 1)

Geology of the study area

In respect of Geological properties, the region as apart of Alborz mountains is located in central Alborz approximately in the boundary of configuration zones of central and western Alborz. The study conducted by Anlez et. al.(1975) shows that the rocks are Palaeogene consisting of three different volcanic phases. The first phase is under water blow-out, of which the probable age is Eocene Period, mostly comprised from evaporated sediments including Mudstone, Conglomerate, Shale, Volcaniclastic, (Tuff, Tuffite) and Hydroclastic Breccia in the stratified shape. Being with Andesite and Basaltic Andesite lavas. Phases (2) & (3) have aerial volcanic eruptions, their probable age is in the Oligocene period. Phase (2) is mostly comprised from Tuff, Lapilli-tuff, Basalt& Basaltic Andesite lavas. Phase 3 rocks did not lie within the area of the study.(Figure 2)

Petrogeraphi

Petrological study of Kaolin mother-rock, under the microscope shows that the rock is vitric Tuff with a Rhyolitic combination, having a falcated and embowed glass shards (Figure 3). The layer thickens is about 20 meters, being formed unconformably on a layer of Conglomerate with the thickens about 40 meters. The colour of ore surface is bright Buffy, changed into white in the lower parts, with more density and stability toward the upper-side. Regarding the fact that shards have a falcated and embowed shape and that the percentage of reworked material within them is low, Tuff is thus a kind of Pyroclastic and airfall (Figure 4). According to the result of the study, it is proved that ash-falling has happened in the water. Strata-bound layers show that the syngenetic deposits can be the main factor in the formation of the clay bound as a result of alterations(Figure 5 & 6).

The study of chemical combination & mineralogy

In this area we can recognize tow different vertical mineralization zones : the deeper zone which mainly includes Bentonite and the surface zone which mainly contains Kaolin.

1-4 Bentonite Zone : The results of X-Ray show that major minerals include: Quartz and Montmorillonite,.. in respect of frequency. The result of XRF are illustrated in table (1).

According to the above analyses, it can be concluded that the type of this deposit is calcite Bentonite.

2-4- Kaolin zone: The results of X-Ray show that major minerals include : kaolinite , quartz , in respect of frequency. The result of XRF are illustrated in table (1).

According to the above results and to the low percentage of iron Oxide and alkaline oxide and non- existence of harmful minerals such as Sulphur minerals, Kaolin can be use in porcelain industry.

The genesis and determination of kaolin deposit

Briefly the conditions of Kaolin genesis can be described as follows:

As a result of aerial blow-out eruptions of phase 2 in the period of Oligocene, with forming the horst and graben in the region, small and relatively big lakes were created. Volcanic ash fall in sedimentary environment. Very small ash particles have suspended in this basin for a long period of time, then precipitating slowly and quietly. During the period, they change to the Argillaceous minerals by alteration regarding Ph & Eh condition of the environment. The significant finding in this mine is that the sub-conglomerate contact, in the under-most depth of the sedimentary minerals are formed more than Kaolinite minerals. With reducing the depth of sedimentary basin caused by the accumulation of sediments, the proportion has thus caused the increase of Kaoline and the gradual reduction of Montmorillonite mineral.

The phenomenon can be expressed as such that the longer time the suspension of ash particles takes, the more the particles are changed into Montmorillonite as a result of hydration and alteration, but with gradual filling of sedimentary basin and the decrease of the suspension time, their hydration and alteration will decrease. Even with the change of Ph & Eh of the environment, Kaolinite ores are mostly formed. The interesting point is that with the process going on, the alteration will decrease insofar as the ash particles precipitate in the air and Tuff layers remain. This condition is unlike the theory of Anlez and other researchers who studied the region. As they claim, since volcanic eruptions in Oligocene and particular geochemical and geophysical conditions of the sub-sea in the particular formation time period, the dispersed Feldspar in the sea, affected by the appropriate chemical and physical conditions, became altered, precipitating in the shape of strata bound. Numerous glassy shards show blow-out in the land and lack of large expansions and dispersions of kaolinite ores in the area, which invalidate the theory proposed by Anelz et. al.

If the genesis of Bentonite was formed in the sub-sea, Bentonites containing sodium ion must have been formed, just like the most Bentonite zones of central Iran, because of the abundances of sodium ion in the environment. But Bentonite formed in this mine are of Calcic type. As the results of experiments show, the amount of Sodium Oxide is less than 0.1%. From the very low percentage of Sulphur, there is less than 1 ppm, while the amount of Cl is less than 22 ppm in the chemical analysis of the ore body. The observable and slender bedding in the mine and the other foregoing reasons, we can conclude that the genesis of Kaolin ore is autochthonous and sedimentary. Regarding the exploratory operations, the amount of recoverable reserve is estimated nearly about 8 million tons and the amount of mine-able Bentonite, 450000 tone.

The application of Pirkoh Kaolin

One of the main uses of kaolin is in the porcelain Industry; therefore, the usability of the mineral ore has been studied in the industry. Particular properties and characteristics are determined for the raw materials whose limitation and characteristics ensure the quality of products in every industry. The measurement of the water absorption, the temperature of drying and baking, the parameters of shrinkage and dilation during baking and drying, the measurement of the brightness after baking (named as baking colour), are all among laboratory experiments conducted for specifying the baking characteristics (table 2). The amount of Alkali materials has a considerable effect on the vitrescent properties, because they are able to change porosity of ceramic body. The Kaoline used in the ceramic Industry must have less than 1.5% potas, the least amount of Titanium and free silica. All the above experiments have been conducted in the kaolin mine.

conclusion

Petrological study of Kaolin mother-rock, under the microscope shows that the rock is vitric Tuff with a Rhyolitic combination, having a falcated and embowed glass shards

The layer thickens is about 20 meters, being formed unconformably on a layer of Conglomerate with the thickens about 40 meters.
Regarding the fact that shards have a falcated and embowed shape and that the percentage of reworked material within them is low, Tuff is thus a kind of Pyroclastic and airfall
According to the result of the study, it is proved that ash-falling has happened in the water. Strata-bound layers show that the syngenetic deposits can be the main factor in the formation of the clay bound as a result of alterations
The results of physical testes show the appropriate quality of the deposit in the use of porcelain industry (table 3). The mineral processing of Kaolin results in the reduction of its free silica, Iron Oxide and the other gangue minerals. The concentration can be used for the porcelain and ceramic Industry or even for the production of Mucilage.

Reference

1-Abrari,M,(2009), "Exploration of bentonite in south-west Lahijan eara" , M.S dissertation in Tehran Azad University.

2-Annells, B.N. 1975. Explanatory text of Qazrin and rasht Quadrangles map Geological survey of iran

3-Asadi,F, (2008), " Exploration report about Pirkoh Bentonite mine" mine and industry organization of Guilan province

4-Fredrickson, A.F.(1951) ,mechanism of weathering" :Geol. soc. amer. bull.62, pp.221-232.

5- Goldich .s. s.(1938) ، "a study in rock weathering" :jour .Geol .vol.46.pp17-58

6-Senshenas,M, 2009, Report of physical test kaolin Baking in Khazar Tail Factory.

7-Wedepohl, K.H., Ed. 1969. Handbook of Gochemistry. Springer- Verlag, New York, Heidelberg, Berlin, various paging. Wedepohl, K.H. 1971a. Geochemistry, Holt, Rinehart and Winston, New York, 231 **pp.**

Figure 1: location of study area

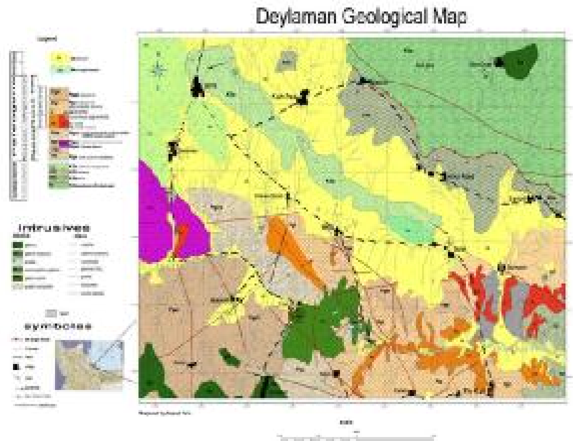
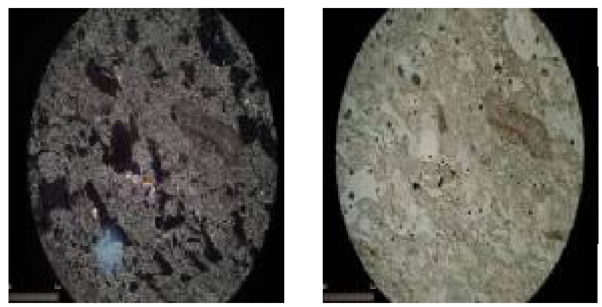


Figure2 : Geological Map of Deylaman-Pirkoh

Figure 3 vitric tuff with egnemberite texture that have shard glass (XPL)



Figuer 4 XPL PPL

Littik breccia tuff in which texture Feldspar& Quartz can be seen

Figure 5 strata bound of ore body in the study area

Figure7 Sample kaolinite.J.s

Table 1 : chemical combination of the Bentonite & kaoline sample

XRF Analyze Report

Sample.	Unit	Bentonite.J.100	Kaolinite.j. s	Kaolinite.j.140
SiO_2	%	66.39	72.93	63.82
Al2O3	%	15.55	19.26	26.48
MgO	%	1.05	0.07	0.16
Na_2O	%	0.12	0.01	0.01
K2O	%	0.87	0.18	0.20
CaO	%	1.33	0.25	0.20
TiO2	%	0.39	0.313	0.342
Fe2O3	%	1.03	0.60	0.43
SO_3	%	0.003	0.003	0.003
L O I	%	13.29	5.94	7.97

Table 2 : result of kaolin baking

550 cc	Water	Jeliseh _ Pirkoh	Clay Name
3 gr	Liquid Maker	2009.04.12	Sampling Data
1.63	Density (gr/cm3)	2009.04.23	Baking Data
23	Viscosity	5.5	Mosture %
--	+100#	0.17	Expantion%
1105	Baking Temperature	5.92	Pre-baking Resistance
52	Baking Cycle	17.21	Water Absorption %
1100 - 2800	Pressure	--	Post- Baking Risistance
		4.68	Heating Waste%
		0.41	Baking Contraction
		White	Post-Baking Color

Table 3 : Formulation of clay baking use in Khazar Tile Factory

		%	Formulation compound
test 1	Body Code	20	Pirkoh Kaolin
10.2. 88	Baking data	0.16	Noncombustible clay (shiraz – Abadeh)
5.2	Mustier %	22	Cheskin Kaolin
0.4	Expand %	10	Chobar- Shaft kaolin
6.8	Pre – Baking Resistance (kg/cm2)	12	Hamedan Dolomaite
14.7	Water Absorption %	15	Zenoz Kaolin
195	Post- Baking Risistance (kg/cm2)	5	B.T
8.5	Heating Waste %		
1.3	Baking Contraction (mm)		
White – chocolate	Post-Baking Color		