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CONCENTRATION OF SYLVINITE ORES

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4 Claims. (Cl. 209—166)

This invention relates to a froth flotation process for the separation of the soluble constituents of sylvinite ores.

Sylvinite ore consists of sodium chloride and potassium chloride crystals as principal constituents, together with minor inclusions of other mineral matter, such as iron and manganese oxides, polyhalite, clays and the like generally classed as gangues.

The invention relates primarily to the separation of certain salts of the ore to the end that potassium chloride may be recovered as a substantially pure product, and it is an object of the invention to provide a simple, inexpensive and efficient treatment by which the potassium chloride constituents are selectively floated in a froth for separation from other constituents of the ore.

Another object of the present invention is to provide a class of reagents effective for promoting frothing and collection of potassium chloride constituents of sylvinite ore in a froth flotation operation.

In such a flotation treatment, the pulp-forming step involves the introduction of the ore in finely-divided condition into a solution saturated with respect to both sodium chloride and potassium chloride and which usually is a saturated solution of the ore. Dissolution of the soluble particles of ore is prevented in this way. A corresponding pulp-forming step has been disclosed in the patent to Anderson 2,046,312, and certain features described but not claimed herein have been claimed in the aforementioned patent.

The present application is directly related to and a continuation-in-part of my co-pending applications, Serial No. 7,219, filed February 19, 1935, for Concentration process, and Serial No. 38,316, filed August 28, 1935, for Flotation process for sylvinite ores, which were patented February 6, 1940, and numbered respectively No. 2,188,931 and No. 2,188,932.

Features described but not claimed in the aforesaid applications are being claimed herein. Thus, application Serial No. 38,316 discloses a milling operation inclusive of a flotation circuit utilizing separation methods of the present case, but the claims of said application are restricted to procedural details of the milling circuit and do not claim the flotation separation per se.

Similarly, application Serial No. 7,219 discloses substantially the same class of reagents described and claimed herein. However, the claims of said application are specific to designated members of the class, while the present application will be relied upon to cover the class in generic terms, as well as certain specific members other than those claimed in the aforesaid application.

The class of reagents found effective for purposes of the present invention may be designated as alkali salts of a sulfated aliphatic alcohol having from five to fourteen carbon atoms in the molecule, namely, sulfates of amyl alcohol and of each successive member of the homologous series up to and including tetradecyl alcohol. Investigations have demonstrated that all the members of the class within the range stated will give satisfactory results, and even those members immediately above and below the range will give some separation, although they are not known to be efficient enough to be usable for commercial purposes.

The reagents of the present treatment produce frothing, collection, promotion and selection in the froth flotation of ores of the above described character in a pulp of the type described.

The ore is prepared for treatment in the usual way by grinding or otherwise reducing the same to a finely-divided condition. While each operation involves some variations in treatment based upon variable characteristics of the ore and similar conditions, grinding to minus forty-eight mesh may be taken as a standard for efficient operation.

The ground ore is entered into the aforementioned saturated solution and it will be understood that any of the well-known methods of dry or wet grinding may be employed. However, in practice it has been found desirable to employ wet grinding in a pebble mill in closed circuit with a classifier using the saturated solution as the liquid phase of this operation.

The pulp is then conducted to any suitable froth flotation apparatus and subjected to selective flotation by the use of a reagent, which may be any one of the aforementioned compositions, or mixtures thereof. The reagent may be mixed initially with the pulp before being subjected to agitation and aeration, or, if more convenient, both pulp and reagent may be introduced into the flotation tank separately and mixed by the agitative action of the process.

In the flotation apparatus, the agitation and aeration serve to bring the reagent in intimate contact with the solid constituents, and as the reagent has a strong affinity for potassium chloride or constituents containing it, these solids adhere to rising gas bubbles and carry to the surface in a froth and subsequently are removed in a manner well-known in the art.

The reagent has no affinity for sodium chloride constituents in the aforementioned saturated so-

lution, and as a result, these solids remain in an unfloated condition, which at the completion of the separation are removed from the apparatus as a waste or tailings product.

While I do not wish to be limited to any exact proportions in the use of the compositions comprising the reagent, satisfactory results have been obtained by the use of from one-fourth to twenty pounds of reagent per ton of ore, and preferably the amount used should be approximately four pounds per ton of ore.

To afford a better understanding of the operating procedure, reference will be made to several test operations. In the first of these, sylvinite ore from the Carlsbad, New Mexico, field was subjected to treatment. This ore in finely-divided condition was introduced into a saturated solution of the ore to which was added a solution of sodium lauryl sulfate (12 carbon atoms in the molecule) and subjected to a froth flotation treatment. The froth overflow product of the resulting separation was found to contain an average of seventy-three per cent potassium chloride content in an amount equal to forty-seven per cent of the weight of ore taken. The ore taken for test contained forty-two per cent potassium chloride, and consequently a recovery of eighty-one per cent was obtained.

In another test, five hundred grams of minus sixty-five mesh sylvinite ore from the Carlsbad, New Mexico, field was taken for test. This material was introduced into a saturated solution of the ore and subjected to a froth flotation treatment in the presence of two cc. of five per cent sodium octyl sulfate solution (eight carbon atoms in the molecule). In this testing, the following results were obtained:

Flotation products

	Wet weight	Dry weight	Per cent weight	Per cent KCl	Recovery per cent
Froth	175	142	48.5	73.0	91
Tailing	180	150	51.5	7.2	
		292			

The foregoing testing demonstrates that the members of the homologous series intermediate the upper and lower limits specified are effective for promoting a separation sufficiently efficient for commercial purposes. Those members at the upper and lower limits give a rather weak action and are important principally in measuring the limits of the range.

In this connection, such reagents are relatively expensive, particularly the sulfated myristic alcohol (fourteen carbon atoms), for which reason preference would usually be given to the more efficient members of the series providing a reduction in operating costs.

To provide a comparison, a test is cited in which five hundred grams of thirty-five mesh sylvinite ore was introduced into a saturated solution of the ore and mixed with twenty cc. of a concentrated solution of sodium amyl sulfate. This pulp was subjected to a froth flotation treatment and a relatively feeble flotation of KCl was obtained.

From the foregoing, it will be evident that the respective members of the homologous series will be effective in promoting the separation of KCl from other constituents of sylvinite ores and the tests cited herein serve as a guide in the selection of the respective members for both commercial and scientific purposes.

Inasmuch as each ore treated, and sometimes ore from different portions of the same deposit, will vary in physical and chemical properties to a degree sufficient to require variations in flotation procedure, preliminary testing of the individual members of the group will disclose which reagent should be used to obtain the most efficient separation in the treatment of any given ore.

However, the general characteristics described herein will provide a basis for a simplified selection of the proper reagent.

Changes and modifications may be availed of within the spirit and scope of the invention as defined in the hereunto appended claims.

What I claim and desire to secure by Letters Patent is:

1. The process of treating sylvinite ore, which comprises the treatment of such an ore in a solution saturated with respect to sodium chloride and potassium chloride and containing sodium chloride particles and potassium chloride particles in undissolved form, preferentially filming the undissolved potassium chloride particles with a collector reagent consisting of an alkali salt of a sulfated alcohol having from five to fourteen carbon atoms in the molecule, and froth floating the particles so filmed on the surface of the solution.

2. The process of treating sylvinite ore, which comprises the treatment of such an ore in a solution saturated with respect to sodium chloride and potassium chloride and containing sodium chloride particles and potassium chloride particles in undissolved form, preferentially filming the undissolved potassium chloride particles with a collector reagent consisting of an alkali salt of a sulfated aliphatic alcohol having from five to fourteen carbon atoms in the molecule, and froth floating the particles so filmed on the surface of the solution.

3. A process according to claim 2 in which the collector reagent is present in the treatment in the approximate proportion of one-fourth to twenty pounds of reagent per ton of ore treated.

4. A process according to claim 2 in which the reagent is present in the treatment in the approximate proportion of four pounds reagent per ton of ore treated.

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