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TREATMENT OF POTASH ORES

Edmund A. Schoeld and John Melvin Fritschy, Carlsbad, N. Mex., assignors to Potash Company of America, Carlsbad, N. Mex., a corporation of Colorado

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This invention relates to the treatment of potash ores, and more particularly to flotation processes for recovery of potassium chloride from potash ores using guar flour in the processes as a flocculating agent, a clarifier, and a flotation modifier.

In general, potash ores contain potassium chloride and sodium chloride in varying proportions, as well as smaller amounts of other salt and insoluble matter such as clay. Commercially, the potassium chloride is recovered from the sodium chloride and other impurities of the ore by a froth flotation process. In flotation, finely ground potash ore is mixed with a saturated solution of the ore, and by adding collection, conditioning, levitation, frothing, etc. agents the sodium chloride is floated away from the potassium chloride or vice versa. Various combinations of processes and agents are well known in the art of treating potash ores, and we have now discovered that very small amounts of guar flour introduced into the separation processes unexpectedly and uniquely aids in the separation. In the flotation phase of floating one major constituent of ore from the other major constituent, very small amounts of guar added to the pulp improve the metallurgical performance. Starch has been used as a froth modifier in the prior art with some success, but we have now discovered that guar flour is effective as a flotation modifier in amounts of down to one-tenth or less of the amounts of starch required in the prior art processes. This unique discovery not only greatly saves material, but increases the efficiency of the process.

It is an object of the present invention to provide an improved froth flotation for treating potash ores. Another object of the invention is to provide a new and efficient froth modifier for flotation processes.

A further object of the invention is to provide a new and efficient flocculating and floating agent for insoluble impurities in the froth flotation of potash ores.

Another object of the present invention is to provide a new and unique froth modifier for flotation processes of treating potash ores, which is equally effective in the flotation of either potassium chloride or sodium chloride.

These and other objects will be apparent by reference to the following description.

Small amounts of guar flour added to a potash ore pulp during flotation improves the metallurgical performance, giving a lower grade of tailings and a higher grade of concentrates. In speaking of the grade, the proportion of potassium chloride is the reference. The addition of the small amounts of guar, aid the separation of the components of the potash ore, whether either the potassium chloride or the sodium chloride is floated. The use of guar is an aid to the flotation with the use of several of the common flotation reagents, including soap, soap-like reagents, alkyl amines, etc.

Although the guar shows somewhat different behavior with the different reagents the essential action is the same. In soap flotation, for example, the water insoluble matter tends to float and the guar assists by reducing the number of particles which makes the froth easier to handle. Extremely fine particles tend to build up a permanent froth, but the guar flocculates these fine particles to prevent the building of such a permanent froth. Further, the flocculation assists in the actual separation. In amine flotation the insolubles tend to be floated quite vigorously by the amine. The amine is absorbed by the insoluble matter more readily than by the potassium chloride, which of course uses up the amine reagent. Normally the clay must be removed or inactivated to enable the amine to be absorbed and float the minerals of value. The use of guar protects the clay from excessive absorption of the reagent, and improves the metallurgical performance of the flotation.

CLARIFICATION WITH GUAR

In small amounts, guar is an excellent clarifier, and is more effective than starch in amounts of about 1/10 of the amount of starch required to do an equivalent clarification.

A settling test was performed by slurrying about 60 grams of filter plant tailings from a commercial operation with a brine to give about a 20% solids by weight slurry.

Various samples of this slurry were placed in 250 ml. graduates, with or without clarifying agents, and as the solid material settled the depth of the clear supernatant layer was measured at regular time intervals, shown in the following table:

Table I.—Inches of clear liquid above suspended solids

Reagent as Lbs./Ton	None	0.52 Starch	0.008 Guar
Time Elapsed, min.:			
1	none	1½	2
2	1½	3⅛	3⅞
3	2⅛	3⅞	4¼
4	3¼	4¼	4½
5	3⅞	4⅜	4¾

FLOTATION WITH GUAR MODIFIER

The flotation tests were conducted in a laboratory model flotation machine which uses 200 grams of ore in a batch. Ore was prepared by grinding a screening through 28 mesh screen, then slurried in brine and placed in the machine. The modifier was added and after preliminary agitation, the flotation reagents were added and flotation continued until complete.

In flotation, 0.1 to 0.5 pound of guar per ton of ore shows excellent metallurgical performance. The guar is effective in the flotation of sodium chloride as well as of potassium chloride. In the flotation of salt, guar flocculates the extremely fine water insoluble clay, which otherwise collects in the bubbles and makes a very stable froth. The following tables show the comparison of guar to starch, and the quantities of each.

Table II.—Flotation with soap reagent

[Brine-containing lead salt equivalent to 2 grams lead per liter. Flotation reagents in order of addition (half in tails flotation, half in middlings flotation). Creoylic acid—.21 lbs./ton. Soap of mixed aliphatic acid used in commercial operation 1.4 lbs./ton]

Modifier	None	Starch 0.5 lbs./Ton	Guar 0.1 lbs./Ton
Comparative Depth of Froth	1.0	0.62	0.69
KCl in Concentrate, percent	72.4	81.2	82.1
KCl in Mids, do	7.6	8.8	10.3
KCl in Tails, do	2.5	4.1	4.1
Insolubles in Conc, do	41.0	35.0	23.0
Insolubles in Tails and Mids, do	59.0	65.0	77.0

This table shows 1/5 the amount of guar to be a better flotation modifier than starch. The guar upgrades the concentrate, showing excellent metallurgical performance. The use of guar increases efficiency more than

is evidenced by the tables, as it not only improves the metallurgical performance it also improves the handling of the tailings and the concentrates. Soap reagent when used herein includes true soaps, fatty acids, etc. which produce the same effect as soap in the flotation of the potash ore.

In the alkyl amine flotation, guar gives very good metallurgical performance whether the insoluble matter is present or not. Normally, in amine flotation the insoluble slime must be removed or inactivated to enable the amine to be absorbed on and float potassium chloride. Guar prevents absorption of amine on the slimes, so excessive amounts of reagent are not required. The following table shows the comparison of using starch and guar in the flotation.

Table III.—Flotation tests with amine reagent

[Preliminary agitation: 2 minutes. Flotation reagents: pine oil or methyl isobutyl carbinol 1 drop in first float, 1 drop in cleaning octadecylamine acetate added in 2 stages in first float]

Modifier lbs./Ton	Starch 2	Starch 1.5	Starch 1	Guar 0.5	Guar 0.4	Guar 0.3	Guar 0.2	None
Amine lbs./Ton	0.36	0.32	0.32	0.32	0.36	0.36	0.36	0.36
Percent KCl in Conc.	[1] 90.5	98.3	94.1	96.6	[1] 91.6	[1] 87.4	[1] 88.2	[1] 69.4
Percent KCl in Tails	1.8	1.13	8.3	0.89	1.13	1.42	2.83	35.1
Recovery in Conc.	97.4	96.2	61.1	97.8	98.5	98.1	96.0	16.0
Percent Insolubles Floated	45	74	75	57	62	76	75	----------
Percent Insolubles in Tails	55	26	25	43	38	24	25	----------

[1] Concentrates were not cleaned by refloating, and show higher grade on cleaning.

This table shows excellent metallurgical performance for guar modifier as compared to much larger amounts of starch. The flotation with the amine reagent is effective in amounts down to about 0.1 lb. per ton for reducing reagent absorption and inducing adequate flocculation. The guar improves metallurgical performance, giving lower grade of tailings and a higher grade of concentrates than possible without a flotation modifier.

The examples and description above are for illustrating the principles of the invention, but should not be construed to limit the scope thereof. Guar is valuable in flotation in more aspects than shown, but there is no intention to limit the invention to the precise details disclosed except in so far as defined by the appended claim.

We claim:

A process for the treatment of sylvinite ores, in which a brine of the ore is recycled through a succession of separations of the soluble constituents of the ore, which comprises forming a pulp of the ore by introducing finely divided sylvinite ore into a saturated solution of the ore containing approximately two grams of soluble lead per liter, introducing such pulp into a flotation stage in each brine cycle, introducing guar flour in the amount of about 0.1 to 0.5 pound per ton of ore into said flotation stage for flocculating fine particles of water-insoluble clay contained in said pulp so as to produce a less stable froth at the flotation stage, directing the separated products of flotation to subsequent treatment stages, and clarifying the brine at a subsequent clarification stage prior to its next pass through said system by the introduction of an additional amount of about .008 lb. guar flour per ton of ore to said clarification stage.

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