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CONDITIONS FOR OBTAINING HIGH QUALITY FELDSPAR PRODUCTS FROM WASTE RAW MATERIALS

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ABSTRACT A technological diagram and results of beneficıatıon of various granite tailings have been presented It has been proved that one can obtain feldspar-quartz or feldspar products from the raw materials containing about 7-8% alkalies and up to 2,8% Fe_20i thus satisfying the requirements of glass and ceramic industries in the course of the application of flotation and magnetic separation

1 INTRODUCTION

In Poland, as a result of the exploitation of magma rocks, several millions tons of fine-grained tailings, class below 15 mm or less 5 mm originate a year and they are, at present, only partially utilized Their considerable part is stored m dumps These are mostly granite tailings and they contain about 50 - 60% feldspars (about 7 - 8% K_20 + Na_20 - the sum of alkalies) and up to about 2,8% FeA Granite tailings, depending on the type of rocks, their origin and degree of metamorphosis, are different as far as their chemical and mineral compositions are concerned They contain the quantity and type of feldspars, quartz, micas, clay minerals, oxides and hydrated iron and titanium oxides etc that are different These components, their number and kind do not help the direct utilization of tailings as feldspar raw materials for the glass and ceramic needs The supply of feldspar products with a convenient quality high contents of alkalies, low contents of dyeing compounds, mainly those of iron and titanium, erguires the application of" suitable technologies of grading and beneficiation of these raw materials The technological diagrams of processing, apart from size reduction and sieving, ı e activities helping the products to obtain a suitable granulometnc composition, ought to include also activities helping to

1 Remove the excessive amounts of clny ininciah, c g by washing, kissing and hydraulic classification

2 Remove micas and minerals containing iron and iilamuiu compounds Thus., depending on (lie type of r.iw m.itciial, quantity, kind and lorm of an ocnnfence of mineial admixtures one can apply hyiiiaulic classification, beneficiation carried oui on the lonccntrating tables, mechanical ubbung of the smlaie magnetic scpaialion, flotation and chemical processing etc Flotation is particularly recommended in the case when the raw materia! contains micas of the muscovite group that cannot be removed as a result of magnetic separation

3 Separate feldspars from quartz m the process of flotation The flotation of feldspars is earned out in the acid environment (pH below 3) in the presence of hydrofluoric acid (HF) as an activator of feldspars and a depiessor of quartz and aliphatic amines as a collector The amount of HF ought to be carefully selected for a griven raw material and it was from about 1400 to 2000 g/Mg of the feed for our raw materials (Ociepa, 1991, 1994, 1996)

4 Increase of the ratio K_20 do Na?0 (of the module of alkalies) in one of the feldspar products due to the separation of potassium feldspars from the sodium ones and plagioklases in the process of the selective flotation of feldspars or electrostatic separation A selective flotation of feldspars m the solutions of sodium chloride (NaCl), the amount being about 10 g/dm of flotation pulp is suggested for oui raw materials (Ociepa 1977, 1991,1991) The separation of feldspars is possible, however, only w hen j sufficient separation mixing of the pola-,smm ph.tst, from the sodium ones and calcium has ocuued in (he process of then cryslah/alion If the kld'pirs show *a* high degree of ptititi/atiou, ihuı sepaialioii ıs lıllllı effective and the. si lei live Hol tum ı, mit icxomiriendul loi sikh ı,.w IIMUH,,!

In the papu d sıiggıslud ıhagiaiıı ol hunin laiıon ot raw materials has been presented as well as icsulls of beneficiation ol granite tailings (coming Sioin different depositcs of the Lowei Silesia) while nsmj' the method of flotation and magnetic separation have been shown as examples

2 SUBJECT MATTER AND RESULTS OF INVESTIGATIONS.

The granite tailings coming from the granite massive of the Lower Silesia have been subject to investigations. In most cases it has been a strongly weathered material, grain-size being below 15 mm, containing about 60% of feldspars and considerable amounts of dark minerals, mainly, biotite

These tailings have been subject to the preliminary desludging and, next, size reduction and hydraulic classification- In consequence of these activities, products of the grain size below 0,5 mm or below 0,3 mm have been obtained. The products of the grain size below 0,5 mm were helpful in obtaining the feldspars-quartz flour and, after desludging, were subject to magnetic beneficiation (variant I, Fig. 1)

The material of the grain-size below 0,3 mm was subject to flotation apart from desludging and magnetic separation to obtain feldspar concentrates (variants II and III, Fig 1).

Magnetic beneficiation was carried out twice, in dry conditions, in the disk separator of the Ullrich type, magnetyzing current intensity being 2A.

Flotations have been made in the laboratory impeller flotation machine, capacity of the flotation chamber depending on the need being 3 or 1 dm^3,contents of solid parts being 300 or 100 g in 1 dm^3 of the flotation pulp depending on the kind of flotation.

In the flotation the following were applied:
- hydrofluoric acid (HF - pH of the pulp about 2,6) which, in this case, performed three it acted as a regulator of the concentration of hydrogen ions, a depressor of quartzand an activator of feldspars,
-hydrochloride of dodecylamine (Ci.-H^NFL.Cl), technically pure, as a collector,
- sodium chloride (NaCl) in selective flotations as a depressor of sodium feldspars and plagioclases

The collecting reagent has been applied by portions, along with the decay of flotation The method of dosing of reagents and conditions of flotation have been given in Table 1 containing, as an example, the results of flotation for one of the investigated raw materials

Table 1 includes the results of
- collective flotation with punficaiton of the feldspar concentrate.
- collective flotation with the selective distribution of the collective concentrate m the solution NaCl - 10 g/dm^3ofthepulp,
- selective flotation of feldspars in the presence of NaCl, the amount being 10 g/dm^1 of the pulp.

The presented results show that feldspar concentrates containing about or over 10% of alkalies are obtained as a result of flotation from the granite tailings containing about 7% alkalies. The quality and quantity of the obtained concentrates depend on the method and conditions of flotation. For the raw material in question, selective flotation gives a possibility to separate potassium feldspars from sodium ones and plagioclases. As a result of selective • flotation, more diversified concentrates as far as the module of alkalies is concerned - from about 2,9 to 1 (the ratio K_20 to Na_20) are obtained.

In Table 2 the results of magnetic and flotation beneficiation of granite tailings have been listed. The granite tailings come from different deposits of the granite Strzegom-Sobötka and Karkonosze massifs. An analysis of the results of the magnetic beneficiation shows that the decrease of the content Fe_20_3 to about and less than 0,2% is possible for almost all analyzed wastes. It means that the obtained products as for as the content of iron is concerned satisfy the requirements for the feldspar-quartz flours.

An introduction of the collective flotation helped to obtaining feldspar concentrates containing over 10% of alkalies along with the output of the concentrates over 50% from all investigated raw materials.

The results of the selective flotation while applying NaCl show that the introduction of the selective flotation would not be purposeful for all the granite tailings. From the investigated raw materials, feldspar concentrates of the module of alkalies over 2 have been obtained only from the Gniewkôw and Karpniki tailings (about 2,5 for Gniewkôw and about 2,9-3,6 for Karpniki)

As a result of ihe investigations carried out at the University of Mining and Metallurgy and concerning-the beneficiation of different feldspar raw materials (Dlugosz, Ociepa, 1975,1980, 1994), a schematic diagram of processing operations indispensable for obtaining the feldspar products of the detei mined quality has been suggested

This diagram (Fig 1) takes into account ilic qualitative «imposition . of the raw material, especially, a degree of the pertitization of feldspais The suggested diagram includes tincc

Table I. Results of flotation for granite tailings from Karpniki deposite. pH about 2,6 (HF , about 1400 g/Mg).

Kind of flotation	Amine [g/Mg]	Time of flotation [mm]	Product	Yield *[%)*	Contains of K_2O [%]	Contains of Na_2O [%]	Sum of alkalies	Mode of alkalies
l.			Feed	100.00	4,01	2.93	6,94	1,37
			Tailing	42,66	0,86	1,04	1,90	0,83
1 Collective	325	9.5	Collective concentrate	57,34	6,36	4,34	10,70	1,46
and cleaner flotation	Cleaner flotation-25	Î.5	Conce.l	15,57	6,87	3,98	10,85	1,73
	25	1	Cone 2	10,00	7,05	4,38	11,43	1,61
	25	1	Cone. 3	16,00	6,48	4,80	11,28	1,35
	-	-	Tailing	15,67	5,30	4,21	9,51	1,26
II Collective and selective flotation Na CI = I0g/dm	Collective flotation 300	7.5	Feed	100,00	3,91	2,82	6,73	1,38
			Tailing	49,04	1,15	1,35	2,50	0,85
			Collective cone.	50,96	6,55	4,24	10,79	1,55
	Selective flotation	0.5	Conc.l	17,80	8,36	2,90	11,26	2,88
		1.5	Cone.2	10,30	6,90	4,50	11,40	1,53
			Tailing	22,86	5,00	5,16	10,16	0,97
III Selective flOta: ion N a O 1 " *Z İ7-*.			Feed	100,00	4,05	2,92	6,97	1,38
	200	2.5	Conc.l.	18,91	7,38	2,60	9,98	2,84
	100	0.5	Conc.2.	12,27	6,80	4,04	10,84	1,68
	50	2,0	Cone. 3	18,74	5,45	5,45	10,90	1,00
	3?n	5.0	Sum of cone.	49,92	6,51	4,02	10,93	1,62
	-	-	Tailing	50.08	1.60	1,82	3,42	0,88

Tabi 2 Res»] Is of magnetic and flotation bcncficialion of granite weste

No	Evaluated parameter	Feed	Product after beneficiation			
			Product of grain-SIIC 0,5-0 1 mm after dcsludging andmagncUc separation	Products of grain si/c 0 3 0 OGmm .illcr dcsludging,magnetic separation and flotation		
				Collective flotation (collective concentrate of feldspars)	Selective flotation NaCI- lOg/diu'	
					Concentrae of potassium-sodium feldspars	Concentrate of sodinm-polassiuni feldspars
1	2	3,	4	5	6	
1 The Karkonoszc Massif						
1 1 Granite tailings from the Szkljrska Porcba quarTy						
	% k-,0 % Nd;0 •: alkal % alk mode \icd %	3 9 2 85 1 0 2 17 6 75 1 37 100,00	0,23-0 34	6 19 4,30 0,22 10 49 1,44 50,40	8 22-6 23 4 31-3 59 0 23 -> 53-9 82 1 9i 1 74 7 5-2S \	ft OS 6 co 5 7ft-4 72 I I 81 11 32 1 0S-I 40 37 24
I ? Cir.inile laihnps from Illc Wici<nkti quarrv						
	% K « % $Na_2$0 % f-cOj £ .ilkal % alk mode Meld %	4 84 3 6ft 1 5S 8 50 1 32 100(H)	4 24 2 80 0 30 7 04 1 51 -	5 53-5 78 5,05-5 11 0 3 10,58 10 89 1 1 1 13 60 2 56 8	8 4-6 31 4 48-4,16 12,84- 10 47 1 87-1 52 12 9-38 2	ft 3-5 88 4 16-6 10 - 10 46 11 98 1 52-0 97 38 2 14 0
1 3 *(n mile From tin.* Ksrpntki						
	% k 0 % N.i-rfi v I\A Ï ılkıl ' dlk mode \iUd 'Vi	4 35 2 85 ; 81 7 •> 1 S3 100 00	4 2S 3 30 0 72 7SS 1 29 87 1(1	ab 6 ıı ab 4 1 0 4 10 10 1 4ft St (*Ahi)*	8 3(> <J 8 2 9-2 706 0 IX I M 1? S 2 88 3 6 I II S MO	S 58-6 1 4 95-3 70 0 23 10 S3 ')8 1 13 1 CS 79 0 IX S
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11 *)* (i mili, i iilni),s İnim tin (inovikim (JIMMY						
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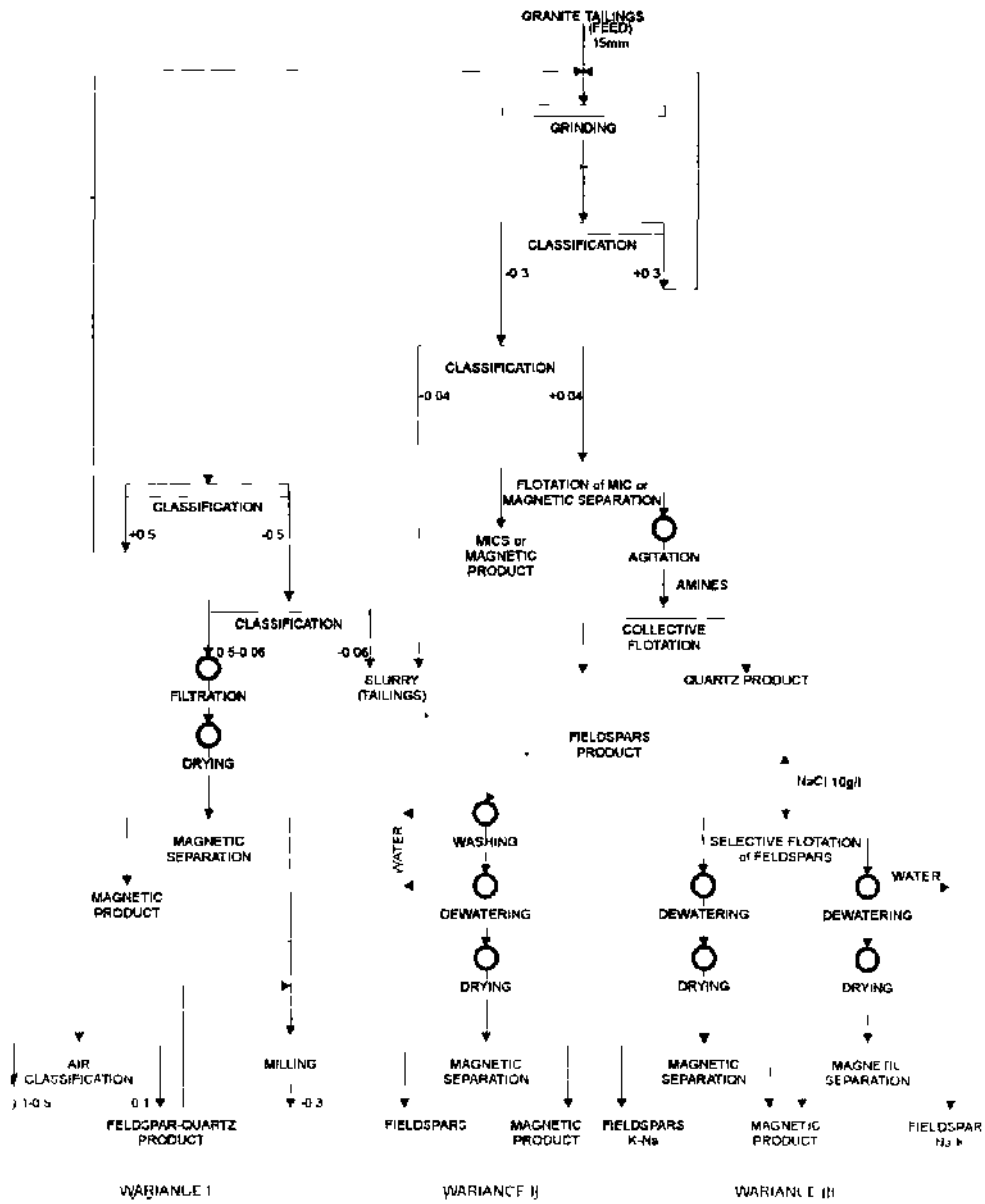

[i^Liic I I lowslitct developed to pioduce feldspar of required quality

technological series that can be treated, when dependent on needs, as three different beneficiation variances. In the case of processing of a feldspar mineral of fine-grained structure and a high degree of feldspar pertibzation, a system of activities including classification and magnetic separation presented m the series I, that ensures the obtaining of feldspar-quartz product will be convenient. Introducing the flotation (variance II, Fig. 1) one can also obtain feldspar concentrates of high contents of alkalies from this kind of mineral. For feldspar minerals that are characteristic for their high grade of demixing of potassium feldspars from sodium feldspars and plagioklases in the crystallization phase, the variance III (Fig. 1) with the selective flotation of feldspars has been suggested. This series creates a possibility of obtaining several concentrates distinctly diversified as far as the contents of sodium and potassium feldspars are concerned. In each of the suggested variances of processing, hydraulic classification is planned and it has two purposes: ensurance of a suitable granulometric composition of products and removal of the so-called sludge fraction, that is, fine grains less than 40 or 60 um. The separation of this fraction whose yield reaches sometimes 25% and its treatment as tailings at the present stage of investigations are imposed by technological and economic considerations. In this fraction ferme minerals, products of granite weathering which, if not removed, make the separation of feldspars from quartz complicated causing a decrease in the quality of feldspar concentrates.

3.SUMMARY

The results of investigations show that feldspar-quartz or feldspar concentrates satisfying standard requirements can be obtained from granite tailings depending on the assumed method and conditions of beneficiation. The investigations showed that the quality of the concentrates is dependent not only on the accepted method of beneficiation but also on the quality and type of the beneficiated raw material. The kind of feldspars occurring in the raw material, their structure and degree of pertitization are decisive for the course and results of flotation. Depending on the type of the raw material and accepted conditions of flotation, feldspar concentrates containing from about 8 to 15% of alkalies, the module of alkalies being from about 1 to 3 and about or below 0,2% Fe_2O_3 can be obtained from granite tailings containing about 7 -8% of alkalies and up to about 2,8% of Fe^Oj-

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