

Study of the influence on potassium chloride enrichment technology in potassium ore

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Abstract. Due to the fact that the rich reserves of potash minerals are decreasing in the world, scientific research is being carried out on the development of effective technologies for beneficiation of minerals containing a small amount of potassium. In this regard, to study the mineralogical composition of low-grade potassium ores of the Tyubetagan mine, to conduct theoretical analysis of the galurgic method of beneficiation and to carry out research in laboratory conditions, to study the influence of various technological parameters on product output and to find optimal conditions, to develop a technological scheme of beneficiation of low-grade sylvinite ores by the galurgic method special attention is paid to the output. In this study, the mineralogical composition of potash ores of Tubegatan mine was studied and methods of beneficiation were proposed according to the relationship between the content of KCl, NaCl, insoluble residue and particle size of potash ores.

1 Introduction

Recently, due to the steady growth of the world population, the demand for food is increasing. Providing humanity with enough food is one of today's global problems. However, one of the main factors that ensure food security is obtaining a high and high-quality harvest from agricultural crops based on the application of fertilizers according to scientifically based standards and the proper irrigation [1-3].

Currently, approximately 95% of potassium salts produced in the world are used as mineral fertilizers in agriculture [4-6]. In addition to increasing productivity, potassium fertilizers improve the quality of cultivated products: they help to increase the resistance of plants to diseases, increase the quality of storage and durability of fruits during storage, and also improve their taste and aesthetic properties. Therefore, the development of potash industry is closely related to the level of development of agriculture [6-7]. Due to the fact

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that rich reserves of potash minerals are decreasing in the world, scientific research is being carried out on the development of effective technologies for beneficiation of minerals containing a small amount of potassium [8]. In this regard, to study the mineralogical composition of low-grade potassium ores of the Tyubetagan mine, to conduct theoretical analysis of the galurgic method of beneficiation and to carry out research in laboratory conditions, to study the influence of various technological parameters on product output and to find optimal conditions [8-10], to develop a technological scheme of beneficiation of low-grade sylvinitic ores by the galurgic method special attention is paid to the output.

2 Methods

In order to study the mineralogical composition of potash ores of Tubegatan mine and to propose methods of beneficiation based on the relationship between the content of KCl, NaCl, insoluble residue and particle size of potash ores, samples of potash raw materials with the following average weight content of potassium chloride were studied: 1-sylvinitic (9.2% KCl), 2-sylvinitic (13.2% KCl), 3-sylvinitic (18.3% KCl), 4-sylvinitic (26.1% KCl), 5-sylvinitic (31.1% KCl) [11-14].

Crushed samples 0.5mm; 1mm; 3mm; 5mm; Passed through a set of 7 mm and 10 mm sieves and the particle size is -10+7 mm; -7+5mm; -5+3mm; -3+1mm; -1+0.5mm; Divided into fractions of -0.5+0. The chemical composition of samples of different sizes was determined using physico-chemical analysis methods.

The percentage of NaCl, KCl and their water-insoluble residue (e.g.) in the samples of different sizes, the degree of siltation and the change in the amount of potassium chloride due to the separate separation of fractions with -1+0.5 and -0.5+0 mm are table 1 and It is presented in Figure 1.

It can be seen from the table that in the size fractions larger than 1 mm, the level of desilting increases and also the level of crude enrichment with respect to KCl is high. This relationship increases with the increase of KCl in the raw material, that is, the degree of desilting increases from -7.2 to -18.4%, in return, the amount of KCl in the product increases from 12.6% to 33.9% compared to the raw material. When separating fine fractions, i.e. fractions below 1 mm (-1+0.5 and -0.5+0) separately, the degree of desilting increases from +15.86% to +39.6%, and the amount of KCl -14.2% decreases from -35.25%.

3 Results and discussion

A significant amount of NaCl in the composition of potassium raw materials increases the possibility of extracting sodium chloride along with potassium chloride during the enrichment process.

Based on the obtained results, the variation of the amount of NaCl in the sylvinitic samples was analyzed depending on the size of the particles and the amount of potassium chloride in the samples (Table 1 and Figure 2).

As the particle size changes, the amount of NaCl in the samples changes along the A-B line. It is clear from the diagram that NaCl reaches its maximum content (70.5%) in the 18.3% KCl sylvinitic sample with particle size -10+7 mm.

From the results of the research, it can be seen that in the process of beneficiation of potash ores of Tubegatan mine, the separation of ores into fractions of different sizes facilitates the process of extracting KCl from the ore composition.

Table 1. Dependence of the fractional composition of potash raw materials on its chemical composition.

Sample number	Particles size	Composition of components, weight. %			Change in the degree of desilting, %	Change in the amount of KCl, %
		NaCl	KCl	Additive in solution, etc		
1	-10 + 7	57.1	9.2	33.7	-7.2	+12.6
	-7 + 5	56.7	9.8	33.5		
	-5 + 3	56.3	10.4	33.3		
	-3 + 1	56.2	10.8	33		
	-1 + 0,5	52.2	7.2	40.5	+ 15.86	-14.2
	- 0.5+0	50.6	6.8	42.8		
	Average amount,%	54.85	9.2	35.95		
2	-10 + 7	63	13.2	23.8	-8.97	+31.45
	-7 + 5	62.3	13.6	24.1		
	-5 + 3	62.1	13.9	24		
	-3 + 1	61.7	14.8	23.5		
	-1 + 0,5	58	12.4	29.6	+16.8	-32.4
	- 0.5+0	56.6	11.8	31.6		
	Average amount,%	60.4	13.2	26.2		
3	-10 + 7	70.5	18.3	11.2	-12.9	+33.33
	-7 + 5	70.2	18.8	11		
	-5 + 3	69.6	19.1	11.3		
	-3 + 1	69.2	19.7	11.1		
	-1 + 0,5	67.2	17.5	15.3	+26.95	-33.82
	- 0.5+0	66.6	16.2	17.2		
	Average amount, %	68.9	18.3	12.8		
4	-10 + 7	67.8	26.1	6.1	-18.4	+34.75
	-7 + 5	67.4	26.6	6		
	-5 + 3	67.2	26.9	5.9		
	-3 + 1	66.7	27.8	5.5		
	-1 + 0,5	65.5	25.2	9.3	+39.6	-35.25
	- 0.5+0	64.8	24.4	10.8		
	Average amount, %	66.7	26.1	7.2		
5	-10 + 7	66.2	30.6	3.2	-13.33	+33.9
	-7 + 5	65.4	31.8	2.8		
	-5 + 3	65.5	32.2	2.3		
	-3 + 1	65	32.9	2.1		
	-1 + 0,5	66.6	29.5	3.9	+38.33	-33.6
	- 0.5+0	67.3	28.2	4.5		
	Average amount,%	66	31.1	3.13		

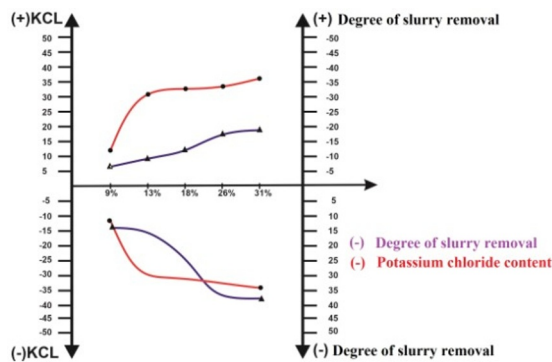


Fig. 1. The effect of changes in the fractional composition of potassium raw materials on the degree of desilting and changes in the amount of potassium chloride.

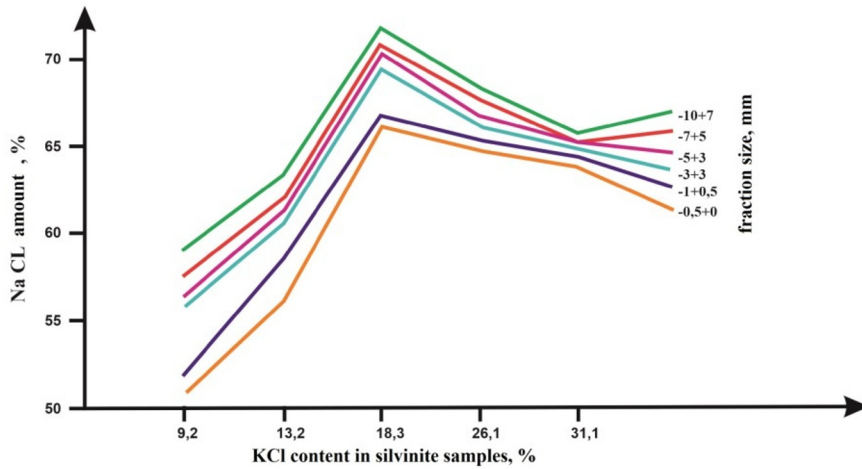


Fig. 2. Changes in the amount of NaCl in silvinitic samples depending on the size of the particles and the amount of potassium chloride in the samples.

Based on the obtained results, the following beneficiation methods and de-slurry technology (Figure 3) were proposed according to the relationship between the amount of NaCl and KCl in the potash ores and the particle size:

- 1) When enriching minerals with a potassium chloride content of less than 18.3%:
 - a) it is possible to enrich directly by galurgy method (particle size -5 mm).

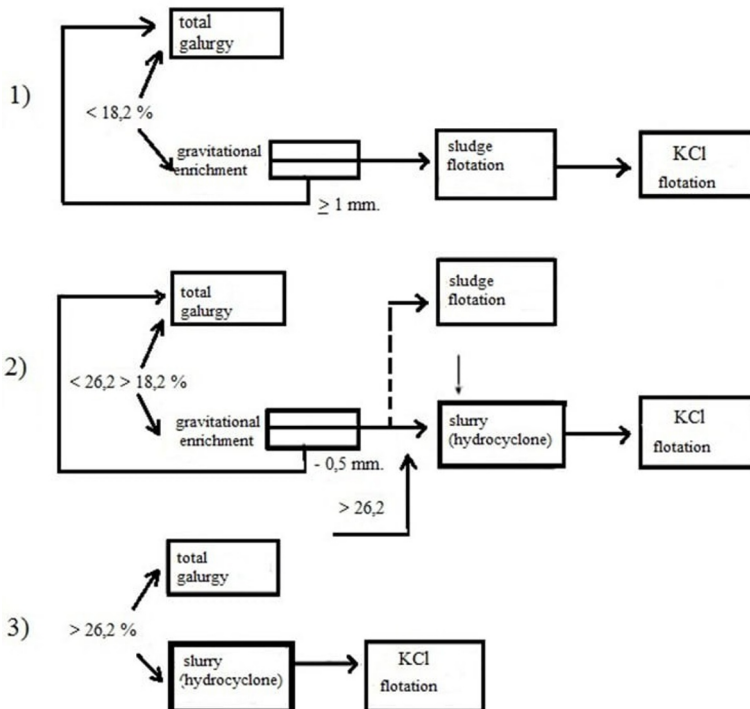


Fig. 3. Desilting technology of potash ores according to the relationship between KCl content and particle size.

b) the ore is initially enriched by gravity and the fraction with the particle size below 1 mm is sent to galurgic enrichment, the fraction with the particle size above 1 mm (+1-3 mm) is first flotation desilted, and then the obtained concentrate is flotation enriched.

2) When enriching minerals with a potassium chloride content of more than 18.3% and less than 26.1%:

a) it is possible to enrich directly by galurgy method (particle size -5 mm).

b) first, the ore is enriched by gravity, and the fraction with particles smaller than 1 mm is sent to galurgic enrichment, and the fraction with particles larger than 1 mm (+1-3 mm) can be enriched by flotation in 2 different ways: in the first method, the slurry is flotation, then KCl is flotation, and in the second method, the concentrate obtained by gravity method is mixed with ore containing more than 26.1% of potassium chloride in certain proportions, desilted and enriched by flotation [15-20].

3) When enriching minerals with a potassium chloride content of more than 26.1%:

a) can be enriched directly by galurgy method (particle size -5 mm).

b) can be enriched by direct flotation method.

As can be seen from the above methods, all ores can be directly processed by galurgy, regardless of the content of KCl and the amount of insoluble residue.

4 Conclusion

In order to study the mineralogical composition of potash ores of the Tubegatan mine and to propose methods of beneficiation based on the relationship between the content of KCl and NaCl, insoluble residue and particle size, samples of potash raw materials were studied: 1-sylvinit (9.2% KCl), 2-sylvinit (13.2% KCl), 3-sylvinit (18.3% KCl), 4-sylvinit (26.1% KCl), 5-sylvinit (31.1% KCl).

When separating fine fractions, i.e. fractions below 1 mm (-1+0.5 and -0.5+0) separately, the degree of desilting increases from +15.86% to +39.6%, and the amount of KCl -14.2% it was found to decrease from -35.25%.

From the results of the research, it can be seen that in the process of beneficiation of potash ores of Tubegatan mine, the separation of ores into fractions of different sizes facilitates the process of extracting KCl from the ore composition.

Based on the obtained results, methods of beneficiation and de-sludging technology were proposed according to the relationship between the content of NaCl and KCl and the size of particles.

It was found that all minerals, regardless of the content of KCl and the amount of insoluble residue, can be processed directly by the galurgy method.

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