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FLOTATION PROCESS

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This invention relates to improvements in the so-called flotation process, and more particularly to the use of certain reagents, by means of which certain minerals, hereafter specified, can be selectively floated for their separation from other minerals or foreign matter with which they are associated in their native state.

This invention relates particularly to the froth flotation separation of potassium chloride (sylvite) from sodium chloride (halite) when the finely ground minerals halite and sylvite are treated while in suspension in a saturated brine made from these minerals. Subjects matter described but not claimed in the present application have been described and claimed in my co-pending applications Serial No. 755,577, filed December 1, 1934; Serial No. 28,983, filed June 28, 1935 and Serial No. 81,729, filed May 25, 1936.

The object of this invention is to provide a reagent by means of which sodium chloride can be separated from potassium chloride when both are present in a solution, and which will cause the sodium chloride and gangue to be selectively coated so that they will collect and rise to the surface by adhesion to air bubbles produced in the froth flotation treatment while the potassium chloride is not floated and remains in the pulp.

The reagent by means of which the selective separation referred to can be effected is an alkali resinate soluble in brine which is used in connection with lead or bismuth in solution.

The alkali resinate may also be used in combination with coconut oil soap or other soaps soluble in brine when employed with lead or bismuth salts. This combination is particularly valuable as a means for controlling the characteristics and the volume of froth formed.

The ore is prepared for treatment in the usual way by grinding or otherwise reducing it to a finely-divided condition. It is then introduced into a saturated brine solution of the minerals, which also contains a soluble lead or bismuth salt of the kind hereinafter specified. The finely-divided particles are maintained in liquid suspension in the brine, inclusive of the dissolved lead or bismuth. The pulp is then subjected to selective froth flotation and an alkali resinate is added. The best flotation results are obtained when the reagents are added separately, the lead or bismuth salts being added first to properly condition the solution and the alkali resinate being added after the ore has been added to the brine solution to promote frothing and collection.

The process can be most clearly defined by de-

scribing one or more tests, which will now be done.

In the first example or test, head ore containing forty two per cent (42%) of potassium chloride (KCl) was ground to pass a 48 mesh screen, and then added to four (4) parts by weight of saturated brine of the minerals sylvite and halite to which lead acetate had been added. The pulp thus formed was subjected to froth flotation at the beginning of which sodium resinate was added. There was recovered in the non-flotatable residue a concentrate showing an analysis 90.2% of potassium chloride (KCl). The solids in the flotatable pulp showed 2.3% potassium chloride as a tailings or reject product.

In the other example three (3) pounds of coconut oil soap and one (1) pound of sodium resinate were used per ton of ore in a brine containing 1.23 grams of dissolved lead per liter. The pilot mill in which the test was made showed a sodium chloride or froth concentrate reject of only 0.58% KCl. The potassium chloride concentrate analyzed 96.7% KCl with an overall recovery of 99.3%.

While in the examples given, certain specified proportions of reagent were employed, these are not an essential feature as good results can be obtained by employing the reagents in other proportions.

Examples of lead salts that may be used are lead acetate, lead chloride, lead sulphate and lead nitrate which however are merely given as examples of soluble lead salts, but any lead composition which is soluble in a brine solution may be employed.

Instead of lead salts, bismuth salts can be used and the following are suitable for this purpose: bismuth nitrate, bismuth chloride, bismuth sulphate, and bismuth oxide, or in fact, any bismuth composition which is soluble in a brine solution of these ores.

It is to be expressly understood that the term "brine-soluble" as used in the description and claims is intended to designate the solubility of a substance in a saturated halite-sylvite solution containing lead or bismuth in solution.

It is also to be understood that the reagent designated as an "alkali-resinate" refers to any alkali resinate soluble in the aforesaid solution which is capable of floating sodium chloride and gangue therein.

Unlike the alkali resinate, the dissolved lead or bismuth is not removed or destroyed in the flotation reaction, and therefore does not have to be

supplied continuously, once the pulp is properly conditioned.

In conditioning the pulp for treatment, either lead, or bismuth, or both may be dissolved in the saturated halite-sylvite solution in any suitable manner. Thereafter, the resulting solution may be used continuously in the process through the continuous addition of the ore and with only occasional additions of small quantities of lead to replace whatever has been mechanically lost in the process. The desired separation is then effected by the continuous use of the alkali-resinate reagent added in the flotation operation and which is continuously consumed in the flotation reaction.

Since dissolved lead and/or bismuth is an essential constituent of the pulp in the performance of the process, the term "cation of the lead, bismuth class" has been used in the description and claims to designate any form of dissolved lead or bismuth or combinations thereof in the halite-sylvite solution.

Having described the invention what is claimed as new is:

1. A process for the recovery of potassium chloride from halite-sylvite ores by selective flotation, which comprises entering a halite-sylvite ore into a saturated solution of such ore to form a pulp, and subjecting the pulp to a froth flotation treatment in the presence of a brine-soluble alkali resinate and a cation of the lead, bismuth class.

2. A process for the recovery of potassium chloride from halite-sylvite ores by selective flotation, which comprises entering a halite-sylvite ore into a saturated solution of such ore to form a pulp, and subjecting the pulp to a froth flotation treatment in the presence of a brine-soluble alkali resinate and lead in solution.

3. A process for the recovery of potassium chloride from halite-sylvite ores by selective flotation, which comprises entering a halite-sylvite ore into a saturated solution of such ore to form a pulp, and subjecting the pulp to a froth flotation treatment in the presence of a brine-soluble alkali resinate and bismuth in solution.

4. A process for the recovery of potassium chloride from halite-sylvite ores by selective flotation, which comprises entering a halite-sylvite ore into a saturated solution of such ore to form a pulp, and subjecting the pulp to a froth flotation treatment in the presence of sodium resinate and a cation of the lead, bismuth class.

5. A process for the recovery of potassium chloride from halite-sylvite ores by selective flotation, which comprises entering a halite-sylvite ore into a saturated solution of such ore to form a pulp, and subjecting the pulp to a froth flotation treatment in the presence of a brine-soluble alkali resinate, coconut oil soap and a cation of the lead, bismuth class.

6. A process for the recovery of potassium chloride from halite-sylvite ores by selective flotation, which comprises entering a halite-sylvite ore into a saturated solution of such ore to form a pulp, and subjecting the pulp to a froth flotation treatment in the presence of a brine-soluble alkali salt of abietic acid and a cation of the lead, bismuth class.

7. A process for the recovery of potassium chloride from halite-sylvite ores by selective flotation, which comprises entering a halite-sylvite ore into a saturated solution of such ore to form a pulp, and subjecting the pulp to a froth flotation treat-

ment in the presence of a brine-soluble alkali resinate and lead acetate.

8. A process for the recovery of potassium chloride from halite-sylvite ores by selective flotation, which comprises entering a halite-sylvite ore into a saturated solution of such ore to form a pulp, and subjecting the pulp to a froth flotation treatment in the presence of a brine-soluble alkali resinate and lead chloride.

9. A process for the recovery of potassium chloride from halite-sylvite ores by selective flotation, which comprises entering a halite-sylvite ore into a saturated solution of such ore to form a pulp, and subjecting the pulp to a froth flotation treatment in the presence of a brine-soluble alkali resinate and lead sulfate.

10. A process for the recovery of potassium chloride from halite-sylvite ores by selective flotation, which comprises entering a halite-sylvite ore into a saturated solution of such ore to form a pulp, and subjecting the pulp to a froth flotation treatment in the presence of a brine-soluble alkali resinate and bismuth nitrate.

11. A process for the recovery of potassium chloride from halite-sylvite ores by selective flotation, which comprises entering a halite-sylvite ore into a saturated solution of such ore to form a pulp, and subjecting the pulp to a froth flotation treatment in the presence of a brine-soluble alkali resinate and bismuth chloride.

12. A process for the recovery of potassium chloride from halite-sylvite ores by selective flotation, which comprises entering a halite-sylvite ore into a saturated solution of such ore to form a pulp, and subjecting the pulp to a froth flotation treatment in the presence of a brine-soluble alkali resinate and bismuth sulfate.

13. A process for the recovery of potassium chloride from halite-sylvite ores by selective flotation, which comprises entering a halite-sylvite ore into a saturated solution of such ore to form a pulp, and subjecting the pulp to a froth flotation treatment in the presence of a brine-soluble alkali resinate, a brine-soluble soap, and a cation of the lead, bismuth class.

14. A process for the recovery of potassium chloride from halite-sylvite ores by selective flotation, which comprises entering a halite-sylvite ore into a saturated solution of such ore to form a pulp, entering lead in solution in the pulp, subjecting the pulp so treated to a froth flotation treatment in the presence of a brine-soluble alkali resinate, and collecting potassium chloride particles as a non-floated residue of the treatment.

15. A process for the recovery of potassium chloride from halite-sylvite ores by selective flotation, which comprises entering a halite-sylvite ore into a saturated solution of such ore to form a pulp, entering bismuth in solution in the pulp, subjecting the pulp so treated to a froth flotation treatment in the presence of a brine-soluble alkali resinate, and collecting potassium chloride particles as a non-floated residue of the treatment.

16. A process for the recovery of potassium chloride from halite-sylvite ores by selective flotation, which comprises entering a halite-sylvite ore into a saturated solution of such ore to form a pulp, entering lead in solution in the pulp, subjecting the pulp so treated to a froth flotation treatment in the presence of a brine-soluble alkali resinate, and a brine-soluble soap, and collecting potassium chloride particles as a non-floated residue of the treatment.

17. In a process for the recovery of potassium chloride from sylvinite ores by selective flotation, including the treatment of such ores in a saturated solution of the same, containing a cation of the lead, bismuth class thereby forming a pulp, and the step of recovering potassium chloride as a non-floated residue, by subjecting the pulp to a froth flotation treatment in the presence of an alkali resinate capable of floating sodium chloride and gangue therein.

18. In a process for the recovery of potassium chloride from sylvinite ores by selective flotation, including the treatment of such ores in a saturated solution of the same, containing a cation of the lead, bismuth class thereby forming a pulp, and the step of recovering potassium chloride as a non-floated residue, by subjecting the pulp to a froth flotation treatment in the presence of an alkali resinate and a soap, capable of floating sodium chloride and gangue therein.

19. A treatment according to claim 17, in which the alkali resinate is present in the ap-

proximate proportion of one pound per ton of ore in the pulp.

20. A treatment according to claim 18 in which the soap is present in the approximate proportion of three pounds per ton of ore in the pulp.

21. A treatment according to claim 18, in which the alkali resinate and soap are present in the approximate proportions of one pound and three pounds respectively, per ton of ore in the pulp.

22. A process for the recovery of potassium chloride from sylvinite ores by selective flotation, including the treatment of such ores in a saturated solution of the same, containing a cation of the lead, bismuth class thereby forming a pulp, and the step of recovering potassium chloride as a non-floated residue, by subjecting the pulp to a froth flotation treatment in the presence of a reagent, comprising a mixture of an alkali resinate and a fatty acid derivative, which is capable of floating sodium chloride therein.

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