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Properties and Suitability of East Aqaba Area Feldspar for Glass Industries in Jordan

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Abstract

In this study, a pegmatite ore with a Na_2O/K_2O (5.54-4.29) ratio of 1.29 was studied in a Denver flotation cell in which both at natural and acidic pH using HF and H_2SO_4. Because of the perthitic structure of the ore no significant separation is observed at natural pH. Interestingly, a selective separation was achieved at low pH using HF and H_2SO_4 (pH 2–3). a pegmatite ore composed of 5.53% Na_2O and 4.29% K_2O is upgraded to 10.51% Na_2O and 6.59.02% K_2O with a Na_2O/K_2O = 1.62 in HF medium and to 2.55 in H_2SO_4 medium. It is shown that products recovered in various stages are also considered as commercially significant; especially quartz which is recovered in the tailings in HF medium is suitable for glass industry.

Keywords: flotation, dry screen analysis, crushing, screening, heavy liquid separation

1. Introduction

Feldspar is the most common rock-forming mineral occurs in igneous, metamorphic, sedimentary, and numerous granitic rocks and thus can be found throughout Aqaba at south of Jordan. Feldspar weathers to kaolin which is the main clay mineral used mainly in the manufacture of ceramics, glass, and fine pottery. Feldspar minerals subdivided into plagioclase feldspars, and potassium feldspars. Plagioclase feldspars are sodium, calcium, aluminum, and silicates. The plagioclase feldspar is albite (moonstone) (sodium rich), anorthite (calcium rich), andesine, Oligoclase, and labradorite. Two properties makes feldspar useful for downstream industries, which is alkali and alumina contents, therefore we can distinguish their families as Feldspathic, pegmatite and Feldspar. Further distinction can be made between sodium potassium and mixed Feldspars depending on the type of alkali they contain. Feldspar plays an important role as fluxing agent in ceramics and glass application and also used as functional fillers in the paint plastic, rubber and adhesive industries.

It is found that the area of Aqaba city is the best for my study, because large amount of alkali feldspar granite raw materials on the surface containing about 71% potassium, 23% sodium and the proportion of quarts in purities mostly 5.5 mere bat of iron. Also you find the effect of the tectonic movements on the area cracked and shattered a large part of the rocks in different ways affecting mostly the middle part of the region. Moreover the way of reaching the area is very easy either by roads or valleys.

Generally, feldspar is used in the manufacture of glass products (70%), ceramics and other products (30%) (Potter1996). Feldspar is an important ingredient in the manufacture of glass. The raw material for glass consists of silica sand, soda ash (sodium carbonate) and limestone (calcium carbonate). Feldspar adds certain qualities to the process. Alumina provides hardness, workability, strength, and makes glass more resistant to chemicals. Na_2O and K_2O from feldspar are fluxes that reduce the melting temperature, so decrease the energy used and decrease the amount of soda ash needed (Kauffman & Van Dyk, 1994; Bourne, 1994). About 110 pounds of feldspar are used to produce one ton of container glass (soda bottles, e.g.), and 100 pounds are required to produce one ton of flat glass (Alex Glover, 1999, pers. com). The alkali content in feldspar is an important ingredient in the manufacture of glass, because it acts as a fluxing agent, reducing the melting temperature of quartz and helping to control the viscosity of glass, thus reducing production costs. While alumina acts as a stabilizer and improves the finished product by increasing resistance to impact, bending, thermal shock, increases viscosity during glass formation, and inhibits devitrification.

2. Processes of Collecting Samples

For focusing purposes three samples were collected fully representative from three parts of the region of the study at Aqaba south of Jordan as follows:

Composite sample no.1 represents central part, where the sample collected from 69 different sites a round., where the amount of each sample was fixed by 10 kg. Composite samples have deferent sizes of rocks; they were crushed to obtain soft and smooth powder for chemical analysis.

3. Laboratory Chemical Charactrectes

Chemical analysis were conducted by calibration size process after resolution of one gram of the composite sample powder in 10 ml of Chloride acid and water then heated until boiling for ten minutes; all the compounds dissolved except silicon dioxide. The sediment of the filtered composite sample powder by useless ash paper washed with distilled water several times and the resulting sludge incinerated at 1000 degrees Celsius for three hours in order to determine the proportion of silicon dioxide in the composite samples. The output of the filtered composite sample were taken and put in a 100 ml beaker and later used for chemical analysis to determine Fe_2O_3 and Al_2O_3 in sedimentation by Sodium Hydroxide Solution of 0.1 concentrations in presence of methyl red detector until the color change to yellow. The resulting sludge faltered by useless ash paper washed then calcining the sediment as in the case of determining Silicon. For iron proportion I toke a portion of the sediment output filtered by useless ash paper and washed by distilled water, then resolve the resulting oxides solution of acid with concentrated chlorine and heated to calibrate iron using a solution of EDTA in presence of salicylic acid detector, and the difference identified aluminum. Determining the MgO and CaO by calibrate a solution of EDTA in presence of Erochrom black T detector. For determining K_2O and Na_2O we used flame photometer process.

Table 1. Analysis of the Composite Samples in laboratory

Sample no.	LOI	SiO_2	CaO	MgO	Fe_2O_3	Al_2O_3	TiO2	Na_2O	K_2O	Mn	Na_2OK_2O
Sample 1	1.04	72.46	2.46	0.25	1.32	13.98	0.88	5.53	4.29	0.02	9.82
Sample 2	1.31	74.72	2.04	0.20	0.37	13.63	0.92	5.34	4.34	0.03	9.68
Sample 3	1.78	72.33	2.22	0.42	0.81	12.90	0.32	5.54	3.05	0.03	8.59

To audit the results obtained in the laboratory through chemical analysis we identified the proportion of acids that the composite samples constitute by XRF ray on XRF device, and the results was almost compliance as we see in tables1&2. The normative classification for the three composite samples represented in table 4.

Table 2. Analysis of the Composite Samples by X.R.F

Sample no.	LOI	SiO_2	CaO	MgO	Fe_2O_3	Al_2O_3	TiO2	Na_2O	K_2O	Mn	Na_2OK_2O
Sample1	1.01	72.20	2.22	0.23	1.31	13.91	0.87	5.58	4.28	0.03	9.86
Sample2	1.32	74.83	2.28	0.19	0.40	13.71	0.91	5.39	4.42	0.05	9.81
Sample3	1.77	72.31	2.28	0.53	0.84	12.95	0.38	5..57	3.01	0.03	8.58

Table 3. Chemical Composite

Minirals			
Quartz	23.12	25.08	21.91
Orthoclase KAlSi3O8	23.05	25.02	23.91
Albite Plagioclase NaAlSi3O8	45.53	41.82	48.21
Anorthite Ca Al Si2O3	2.05	1.89	0.56
Mafic	5.95	6.19	6.02
Orthoclase+ Albite +Anorthite	70.63	68.73	72.68

Table 4. Normative Classification of Composite Samples

Chemical composition		Samples 1	Samples 2	Samples 3
Potassium Oxides	k2O	25.37	26.23	20.41
Sodium Oxides	Na2O	46.73	45.13	46.81
Calcium Oxides	Ca2O	0.63	.0.09	0.12
Mafic Group Oxides	Fe2O3 +TiO3+MgO	5.27	5.54	6.00
Quartz		22.00	23.01	30.07
Total		100.00	100.00	100.00
Feldspar		72.73	71.45	67.34

4. Chemical Aspect

The results of chemical analysis of the composite samples showed that ore granite Alkali Feldspar is of medium Grade kind (Contain 8.5- 9.5 percent of the oxides of sodium and potassium). Therefore to meet the specifications required for the manufacture of white Transparent glass, and industries of high quality of ceramic tiles, we should reduce the amount of impurities to the minimum rate that required to get a fine product without impurities of iron compounds, magnesium compounds and titanium compounds, as well as alleviate the proportion of silica, and separate the pure feldspar into two types which is Sodium spar and Potassium spar.

5. Mechanical Laboratory Process

Table 5. dry screen analysis of the composite samples

Size Fraction in mm	Wt%	Cumulative Wt. %	Na2O%		K2O%		Al2O3%		SiO2%	
			Assay	Units	Assay	Units	Assay	Units	Assay	Units
+2	6.53	6.53	4.21	27.49	4.61	30.10	13.64	89.07	71.60	467.55
-2+1	27.68	34.21	6.00	166.08	4.35	120.41	14.14	391.39	70.28	1945.35
-1+1/2	10.06	44.27	5.12	51.51	4.55	45.77	13.29	133.70	70.44	708.68
-1/2+1/2	10.82	55.09	5.28	57.13	4.41	51.61	13.57	146.83	70.90	767.25
-6.35+4	6.76	61.85	6.02	40.69	4.43	29.95.	14.14	95.59	71.34	482.26
-4+2	8.11	69.96	6.25	50.69	4.53	36.74	14.19	115.05	70.49	571.67
-2+1	7.77	77.73	4.85	37.68	4.43	34.89	13.23	102.80	70.99	551.59
-1+0.5	7.58	85.31	5.35	40.55	4.71	35.70	14.78	112..03	70.90	537.42
-05+0.297	4.29	89.80	5.68	24.37	4.10	17.59	13.75	30.48	70.39	301.97
-297+210	2.12	91.72	5.18	10.98	437	9.26	14.38	39	71.36	151.28
--210+149	2.80	94.52	5.25	14.70	4.36	1221	14.10	48	70.92	198.58
-149+74	2.28	96.80	5.40	12.31	4.24	9.67	14.40	32.83	72.86	163.84
-74+53	0.58	97.38	5.18	3.00	4..13	2.39	14.50	8.41	70.61	40.95
-53	2.62	100.00	5.31	13.21	493.	10.30	14.68	38.46	70.62	185.02
calculated	100.00		5.51		4.43		13.95		70.73	
Chemical Analysis		5.53		4.29		13.98		71.46		

The ore feldspar granite of the composite samples for Laboratory tests were mechanically processed as follows:

Firstly dry screen analysis processed by drying the composite samples then screening the composite samples for 20 Minutes with screening machine (RO-Tap) Tyler Testing Sieve Shaker of type (Tyler Sieve System). Secondly dry screen analysis of the composite samples after crushing plus minus 2MM Table 5.

Note that the mechanical dry analysis had no impact on the metals as oxides of sodium and potassium silica oxide, since these metals distributed by different proportions to the all different sizes. Chemical analysis of different size fraction of the dry screen of the first composite sample is represented in Table 6.

Table6. Chemical analysis of different size fraction

size Fraction in mm	Composite Sample 1		Composite Sample 2		Composite Sample 3		Composite Samples 1+2+3 Average by calculation	
	Wt.%	Cumulate Wt.%.	Wt.%	Cumulate Wt.%.	.Wt%	Cumulate Wt.%.	Wt%.	Cumulate Wt.%
-2+1	26.53	26.53	28.21	28.21	27.61	27.61	27.56	27.56
-1+0.50	27.58	54.11	30.57	58.78	28.07	55.68	28.89	56.45
-0.50+0.297	13.62	67.73	12.87	71.65	13.69	69.37	13.37	69.82
-0.297+0.210	7.28	75.01	7.10	78.75	7.38	76.75	7.25	77.07
-210+194	6.95	81.96	5.37	84.09	6.53	83.28	6.19	83.26
-149+105	4.59	86.55	4.10	88.19	4.20	87.48	4.26	87.52
-105+74	2.60	89.15	2.20	90.39	2.86	90.34	2.54	30.06
-74+53	4.41	93.56	4.30	94.69	3.96	94.30	4.20	94.26
-53	6.44	100.00	5.31	100.00	5.70	100.00	5.74	100.00
total	100.00		100.00		100.70		100.00	

6. Crushing and Screening

Crushing and screening of the composite samples done in two phases (Figure 1):

Phase 1; Crushing the crude to pass from a sieve of size 25.4 mm, in which the primary crushing used Jaw crushing machine.

Phase 2; Crushing the crude to pass from a sieve of size 2 mm, in which the secondary crushing used a canonical crushing machine.

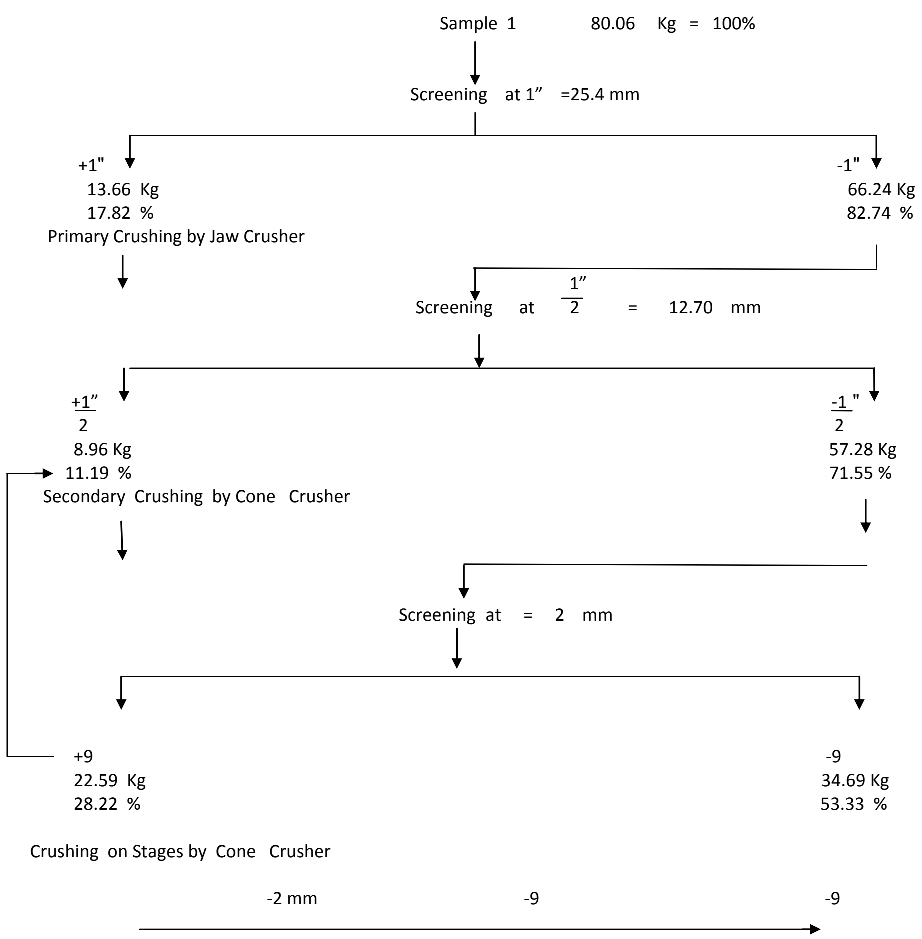

Figure 1. Process of crushing and screening of the composite samples

7. Separation Using Heavy Liquid

Consecutive tests conducted on the raw feldspar using heavy liquid Bromoform to illustrate the concentrations of various density we get:

1-Best density quality of the liquid of heavy Bromoform to separate 90-95 percent of a collection of black metals was 2.594 g/ml. Table7.

2-Best density quality of the liquid of heavy Bromoform to separate black metals plus silica was 2.61 g/ml. Tables 8 & 9.

Table 7. Degree of Liberation

Size Mesh and Micron			Percentage of Liberated Minerals					
			Feldspar		Quartz	Mafic Biotite	Contaminated grains	Total%
			Orthoclase	Plagioclase				
+32	Mesh	500mic	42.2	18.0	23.7	3.2	12.50	99.30
+48	Mesh	297mic	47.0	13.3	23.6	8.5	7.00	99.40
+65	Mesh	210mic	45.8	17.8	26.4	3.9	6.10	100.00
+100	Mesh	149mic	42.3	23.0	20.3	4.0	10.20	99.80
+150	Mesh	105mic	41.5	19.0	24.5	5.5	9.00	99.50
+200	Mesh	74mic	36.6	19.0	24.3	5.5	12.20	97.60
-200			34.4	13.4	25.1	4.9	21.10	98.90

Table 8. Heavy liquid separation1

Products	wt%	Na2O%		K2O%		Al2O3%		SiO2%		Fe2O3%	
		Ass	Unit	Ass	Unit	Ass	Unit	Ass	Unit	Ass	Unit
Float	94.68	6.09	576.60	4.54	429.85	13.89	1315.11	73.51	6959.93	0.25	23.67
Sink	5.32	4.31	22.93	2.37	12.61	11.83	62.94	52.77	280.74	12.01	63.89
Calcul Assay	100.00	5.99		4.42		13.78		72.41		0.88	

Table 9. Heavy liquid separation 2

Products	wt%	Na2O%		K2O%		Al2O3%		SiO2%		Fe2O3%	
		Assay	Recovery	Assay	Recovery	Assay	Recovery	Assay	Recovery	Assay	Recovery
Float	94.68	6.09	96.18	4.54	97.15	13.89	95.43	73.51	96.12	0.25	27.03
Sink	5.32	4.31	3.88	2.37	2.85	11.83	4.57	52.77	3.88	12.01	72.97
Calcul. Assay			100.00		100.00		100.00		100.00		100.00

8. Grinding and Screening

For grinding the raw feldspar granite we used a rod laboratory machine of radius 25 cm and by percent of 60 solid materials as follows:

The raw materials inter for crashing and inter from screener of size (2 mm) on another screener of size 210 micro (65 meshes). The part above the screener to be used in the rod crushing machine, but the other part which interred the screener will be separated then interred through a screener of size 50 micro. Continuing this process for the raw materials we get

Micro	Wt.	
-210+50 =	75.96%	Feed for Flotation
-50 =	24.04%	slime

Table 10. The granite alkali feldspar is the most cruelty in rocks as in the following

Minirals	Degree of Cruelty	Percentage %
Silica	7	23%
Sodium and potassium Oxides	6	71%
Fe 2O3	6	6%

The crashing of granite feldspars is very hard and costly; therefore we should crash it in three steps instead of two. Also it is better to crash the granite alkali feldspar when it is wet to avoid the problems in a dry way. After the process of grinding and screening we made the concentration of raw feldspar by multi flotation.

9. Feldspar Differentiations Flotation

Before any process of flotation we have to do scrubbing (washing), agitation and conditioning. Concentration of raw feldspar by multi-flotation done by three stages:

Table 11. Stage one; Flotation of iron compounds and the Biotite (Mica)

Products		Feldspar CI. Conc	Feld. Rougher Conc.	Feld.Tailing	Mica+Iron Float	Slime	Total
wt%		30.83	18.82	20.92	5.39	24.04	
	Assay	62.06	66.72	82.86	52.77	63.42	67.11
SiO2%	unite	1913.31	1255.67	1733.43	1733.43	1524.62	
	recovery	28.50	18.70	25.80	4.20	22.80	
	Assay	0.24	0.02	0.08	12.01	4.30	1.78
Fe2O3%	unite	7.40	0.38	1.67	64.73	103.85	
	recovery	4.16	0.21	0.94	36.36	58.33	
	assay	0.28	0.06	0.05	4.82	1.72	0.78
MgO%	unite	8.63	1.13	1.05	25.98	41.35	
	recovery	11.00	1.40	1.30	33.30	50.00	
	assay	1.16	0.87	0.77	6.36	2.47	1.62
CaO%	unite	35.76	16.37	16.11	34.28	59.38	
	recovery	22.07	10.10	9.94	21.16	36.65	
	assay	10.65	8.89	2.84	4.31	3.67	6.66
Na2O%	unite	328.34	167.31	59.41	23.23	88.23	
	recovery	49.30	25.10	8.90	3.50	13.20	
	assay	6.59	4.99	2.59	2.37	4.25	4.66
K2O%	unite	203.17	93.91	54.18	12.77	102.17	
	recovery	43.60	20.20	11.60	2.70	21.90	
	assay	17.63	17.08	9.51	11.83	16.50	16.50
Al2O3%	unite	543.22	321.44	198.95	63.76	396.66	
	recovery	35.64	21.09	13.05	4.185	26.02	
	assay	0.54	0.79	0.50	4.76	2.31	1.23
L.O.I%	unite	16.65	14.87	10.46	25.66	55.53	
	recovery	13.50	12.10	8.50	20.80	45.10	

Table 12. Stage two; Flotation of feldspars

wt%	Minerals	Assay%	Recovery%
49.65	L.O.I	0.66	-
	SiO2	64.39	47.20
	Al2O3	18.35	61.00
	Na2O	9.77	74.40
	K2O	5.79	63.80
	CaO	1.01	-
	MgO	0.17	12.40
	Fe2O3	0.13	4.37

Table 13. Stage two; Flotation of feldspars

Feldspar Clean Float				Feldspar Rougher Float			
WT%	Minerals	Assay%	Recovery%	Wt%	Minerals	Assay%	Recovery%
30.83	L.O.I	0.54	13.50	18.82	L.O.I	0.79	12.10
	SiO2	62.06	28.50		SiO2	66.72	18.70
	Al2O3	17.62	38.25		Al2O3	17.08	22.64
	Na2O	10.65	49.30		Na2O	8.89	25.10
	K2O	6.39	43.60		K2O	4.99	20.20
	CaO	1.16	-		CaO	0.87	-
	MgO	0.28	11.00		MgO	0.06	1.40
	Fe2O3	0.24	4.16		Fe2O3	0.02	0.21

Table 14. Stage two; Flotation of feldspars

wt%	Minerals	Assay%	Recovery%
43.19	L.O.J	0.55	25.58
	SiO2	60.20	37.34
	CaO	0.64	24.52
	MgO	0.29	19.65
	Fe2O3	0.47	11.73
	Al2O3	19.30	59.35
	Na2O	11.08	73.86
	K2O	6.73	65.07

Table 15. Stage three; the separation of feldspar for two types' sodium feldspar and potassium feldspar

	Sodic feldspar		Sodic feldespar		Mixed feldspar	
Minerals	Assay%	Wt%	Assay%	Wt%	Assay%	Wt%
L.O.J	0.61		0.35		0.47	
SiO2	64.98		71.47		70.67	
CaO	0.49		0.71		0.85	
MgO	0.06		0.25		0.33	
Fe2O3	0.30	16.61	0.48	23.90	0.93	13.19
Al2O3	14.67		13.68		14.47	
Na2O	10.92		8.49		6.34	
K2O	7.31		3.66		4.67	
Recovery%	25.94		18.70		13.16	
Head wt.=53.69%				Head Recovery=57.80%		

10. Stages of Feldspar Flotation

1-First stage: float iron compounds plus biotite (mica) used the following chemicals:

Sulphric Acid	800-1000 gr/ton	PH 3
Aeropromoter Collector	600-800 gr/ton	
Dow Froth 1012	20-50 gr/ton	
Kerosene	60-80 gr/ton	

2-Second stage: flotation feldspar and quartz Thbit used the following chemicals:

Hydrofluoric Acid 72%	800-1000 gr/ton	PH 3
Aranic T or Aminac T	300-400 gr/ton	
Dow Froth 1012	20-50 gr/ton	
Kerosene	60-80 gr/ton	

3-Third stage: separation of feldspar product of the second phase into Sodium spar and potassium spar used the following chemicals:

Sodium Silcate	500-600 gr/ton	PH 7
Aranic T	250-300 gr/ton	
Pine Oil	60-80 gr/ton	
Kerosene	60-80 gr/ton	

11. Infrared Spectroscopic Analysis (IR)

Infrared absorption spectra in the region of 400 cm^{-1} to 4000 $^{-1}$ cm^{-1} were recorded using KBr sample alkali feldspar. The samples were prepared as pellet method according to Russell and Fraser (1994). In the present work, a Bruker Vector spectrophotometer model FT-IR-22, Germany in the region of 4000-400 cm–1 used. Figures 2, 3, and 4. Table 16 present the absorption spectrum in the infrared region for the collective samples and the absorption band at 3645 cm^{-1} is attributed to stretching vibrations of the O - H group, while at 6454 cm^{-1} the presence of interlayer water and the amount of adsorbed water in clays is related to the deformation vibration of H –O -H group 1664 cm^{-1} where the band at 1042 cm^{-1} and 798 cm^{-1} are attributed to Si - O stretching vibrations, the band at 770 cm^{-1} corresponds to the beidellite species, and the band at 526 cm^{-1} and 455 cm^{-1} correspond to deformation vibration of Si – O - Al and Si –O -Si respectively (volzone et al., 1988).

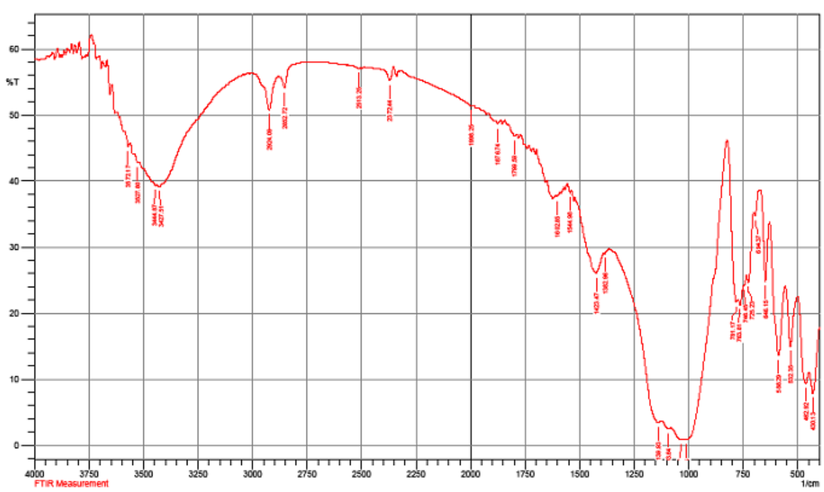

Figure 2. FTIR spectra of the examined sample 1

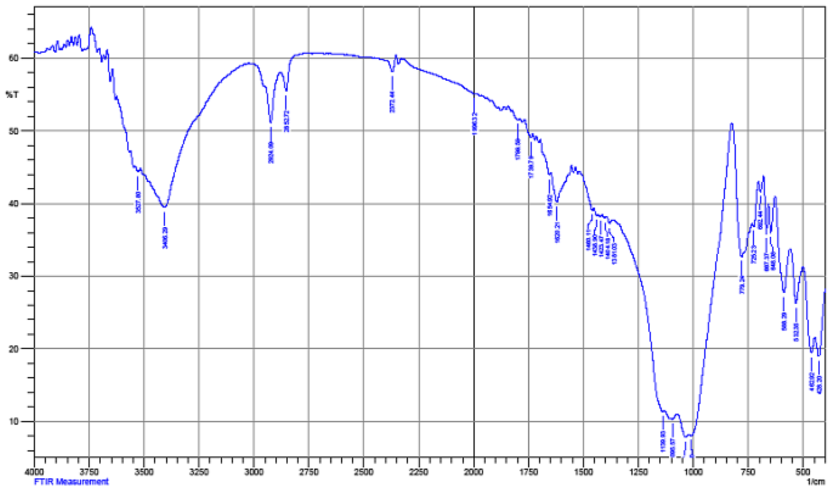

Figure 3. FTIR spectra of the examined sample 2

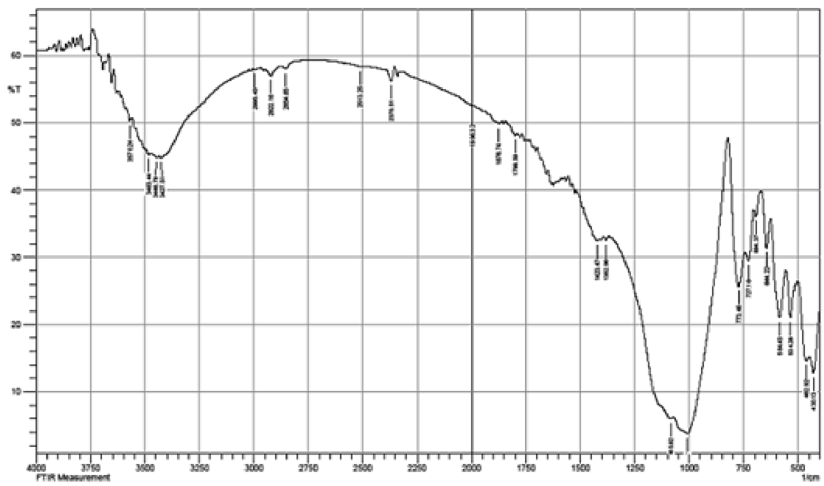

Figure 4. FTIR spectra of the examined sample 3

Table 16. Observed frequencies (cm-1) of the FTIR spectra for all samples

	Sample 1				Sample 2			Sample 3			
	vibration bands				vibration bands			vibration bands			
O - H	3572	3527	3444	3427	3527	3405		3570	3464	3445	3487
	2927	2852	---	---	2924	2852	2772	2995	2922	2854	----
	2512	2372	---	---	---	---	---	2513	2370	---	---
	1999	1876	---	---	1806	---	---	1996	1876	----	----
H –O -H	1799	1602	---	---	1795	1739	---	1790	-----	----	----
	1544	1423	---	---	1654	1620	---	1362	-----	----	----
	1382	1382	1354	---	1361	----	----	1423	-----	----	
Si-0-Si(A1)-0	----	-----	----	---	1059	1139	----	1165	-----	----	----
Si-Si	753	745	725	----	779	725	----	725	727	----	----
O-Si(AI)-0	694	646	----	----	667	645	-----	----	----	----	----
O-Si-O	592	---	---	---	566	---	----	554	----	----	-----
K-O, Na-O	532	---	---	---	532	---	---	53 4	----	----	----
Si-O-Si(Al)	---	---	---	---	425	---	---	452	430	----	----

12. XRD Determinations

Samples were studied using X-ray technology X. R. D on a kind of Phillips, who has an elevator from the copper a wavelength-ray source 1.5401Å, and the candidate of nickel in the area of 2θ: 10-70, and has a software program for processing the data generated, depending on the values of θ taken from the curves and compared with standard curves of metals have been identified d representing the dimensions between levels crystalline, and linked to each of θ and d relationship Prague (Alberty & Farrinction, 1978), and in doing so we got the Table 17, which shows the results of X-ray spectrum analysis.

Table 17. The results of X-ray analysis of the samples

	Sample 1	Sample 2	Sample 3
2θ	d	d	d
08.90	-	9.92	10.2
12.49	-	7.08	-
13.89	6.36	6.38	6.38
20.87	4.25	4.25	4.25
21.06	4.21	-	-
22.04	4.03	4.03	4.03
23.04	3.85	-	-
2355	3.77	3.77	3.77
24.23	3.67	3.68	3.67
25.63	3.47	3.47	3.48
26.39	3.37	-	-
26.63	3.34	3.34	3.34
27.03	3.29	-	3.29
27.52	3.23	3.23	-
27.94	3.19	3.19	3.19
28.16	3.16	3.16	-
28.32	3.14	-	-
29.88	2.99	2.98	2.98
30.06	2.97	-	-
30.47	2.93	2.93	-
30.78	2.90	-	-
31.26	2.86	-	-
35.04	2.55	-	-
36.54	2.45	2.46	2.46
39.46	2.28	2.28	-
40.26	2.24	-	2.24
42.45	2.12	2.12	2.12
45.79	1.97	1.98	1. 98
50.13	1.81	1.81	1. 81
51.14	1.78	-	-
54.86	1.67	1.67	1. 67
59.94	1.54	1.54	1.54
67.74	1.38	1.38	1.37

Fildsparia, we have got these results by comparing the absorption peaks shown in the table where the table shows the absorption peaks for these metals as follows:

Mineral	Range of d [Å]
Feldspars.	3.18–1.58
Albite Plagioclase NaAlSi3O8.	3.19, 4.03, 3.2
Anorthite Ca Al2 Si2O3.	3.20, 3.18, 4.04
Orthoclase KAlSi3O8.	3.31, 3.77, 4.22
Quartz SiO2	3.34, 4.26, 1.82

13. Conclusion

At the laboratory of Al- Huson University college Al- Balqa University we succeeded in producing Sodium feldspar and Potassium feldspar out of the three composite samples from Granite feldspar raw materials collected from different parts of the site of the study 6 km to the east of Aqaba city. The site of the study has a reserve of Millions of tons of the Granite feldspar raw Materials. The beneficiation analysis was successful in producing alkali feldspar, potassium alkali feldspar, sodium alkali feldspar which meets the proportion of the standard grade quality according to the Jordanian standard grade and the Industrial Minerals Handbook (Harben, 1999).

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References

Alberty, R. A., & Farrinction, D. (1978). *Physical Chem.* (5th ed., p. 598). John Wely and Sons.

Bourne, H. L. (1994), Glass raw materials. In D. D. Carr (Ed.), *Industrial minerals and rocks* (6th ed., pp. 543-550). Littleton, CO, Soc. for Mining, Metallurgy and Exploration, Inc.

Brady, G. S., & Clauser, H. R. (1977). *Materials Handbook* (11th ed.). NY: McGraw-Hill Book Co.

Burger, J. (1990). Feldspar and nepheline syenite. *Industrial minerals, 275*, 21-33.

Harben, P. W. (1999). Silica and Quartz *in* The Industrial Minerals Handbook (3rd ed., pp. 183-190). Surrey, UK: Industrial Minerals Information Ltd.

Loughbrough, R. (1992). Italy's industrials. *Industrial mineral, 301*, 38-39.

Kauffman, R. A., & Van Dyk, D. (1994). Feldspars. In D. D. Carr (Ed.), *Industrial minerals and rocks* (6th ed., pp. 473-481). Littleton, CO, Soc. for Mining, Metallurgy and Exploration, Inc.

Lesure, F. G. (1968). Mica deposits of the Blue Ridge in North Carolina: U.S. *Geol. Sur. Prof. Paper 577*.

Mineral Lab Inc. (2000). *Methods and Results, October 13*.

Murphy, T. D. (1960). Silica Sand and Pebble. In *Industrial Minerals and Rocks* (3rd ed., pp. 763-772). NY: The American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc.

Peter W. H. (1999). *The Industrial Minerals Handy Book* (3rd ed.).

Potter, M.J., (1991). *Feldspar, and Nepheline Syenite, and Aplite*. Annual Report, US Dept .of I nterior, US Bureau of Mines.

Potter, M. J. (1996). *Feldspar and Nepheline Syenite*. Minerals Yearbook, US Dept. of Interior, US Geological Survey; (//minerals.er.usgs.gov/minerals).

Potter, M. J. (1997). *Feldspar: Mineral Commodity Summaries*. US Dept. of Interior, US Geological Survey; (http://minerals.er.usgs.gov/minerals).USM 1993, Short Course on : Industrial Processing.

Rao, K. H. anymantha & Forssberg, K. S. E. (1993). *Solution chemistry of mixed cationic/anionic collectors and Flotation of feldspar from quartz*. Proc XVIII International Mineral Processing Congress Vol.4 Flotation II and miscellaneous (pp. 837-844). Australian Institute of Mining and Metallurgy.

Mensah-Biney, R., Carpenter, L. A., Allen, B. J., Miller, J. W., & Reid, J. C. (2001). Glass sand potential or the Pinehurst Formation, Richmond County, North Carolina: Mineral identification and processing. 50^{th} Annual meeting and abstracts Raleigh, North Carolina, Southeastern Section. *Geological Society of America, 33*(2), A-2.

Volzone, C., Zalba, P. E., & Pereira, E. (1988). Activation acid de esmectitas. II - Estudo mineralogical. *Annals de la Association Química Argentina, 76*, 57-68.

Wiener, L. S., Merchant, C. E., & Tanner, J. T. Jr. (1990). High-silica resource potential of the Upper Chilhowee Quartzite, McDowell County, North Carolina: North Carolina Geological Survey. *Information Circular, 26*, 22.

Yachuan, L., Huangu, G., Jichuan, Q., & Keren, Z. (1993) A new Flotation technique for Feldspar- quartz separation. Proc XVIII International Mineral Processing Congress Vol.4 Flotation II and miscellaneous (pp. 857-862). Australian Institute of Mining and Metallurgy.