A study of mineralogical and chemical and industrial applications of south Amlash mica (in East of Gillan) province)

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Abstract

This mineral deposit is in Gillan and south of Amlash geographically in longitude 50° 11' and latitude 37° 4 ′. In this paper, the mineral matter (mica) picking up the mines of south of Amlash city is studied by XRD, DTA, XRF and microprobe methods for apparent density and chemically. The XRD Analysis and microprobe and the chemical analysis of obtained reagent samples of the present storage areas show that consitituent oxides that can belong to Biotite, floroapatite, anatase, calcite, quartz, and orthoclase phases. Using microprobe analysis on macro and microcrystallines determined that mica's compositions are different and in accordace with Mg, Al, Fe, Ti is describable, micas were crystallized initially, they have higher Mg and Al_2O_3 and lower TiO_2 and Fe than delayed kinds and sorts. In this paper, south Amlash mica physical characteristics like as Thermal conductivity is equal to 0/058-0/071 W/mK that show this mica's thermal insulator and it's combustibity is fire proof that rate of it's fire proof is 1250 °C, it's sintering temperature is 1250 °C and it's fusion point is 1320 °C (high), that showing this mica's resistance to the therm and heat. It's cation exchange capacity is 100-180m^2/100 gr and it's specific h&t is 0/20-0/26 Kcal/kgK, this mica water holding capacity is 220-325 weight percentage or 30-50 volume percentage. Also, this mica electrical conductivity is 0/40 ds/m that is cause to use it in the electrical industry as an insulator.

Introduction

Mica is a mineralogical word for a group of minerals with similar (common) chemical structure and characteristics. Mica has a based face in soft slim elastic surfaces structurally and has not been defined minerologically in a way that is belonged to phylite group and on the other hand is seen as a special group called hydrosilicate [1, 2, 3, 4]. Micas as the industrial minerals have the best collection of characteristics. Especially it's usage as the electrical insulator is higher than other comparable materials. Because it has special heat resistance and heat expansion and is not flammable. Also it has good dielectrictic characteristics since it is a good insulator for high potential cables [6,7]. The most important goal of this work is doing exact mineralogical studies on the mica mineral obtained from the south of Amlash and determining it's basis mineralogical component and study of difference of mica's initial and delayed chemical composition on increasing and lamperiphier magma crystallization in this zone and also study and measuring this mica physical characteristics and it's usage in the different industries.

General geological and petrology of the studied area

The studied area is in longitude 50° 11' and latitude 37° 4' which is located in Gorgan-Rasht in the aspect of deviding structural and gological units of Iran and consists of the areas which has limited the sea line of Caspian and is located in the north of Alborz or Khazar faults. By stratigraphy, the oldest wanted stones in the area of sandstones and Jorasic carbonaceous shale shows that they are shemshak formation. After shemshak formation, the gray lime sediments along two eastern and western faults have outcrop. These limes have micraeity ground which became dolomite very little. According to previous researchers [8] the lamprophrey dikes of host stone is the mineral that have cut these limes sparsely. Discussion and activity method

A- sample selection

First, All active and inactive production workshops of the Amlash mica's mine were investigated and was done to provide index samples in the different parts of the workshops. To do practical studies, after visiting the mica production manufactory, different products of manufactory like raw and cooked ones in various sizes were sampled. The identity card of some of gained samples have been given in table 1 (only mica). After doing the mentioned sampling, the samples were prepared and packed and sent to the laboratories to do necessary experiments.

B- XRF Analysis

XRF Analysis did by a device of ARL kind and 8410 model in center of research and mineral matter products of Iran, The obtained results of XRF analysis show in Table 2. This analysis did on two samples of raw and cooked mica. Study of XRF results show that in the M_2 sample (raw *mica),* amount of LOI=4/22% (water and volatile matters) more than LOI of M_{22} sample (cooked mica) that it is equal of 1/22 weight percentage that this matter and subject can explain like that for thermal effect of raw mica, a series of volatile oxides with water and some of cations exit from the cation and the alteration products, that this subject cause to increase the volume and expansion in heated Biotite sample.XRF data shows that the amount of rate Mg^{2+} /Fe^{2+} is less than 2 in all crystals. Therefore these crystals are located in ferritic pole (biotite). According to XRF analysis since the amount of Mg in all these crystals is higher than usual biotite, the crystals are called as magnesium biotite.

C- XRD Analysis:

In study of XRD (X-ray — Diffraction) did by Simens device of D-500 model. The XRD experiments on M_{20} (diagram 1) that black mica has several centimeter dimensions, the lattice spacing is belongs to Biotite phase with very high purity degree and see like as the subsidiary minerals of Anatase, calcite and Apatite, these mineral formation in magma's conditions have full of Ti, F, K, Na. Mg, Fe, P, Ca that after cooling and pressure declining and penetration in the area's stones is caused to the mineral formation. The obtained of XRD study is from cooked product of mica's products factory (M_{22}) belong to Biotite phase that have the impurity of TiO_2 and CaCO3 that it seen in diagram 3. The messenger intensity in the sample [M_{22}] is very less than M_{20} sample, and it hasn't the sample uniformity that it is for low density and also for the micas heated to 900° and water and volatile matters and its oxidants and the crystalline structure is destoring approximately.

D- The Results of DTA analysis on raw and cooked mica:

The DTA experiments did by a device of STA 1640 model in the open air and 15 dig/min average speed. The diagram of the investigated samples of raw and cooked biotite (diagram 3) shows that by increasing the heat to 400°C as a result of oxidation process in crystal structure of biotite we face weight increasing and energy changes and bent slope is to the above. But after 400°C, on the other words by gradual increasing of heat we face decreasing in weight and energy changes, this is probably because of evasive material and water and some cations exiting as a result of heat increasing which shows these reactions are calefactory.

E- EPMA analysis:

Using microprobe analysis on macro and microcrystallines determined that mica's compositions are different and according with Mg, Al, Fe, Ti is describable, micas were crystallized initially, they have higher Mg and Al_2O_3 and lower TiO_2 and Fe than delayed kinds and sorts.

F- Applied —physical experiments:

In this paper, south Amlash mica physical characteristics like as thermal conductivity is equal to %58-%71 w/mk that show this mica's thermal insulator and it's combustibity is fireproof that rate of it's fireproof is 1250°C, it's Sintering temperature is 1250°C and its fusion point is 1320°C (high), that showing this mica's resistance to the therm and heat. Its cation exchange capacity is 100-180m^2/100gr and its specific heat is 0/20-0/26 kcal/kgK, this mica waterholding capacity is 220-325 weight percentage or 30-50 volume percentage. Also, this mica electrical conductivity is 0/40 ds/m that is cause to use it in the electrical industry as an insulator.

G-study of thin section:

The lithology (macroscopic study) of stones consist of mica (figure 1), the analysing Biotite microcrystallines and clinopyroxene is in the same cation's microcrystalline field. The stone texture is porphyria and the stone's name is Munshicite.

Figure 2: the Biotite macrocrystallines that fill in with calcite between many of its separated lamins layers.

Conclusion:

The studied mineral ore deposit is black mica or biotite that these crystals show the middle characteristics of biotite and phlogopite totally and according to the XRD and XRF analysis and microprobe. Microprobe XRF data shows that the amount of rate Mg^{2+} / Fe^{2+} is less than 2 in all crystals. Therefore these crystals are located in ferritic pole (biotite). According to XRF analysis since the amount of Mg in all these crystals is higher than usual biotite. The crystals are called as magnesium biotite. The amount of Mg^{2+} / Fe^{2+} is less than 2 in all of crystals. Therefore, these crystals are in the ferritic pole (Biotite). According to XRF analysis since the amount of Mg in all these crystals is higher than usual biotite, the crystals are called as magnesium biotite. Microprobe investigations and studies have shown that primary biotites have fewer TiO_2 and Al_2O_3 and MgO to the late ones and also the amount of TiO_2 of biotites shows increase by pressure decreasing. The center of these crystals are slighter than the verge because of high Mg and low Fe of the center and the component of these micas (crystalline firstly) is closed to phlogopite structure verge part and ground fine crystals are darker than other crystals because of late crystallization. Also, XRD analysis show orthoclase and anatase and floro apatite minerals beside biotite mineral. The results of XRD experiments from mica crystals show that net distances (d_{hkl}) measured are homologue with standard biotite d_{hkl}. XRD analysis on M_{22} sample signal about floro apatite hasn't been wanted that this subject is for the crystalline structure demolition and destruction of floro apatite mineral on thermal effect. Totally strange phases belonged SiO_2, TiO_2, $CaCO_3$ and also the shape of Ti, Mn, P, Na can be replaced by the elements like Fe^{2+} , Fe^{3+} , Al^{3+} , Mg^{2+} and directly in molecular structure of biotite. Also in this thesis the exterior density of raw and heated biotite was measured. The mean volume in raw mica which is equal V_m= 1/63 8cm^3 is more than mean volume in cooked mica which is V_m=0/0857 and surface density mean in heated mica that is D_m=3/1995 g/cm^3 is higher than surface density mean in raw mica which is equal D_m=3/0074 g/cm^3, and this problem in cooked mica is probably because of exiting water and evasive material from mica crystal net, which caused more concentration of elements inside the crystals and the surface density amount in Amlash biotite is almost equal to surface density of standard biotite which is ***Dm=3/100.*** According to table 4, by measuring the physical characteristics like special heat, electrical and thermal conductivity (low), fusion point temperature (high), combustibility (fire proof), cation exchange capacity. And water holding capacity (high), we could studied the industrial usages of mica's south of Amlash in the different industries. In according to these characteristics of this mica can use it in the fire proof industries as thermal insulation, in the oil well drilling to prevent the drill sticking, in the electrical industries as the electrical insulation, in the agriculture as water, air and cation absorbants and use in the cosmetics for it's bright and brillian and splendent luster and shine.

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Table 1: Survied sample position

Analysis	Surface characteristics description	Sample position	samples Number	Number
XRD,XRF	Black mica with multicentimeter aspects	rough grain product of mica production manufactory	M_{20}	1
XRD,XRF	expanded sliced mica in golden color	cooked product of manufactory with code 501	M_{22}	*2*

Table 2: XRF analysis from the gained reagent samples.

Field	M_{10}	M_{12}	M_{14}	M_{20}	M_{22}
LOI	12/26	29/72	15/56	1/22	4/22
Na_2O	0/26	0/21	0/18	0/48	0/30
MgO	9/55	2/19	3/56	14/61	11/60
AL_2O_3	16/11	7/55	13/42	16/10	16/24
SiO_2	36/93	24/94	29/81	34/59	36/73
P_2O_5	0/51	0/08	1/01	<0/1	0/24
SO^{-2}_3	0/07	0/04	0/22	0/31	0/24
K_2O	3/72	1/61	3/82	11/02	7/29
CaO	5/10	30/11	15/06	0/91	3/11
TiO_2	4/13	0/44	4/09	7/32	6/35
MnO	0/12	0/18	0/12	<0/1	0/11
Fe_2O_3	10/81	2/79	12/24	12/36	12/92
BaO	0/24	<0/1	0/64	0/73	0/44

Table 3: microprobe analysis on mica samples.

Sample	Fine crystal	Fine crystal	Core	Edge	Edge	Core	Edge	Core
SiO_2	36/65	36/60	36/46	34/37	35/56	36/41	35/90	36/05
AL_2O_3	16/05	16/30	15/90	15/03	15/11	16/08	15/18	15/87
TiO_2	8/02	8/12	7/75	10/62	10/09	7/59	7/96	7/92
Cr_2O_3	0/00	0/00	0/14	0.00	0/05	1/10	0/06	0/04
FeO	10/14	9/11	10/45	9/66	10/20	10/45	13/48	9/91
MgO	15/78	15/85	15/61	14/39	14/80	15/40	13/43	15/71
K_2O	9/91	10/14	9/97	9/15	9/35	9/68	9/64	9/55
Na_2O	0/47	0/47	0/59	0.43	0/52	0/53	0/64	0/59
CaO	0/00	0/00	0/00	0/00	0/00	0/00	0/00	0/00
MnO	0/04	0/00	1/05	0/00	0/19	0/02	0/19	0/01
NiO	0/00	0/11	0/00	0/00	0/01	0/00	0/00	0/09
plus	96/95	96/70	96/90	93/64	95/88	96/26	96/46	95/74

Table4: physical properties of exfoliated biotite

Bulk density:	120-250 kg/m^3
Thermal conductivity:	0.058-0.071 W/mk
pH(in water):	≈7
Combustibility:	Non-combustible
MOH Hardness:	1-2
Sintering temperatuer:	1250°C
Fusion point:	1320 °C
Cation exchange capacity(b):	100-180 me/100gr
Specific heat:	0.20-0.26 kcal/kgK
Waterholding capacity(a):	220-325-% by wt
electrical conductivity:	0/40 ds/m

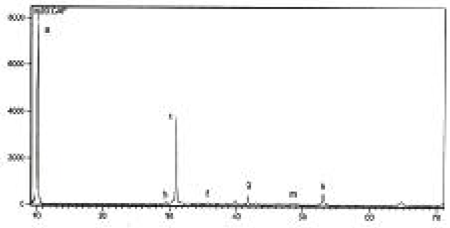

Diagram: XRD analysis of black mica in multi centimeter aspects (M_{20}) a,c,g ,k : reflexes about mineral phase of biotite b: TiO_2 alien (or foreign) phase. m: signal resulted from $CaCO_3$ phase f: apatite (strange phase).

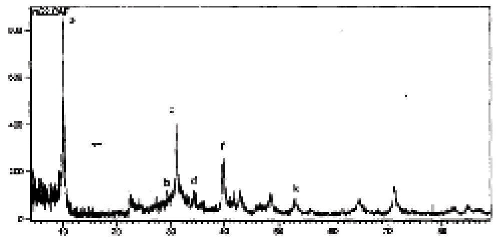

Diagram2: XRD analysis ofM_{22} sample:
k, f, c, a: the obtained signals of impurity Biotite mineral
b: TiO_2 alien (or foreign) phase.
d: the obtained signal of $CaCO_3$ phase.

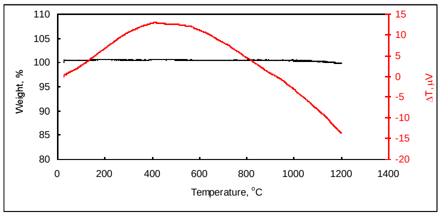

Diagram3: heat analysis (DTA) from raw and cooked biotite (in the air, 15°C in minute to 1200 °C).

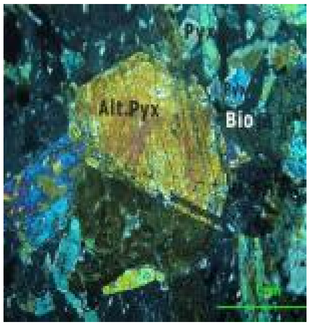

Figure 1: The Biotite macrocrystallines and clino pyroxene that its field is analysing and it see in Munshicite stone (study in light of xpl)

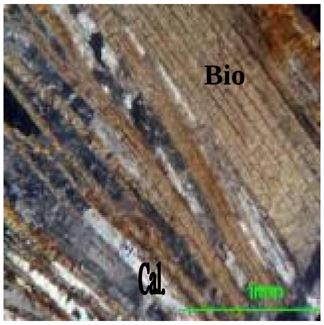

Figure 2: The Biotite macrocrystallines that fill in with calcite between many of its separated lamins. (study in the light of xpl).