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MINERAL CONCENTRATION

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This invention relates to mineral concentration, and more particularly to the concentration of phosphate-bearing materials, such for instance, as apatite, phosphorite, and natural or artificial materials comprising mixtures of sand or the like with tri-calcium phosphate or other insoluble phosphates.

In processes for the concentration of ores whereby, for example, minerals are separated from gangue or the like silicious material, an important problem is the finding of an agent which will "wet" one constituent and not the other in a manner satisfactory for the particular ore or mineral, or class of ores or minerals involved. In the case of sulfide ores, including for example those of silver, copper or even zinc, the material separated is small in proportion to the gangue removed, and the quantity of concentrating agent needed is accordingly slight, so that its cost is relatively unimportant. In these respects, however, conditions differ materially in the concentration of phosphate-bearing materials, so that for such purposes a satisfactory concentrating agent must be inexpensive and economical in various ways.

An important object of the present invention accordingly rests in the provision and use of concentrating agents for phosphate separation which are in general inexpensive and which are peculiarly adapted for satisfactory and economical use in such processes. With this object in view, it has now been found that desirable concentrating agents of that nature are provided by the materials commonly known as sulfonated oils. Among other oils of this class, suitable for the purpose described, there may be noted, for instance, sulfonated castor oil (called Turkey red oil), sulfonated cotton seed oil, sulfonated manhaden fish oil, sulfonated petroleum oil (such as D. P. saponifier), acid sludge from petroleum refining, and the like. In concentrating phosphate materials prepared, for example, as a pulp or in equivalent finely divided state, the practice of the invention may conveniently include mixing the pulp with a small quantity of sulfonated oil as a sole or a principal concentrating agent to wet the phosphate. There may also be mixed with the pulp such other cooperating materials as may be desired, and the mixture may then be fed to any suitable concentration apparatus,—apparatus, for example, of the table variety, such as the Wilfley type, being advantageous. A suitable Wilfley table is shown, for example, in R. H. Richards and C. E. Locke, "Text Book of Ore Dressing" (McGraw-Hill Book Co., New York, 1925), at pages 207–213. Among cooperating materials which may be used in conjunction with the sulfonated oil or oils to accomplish the result desired, there may be mentioned other oils such as petroleum crude, fuel oil, distillate, kerosene, and the like, as well as pine oil. In some cases, a more complete separation of phosphate from the sand or other silicious material may be effected by the use of a small quantity of sodium silicate.

While such sulfonated oils, such as Turkey red oil, and the like, may be employed to produce a desirable concentrate of phosphate bearing material without other treatment of the latter, it has also been found that the separation may advantageously be improved by the use of a suitable conditioning agent, comprising, for instance, a basic soluble sulfide. Such conditioner, which may conveniently be used to treat the phosphate bearing ore or the like prior to conceneration, serves, it is understood, to alter the surface of the rock whereby the sulfonated oils wet that surface more readily; as a further result, economy is effected in that considerably less oil is needed to insure a desirable separation than in instances where no conditioner is used.

In the conditioning treatment, satisfactory results may be obtained, for instance, with materials which may be here conveniently classed as "basic soluble sulfides", including potassium sulfide, ammonium sulfide, barium sulfide, and including as well, calcium sulfides, as of the nature of lime-sulfur (CaS_x).

These materials may be applied in solution, a relatively small quantity being suitable in many cases. It may also be noted that there is not believed to be any substantial conversion of ore into sulfide, with these materials, but merely an altering of the surface, with the described results.

To illustrate the invention in a manner clear to those skilled in the art, the following specific examples are given. The phosphate bearing material employed in these instances was Florida phosphate, which contains approximately 45 to 50 per cent bone phosphate of lime (conveniently abbreviated B. P. L.), it being understood, however, that the processes of the invention including the use of sulfonated oils as concentrating agents are suitable for the concentration of any phosphatic pulp or the like. It may be noted that in these examples, reference throughout is to parts by weight unless otherwise specified.

Example I

550 parts of Florida phosphate débris, of ap-

proximately 45% B. P. L. content, were treated with one part of sodium sulfide, one part of Turkey red oil and 0.8 part of fuel oil distillate, the mass being well mixed with excess water and then fed to a Wilfley table for separating operation. 94.8% of the phosphate was recovered in the concentrate, which analyzed 73.7% B. P. L.

Example II

500 parts of phosphate rock débris, of minus twenty mesh and of about 45% B. P. L. content, were treated with 1.5 parts of sodium sulfide dissolved in 200 parts of water. 0.33 part of sulfonated cotton seed oil and 1.6 parts of kerosene were added, and the whole mixed. Separating operation on 70 parts of the wet mix was effected in suitable concentrating apparatus, without aeration; the resulting concentrate analyzed 77.6% B. P. L. and indicated a B. P. L. recovery of 77%.

Example III

500 parts of the same rock were treated with 0.66 part of sulfonated cotton seed oil, 1.6 parts of kerosene, and 1.4 parts of sodium silicate (42° Bé.), the whole being well mixed with 200 parts of water. On effecting separating operation on 70 parts of the mix (as in the preceding example), the resulting concentrate was found to contain 70.3% B. P. L. and to provide recovery of 33% of the phosphate.

It is to be understood that the invention is not limited to the specific compositions and procedure herein described but can be carried out in other ways without departure from its spirit as defined by the following claims.

I claim:

1. In the art of concentrating phosphatic material in the form of a pulp to separate phosphatic from other constituents, the improvement which comprises establishing a mixture consisting of sulfonated oil for wetting the phosphate, together with substantially soap-free material including phosphatic pulp, and thereafter subjecting the mixture to the concentrating operation and recovering a phosphate-bearing concentrate.

2. In the art of concentrating phosphatic material in the form of a pulp to separate phosphatic from other constituents, the improvement which comprises treating the phosphatic pulp with a conditioner, establishing a mixture consisting of sulfonated oil for wetting the phosphate, together with substantially soap-free material including the aforesaid treated pulp and a petroleum oil, and thereafter subjecting the mixture to the concentrating operation and recovering a phosphate-bearing concentrate.

3. In the art of concentrating phosphatic material in the form of a pulp to separate phosphatic from other constituents, the improvement which comprises treating the phosphatic pulp with a basic soluble sulfide, establishing a mixture consisting of sulfonated oil for wetting the phosphate, together with substantially soap-free material including the aforesaid treated pulp, and thereafter subjecting the mixture to the concentrating operation and recovering a phosphate-bearing concentrate.

4. In the art of concentrating phosphatic material in the form of a pulp to separate phosphatic from other constituents, the improvement which comprises establishing a mixture consisting of sulfonated castor oil for wetting the phosphate, together with substantially soap-free material including phosphatic pulp, and thereafter subjecting the mixture to the concentrating operation and recovering a phosphate-bearing concentrate.

5. In the art of concentrating phosphatic material in the form of a pulp to separate phosphatic from other constituents, the improvement which comprises establishing a mixture consisting of sulfonated cotton seed oil for wetting the phosphate, together with substantially soap-free material including phosphatic pulp, and thereafter subjecting the mixture to the concentrating operation and recovering a phosphate-bearing concentrate.

6. In the art of concentrating phosphatic material in the form of a pulp to separate phosphatic from other constituents, the improvement which comprises establishing a mixture consisting of sulfonated petroleum oil for wetting the phosphate, together with substantially soap-free material including phosphatic pulp, and thereafter subjecting the mixture to the concentrating operation and recovering a phosphate-bearing concentrate.

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