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FLOTATION OF SLIMES FROM SYLVINITE
ORE WITH HYDROXYETHYL CELLULOSERichard I. Jackson, Perrysburg, Ohio, assignor to
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tion, a corporation of New YorkNo Drawing. Application April 6, 1950,
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This invention relates to a process for the concentration of potassium chloride values from sylvinite ore. It has particular reference to an improved process for the beneficiation of sylvinite ores such as those found, for example, in the Carlsbad district of New Mexico.

Many processes and improvements in processes for the flotation of sylvite from sylvinite ore have been developed. In general, these processes comprise preparing an aqueous solution or brine saturated with respect to the sylvinite ore. A pulp is prepared by admixing the ore and the brine. This pulp is conditioned generally with an aliphatic amine flotation reagent, the amine containing a straight chain hydrocarbon group of at least seven carbon atoms. The conditioned pulp is then froth floated in accordance with well established methods and using conventional flotation apparatus. Since the cost of flotation reagents constitutes one item of major expense, it is desirable, obviously, to employ processes which require a minimum amount of such reagents.

It is known that the relatively fine nonpotash materials such as clays, other silicates, and the like, which are commonly designated by the term "slimes," have the undesirable characteristic of sorbing the amine reagent, thus increasing the amount of reagent required for effective flotation of the potash values.

It has previously been revealed that certain auxiliary reagents may be employed to inhibit the sorption of the flotation reagents by the slimes. Among these inhibitors may be mentioned starch, methyl cellulose, esters of cellulose, known as cellulose xanthates, and certain other cellulosic materials such as are mentioned in U. S. Patent 2,364,520 issued to Cole et al. These materials are employed in conjunction with the amine reagent and function in the presence of the amine-reagentized pulp. Even though these auxiliary reagents are employed it has been found necessary to subject the ore to a preliminary desliming operation by hydroseparation, or other similar physical process, prior to reagentizing in order to effectively reduce the quantity of slimes present and thus reduce materially the quantity of flotation reagent required for economical beneficiation. The use of these auxiliary reagents is likewise unsatisfactory in that they fail to inhibit the sorption of flotation reagents by the slimes when the temperature of the saturated solutions employed reaches relatively high atmospheric temperatures of between about 38° and about 42° C. These temperatures are frequently encountered due to the hot climate in the area

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wherein the ore is ground and processed. Further, it is inevitable that in employing physical methods of slime separation, fine particles of potash are lost.

It is an object of the instant invention to provide a process for desliming sylvinite ore.

A further object of the instant invention is to provide a process for the beneficiation of potash ore without resorting to the use of slime inhibitors.

It is another object of the present invention to provide a process for beneficiation of sylvinite ore wherein said ore is deslimed prior to flotation.

Still another object of the instant invention is to provide a process for the flotation of slimes.

These objects, as well as other objects of the instant invention, which will become apparent from the following detailed description, may be accomplished by preparing a pulp comprising sylvinite ore and an aqueous solution saturated with respect thereto. The pulp is then treated with a slime flotation reagent selected from the group consisting of alkylol celluloses and their alkali metal derivatives. The slimes are floated from the pulp, and the substantially slime-free pulp is then conditioned with a conventional amine flotation reagent and sylvite floated therefrom in accordance with well-known methods.

It is to be noted that the instant invention is based on the discovery that the alkylol celluloses such as hydroxyethyl cellulose, when employed in accordance with the instant process, float slimes. In this regard it has been found that these alkylol celluloses produce a froth of such a character that it can be removed in conventional flotation machines. It has also been discovered that this froth contains substantially all of the amine-sorbing slimes.

To remove slimes from sylvinite ore by the aforescribed method the ore is first ground to between about -4 and about +30 mesh size. The preferred mesh size is about -20. However, a coarser mesh size may be employed if it is desired to beneficiate the deslimed ore by tabling or other methods of beneficiation of relatively coarsely ground ore. A pulp is prepared by admixing the ground, sized ore with an aqueous solution saturated with respect thereto. The density of the pulp may vary according to the type of process employed. Generally, however, a pulp of between about 25% and about 30% solids may be suitably employed in the instant novel process. The pulp is treated for slime flotation by adding thereto an aqueous solution containing between about 1% and about 5% by weight of an agent comprising an alkylol cellulose compound

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such as hydroxyethyl cellulose. The solution of hydroxyethyl cellulose is prepared by soaking hydroxyethyl cellulose in the appropriate amount of cold water overnight, agitating the mixture to obtain a clear solution, and heating the solution to about 90° C. for between about fifteen and about twenty minutes. Either purified hydroxyethyl cellulose, or material which contains hydroxyethyl cellulose as the active ingredient along with the by-products of its manufacture, i. e., lower glycols, sodium chloride, and water, are suitable for the practice of the instant process.

The alkylol cellulose compounds were found to lack the inhibitive characteristics of such materials as starch. Likewise, when employed simultaneously with a conventional amine reagent, these cellulosic derivatives contributed no effective means of improving the process of actually floating potash values as was the case when using starch.

After the addition of the slime flotation reagent to the pulp, the mixture, either with or without the addition of further amounts of brine, may then be agitated in a conventional froth flotation cell. The froth produced was found to contain, as previously stated, substantially all of the slimes capable of sorbing the amine reagent. After the slime-containing froth is removed the pulp may be conditioned with one of the numerous and conventional amine flotation reagents available, and the sylvite floated to the cell surface and recovered in accordance with conventional procedures. The aforescribed process also has application to tabling methods of beneficiation, and wherever else it is desired to employ a slime-free ore.

The following examples are given to illustrate more specifically the character of the instant novel process and are in no way to be considered a limitation thereon.

Example 1

Feed material was prepared by crushing sylvinitic ore as received from the mine to about a -20 mesh size. A pulp was prepared by admixing in a laboratory flotation cell 500 grams of the crushed, sized ore and 1500 grams of a brine saturated with respect to said ore. A 1% aqueous solution of a slime flotation reagent, which analyzed approximately 36.0% of hydroxyethyl cellulose, 17.0% sodium chloride, 47.0% volatiles (i. e., glycols and water), was prepared by admixing said slime flotation reagent with the necessary amount of water. 7 cc. of this mixture was added to the pulp, and the resultant mixture agitated while introducing air for about one minute. A voluminous slime-containing froth formed almost at once and was floated off. Then about 2 cc. of 5% amine flotation reagent, a mixture of the acetate salts of hexadecylamine, octadecylamine, and octadecenylamine, was added to the substantially slime-free pulp, and the pulp was conditioned and floated in the conventional manner. The temperature of the pulp during the test was about 34° C. The results obtained are indicated in the following table:

Product	Per Cent By Weight	Per Cent K ₂ O
Feed.....	100	17.5
Concentrate.....	29.1	59.0
Tailing.....	68.9	0.28

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Example 2

A pulp was prepared by admixing in a laboratory flotation machine 500 grams of the same ore and a similar amount of the brine as in Example 1. 20 cc. of a 2% aqueous starch solution was added, and after one minute of agitation 2 cc. of 5% of the same amine solution as used in Example 1 was added. The pulp was conditioned and floated in the conventional manner. The results obtained are indicated in the following table:

Product	Per Cent By Weight	Per Cent K ₂ O
Feed.....	100	17.5
Concentrate.....	28.2	59.0
Tailing.....	71.8	0.78

A comparison of the results obtained in Example 1 with the results obtained in Example 2 shows conclusively that the flotation may be successfully carried out without the use of a slime inhibitor such as starch and that there is a definitely smaller loss of K₂O values in the tailings from the flotation of slime-free ore than from the flotation in the presence of slime inhibitors.

Having thus fully described and illustrated the character of the invention, what is desired to be secured by Letters Patent is:

1. A process of desliming sylvinitic ore which comprises preparing a pulp comprising comminuted sylvinitic ore and an aqueous brine saturated with respect to said ore, treating said ore with a slime flotation reagent comprising material selected from the group consisting of hydroxyethyl cellulose and its alkali metal derivative, subjecting the treated ore pulp to froth flotation, and separating the slime therefrom.

2. In a process involving the beneficiation of sylvinitic ore which has previously been ground to a coarse granular form, the improvements comprising treating the coarsely ground ore prior to subjecting said ore to beneficiation with a slime flotation reagent comprising hydroxyethyl cellulose, admixing the aforesaid treated ore and an aqueous brine saturated with respect to sylvinitic, subjecting the resulting pulp to froth flotation, and separating the slime therefrom.

3. A process according to claim 2 wherein the slime flotation reagent comprises hydroxyethyl cellulose, sodium chloride, glycol, and water.

4. In a process involving the froth flotation of sylvinitic ore which has been previously ground to a coarse granular form, the improvements comprising treating the coarsely ground ore prior to subjecting said ore to froth flotation with a slime flotation reagent comprising hydroxyethyl cellulose, admixing the aforesaid treated ore and an aqueous brine saturated with respect to sylvinitic, subjecting the resulting mixture to froth flotation, separating the slimes from the aforesaid mixture, conditioning said deslimed mixture with a flotation reagent, subjecting the deslimed mixture to froth flotation, and recovering the sylvite concentrate therefrom.

5. A process according to claim 4 wherein the slime flotation reagent comprises hydroxyethyl cellulose, sodium chloride, glycol, and water.

6. In a process involving the froth flotation of sylvinitic ore which has previously been ground to a coarse granular form, the improvements comprising preparing a pulp of substantially -20

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mesh size ore, said pulp containing between about 25% and about 30% solids in an aqueous brine saturated with respect to said ore, treating said ore pulp with an aqueous solution containing between about 1% and about 5% of a slime flotation reagent comprising hydroxyethyl cellulose, subjecting the resulting pulp to froth flotation, separating the floated slimes from the aforesaid mixture, conditioning the deslimed mixture with a flotation reagent, subjecting said conditioned mixture to froth flotation, and separating a sylvite concentrate therefrom.

7. A process according to claim 6 wherein the slime flotation reagent comprises hydroxyethyl cellulose and glycol.

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