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CONCENTRATION OF POTASH ORES

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This invention relates to a method of concentration of ores containing potash, particularly those containing a mixture preponderantly of potassium and sodium chlorides. It relates particularly to the pretreatment of such ores so as to make them amenable to wet methods of concentration such as froth flotation. This is a continuation-in-part of my application Serial No. 308,393, filed December 9, 1939.

Such methods have already been applied to the concentration of potash ores, but the results obtained have been unsatisfactory both as regards the grade of product obtained and the recovery of the desired products. When these ores are pretreated in accordance with the present invention, however, the results are improved to such an extent that the processes become commercially valuable and yield high recoveries of easily marketable products.

For example, I have treated a sylvinite ore obtained from Carlsbad, New Mexico, containing about 25% sylvite (KCl) mixed with halite and a small amount of clay. When this ore was ground and treated by prior flotation methods, non-commercial results were obtained as the grade of concentrate was too low and the recovery was poor. When the ground ore was deslimed just prior to flotation, successful concentration was effected but the losses necessitated by this desliming were large. I have discovered, however, that by desliming the ore after coarse crushing larger than flotation size, for example to pass a 10-mesh screen, and before fine grinding to flotation size, for example to pass a 48-mesh screen, slime losses are reduced to a negligible amount, better concentration is obtained, and the desliming step is much easier to carry out. When this ore is deslimed after crushing and prior to fine grinding an unexpectedly large amount of the deleterious matter is removed from the ore even when the grain size is unusually large. This was unexpected since fine grinding is usually necessary to liberate such material. The investigations made unexpectedly showed that deleterious slimes can be adequately removed from ore containing grains as coarse as 10-mesh or more.

The method of desliming the coarsely ground ore is the same as that used with water-insoluble ores, except that a saturated water solution of ore constituents is employed as the pulping liquid. The ore is pulped with this liquid, the coarse material settles very quickly and the slime suspension is overflowed to remove it. In plant operation any of the well-known settling devices such as bowl classifiers, cones, etc., may be used. Recovery of the desliming liquid in clarified condition is easily effected by flocculating and settling the slimes. For this purpose, well-known flocculants, such as alum, aluminum-chloride, causticized starch, etc., readily coagulate the slimes and speed up their settling rate. Investigations show that the desliming liquid is readily clarified by the use of reasonably-sized commercial thickeners.

The advantages of this invention may be best understood by comparing the results obtained without any desliming of the ore, with desliming of the ore after fine grinding, and with desliming of the ore after coarse crushing and before fine grinding in accordance with the invention.

Test I—Undeslimed ore

Sylvinite ore derived from Carlsbad, New Mexico, was crushed dry in a jaw crusher and rolls, until all the grains passed through a Tyler standard 10-mesh screen. This ore was then ground wet in a pebble mill until all the grains were finer than 48-mesh. The ground material was then made up to 20% solids, placed in a Fagergren laboratory flotation machine, reagents were added and the mixture was conditioned for 10 seconds, then the flotation operation was started. It required from two to three minutes to complete the flotation. The froth obtained was then refloated, requiring another two to three minutes. The cleaned froth was again floated, this also requiring two to three minutes. The reject of the first flotation was considered to be tailing to be discarded. The rejects of the cleaner flotations were considered to be middlings to be returned to the flotation circuit and further values recovered therefrom. The results were as follows:

Reagents	Lbs./ton
Octadecylamine acetate	3.00
Pine pil	0.14

Product	Weight	KCl	KCl recovered
	Per cent	*Per cent*	
Feed	100.0	26.52	100.0
Conc	5.2	68.75	13.5
Midd. 2	5.0	73.40	13.9
Midd. 1	12.6	66.50	31.6
Tail	77.2	14.11	41.0

Comparative Test I–A—Desliming after fine grinding the ore

Same as Test I, except that the ore was deslimed after grinding through 48 mesh. The flotation time now required only one minute for each flotation as compared with two to three minutes, and the quantity of reagent employed was reduced.

Reagents	Lbs./ton
Octadecylamine acetate	0.50
Pine oil	0.14

Product	Weight	KCl	KCl recovered
	Per cent	*Per cent*	
Feed	100.0	24.33	100.0
Conc.	18.8	93.96	72.6
Midd. 2	0.4	53.36	0.8
Midd. 1	2.8	11.66	1.4
Tail	55.8	1.60	3.7
Slime	22.2	23.60	21.5

Comparative Test I–B—Desliming after coarse grinding and prior to fine grinding the ore

The ore was crushed so as to pass through 10 mesh as described in Test I. This product was deslimed, then the deslimed material was ground in a pebble mill to pass 48 mesh. Only one flotation operation was employed. The flotation time was one minute.

Reagents	Lbs./ton
Octadecylamine acetate	1.20
Pine oil	0.14

Product	Weight	KCl	KCl recovered
	Per cent	*Per cent*	
Feed	100.0	26.19	100.0
Conc.	22.2	96.37	81.7
Midd.	3.4	52.80	6.9
Tail	70.3	3.31	8.9
Slime	4.1	16.50	2.5

A comparison of these tests shows the greatly increased grade of concentrate obtained by desliming the ore before flotation, the concentrates assaying 68.75% when the slimes were not removed and 93.96% when the slimes were removed after fine grinding of the ore and immediately before flotation. The recovery of KCl is also increased when desliming is carried out.

But the most interesting fact shown by the foregoing tests is that when the slimes were removed after the preliminary coarse crushing and before fine grinding, Test I–B, the grade of concentrate was still further improved and the recovery increased.

Correspondingly the loss of valuable mineral (KCl) in the slimes was only 2.5% when desliming was carried out after coarse crushing and before fine grinding as compared with 21.5% when desliming was carried out after fine grinding.

The tests demonstrate that a commercially satisfactory product can be made by desliming the ore after coarse crushing and before fine grinding and flotation, and that the losses of valuable mineral during concentration are very low.

Test I–B also shows that the increased grade and recovery of KCl is obtained with only one retreatment of the rough concentrate as compared with all the other tests in which two retreatments were required. In practice this increases the capacity of the floation plant.

Although cationic flotation agents such as the amines and their salts used in the foregoing tests appear to give the best results in the concentration of potash ores, anionic reagents may also be used, and again pretreatment in accordance with the present invention has been found to give greatly improved results when such anionic reagents are used.

Pretreatment in accordance with this invention also gives improved results in the concentration of langbeinite from its ores, as will appear from a comparison of Tests II and II–A which follow:

Test II—Without desliming

A sample of ore from the Carlsbad district of New Mexico and consisting mainly of langbeinite and halite was crushed to 10 mesh and then ground to pass 65 mesh. It was then made into a pulp with a saturated aqueous solution of the ore, conditioned for ten seconds with Chatham fatty acids, 4.29 per ton of dry ore and submitted to froth flotation with Igepon A. P. (a sulphonated, anionic reagent) and pine oil at the rate of 3.00 lbs. and 0.24 lb. per ton of ore respectively.

The froth concentrate was retreated twice without addition of reagents and yielded a final product weighing 32.9% of the original feed, containing 80.85% langbeinite and representing a langbeinite recovery of 55.1%.

Test II–A—Desliming after coarse crushing and before fine grinding

Test II–A was carried out in exactly the same manner as Test II except that the ore was deslimed after crushing to 10 mesh and before grinding to pass 65 mesh.

In this test the final product weighed 38.9% of the original feed, contained 89.19% langbeinite and represented a recovery of langbeinite of 59.5%.

What is claimed is:

1. The process of concentrating soluble potash ores, consisting of coarsely-crushing the ore to larger than flotation size, forming a pulp of such coarsely-crushed ore with a saturated aqueous solution of the ore and removing the slimes therefrom, then fine-grinding the said ore to flotation size and conditioning the fine-ground ore in a saturated aqueous solution of the ore with flotation agents, and then subjecting the thus conditioned pulp to froth-flotation treatment to produce a concentrate of the valuable ingredient of the ore.

2. The process defined in claim 1, applied to a sylvinite ore for the concentration of sylvite therefrom.

3. The process defined in claim 1, applied to a langbeinite ore for the concentration of langbeinite therefrom.

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