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OXYGEN-BEARING ORE FLOTATION

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This invention relates to mineral concentration methods and more particularly to flotation processes employing as reagents aliphatic alcohol esters of unsubstituted higher fatty acids.

It is well known in the art that the values in oxygen-bearing ores or the so-called nonmetalliferous ores can be concentrated or recovered with the aid of fatty acids in conjunction with fuel oil and an alkali, or with fatty acid soaps in conjunction with fuel oil. These and similar reagents act to selectively oil the oxygen-bearing ore particles which may then be collected by various methods such as tabling, stratifying, agglomeration or film flotation and like processes, or by froth flotation in the presence of a frothing reagent such as pine oil.

In accordance with the present invention it has been discovered that aliphatic alcohol esters of unsubstituted higher fatty acids can be employed to replace the various collecting or promoting reagents that have been used in the oxygen-bearing mineral concentrating operations heretofore. For example, the aliphatic alcohol fatty acid esters of this invention can be used to replace the free fatty acids, the fatty acid soaps, the fish oil fatty acids, etc., in the concentration of oxygen-bearing mineral values, by froth flotation or the various other concentrating methods.

The process of this invention can be utilized for recovering the values from any of the oxygen-bearing ores such as for example phosphate rock, limestone, bauxite, barytes, ilmenite, calcite and the like. While the present invention relates in general to the treatment of oxygen-bearing ore materials in the presence of aliphatic alcohol esters of unsubstituted higher fatty acids, it has been found to be particularly efficient in the treatment of phosphate rock.

In carrying out the present invention an aqueous pulp of an oxygen-bearing ore material such as for example a barite-silica ore, may be mixed with a small quantity of fuel oil, pine oil, caustic soda, an ester of an aliphatic alcohol and an unsubstituted higher fatty acid, and the mixture fed to a suitable concentration apparatus, such as a Wilfrey table, a film flotation machine, or a flotation machine, to recover a concentrate of barite.

It is an advantage of the present invention that the aliphatic alcohol esters of the unsubstituted higher fatty acids used need not be of a high degree of purity but may be employed in a somewhat crude form which is an important factor since a reagent to be commercially useful in the concentration of most oxygen-bearing ores must be relatively inexpensive.

While these esters are useful as reagents in the recovery of oxygen-bearing ore materials in general, they are particularly valuable in connection with the recovery of phosphate rock by froth flotation which represents the preferred embodiment of the present invention.

It is also an advantage of the present invention that the reagent permits the adoption of the concentration method which minimizes the consumption of reagents and produces the maximum results. For example, the coarser grades of phosphate rock, 28 mesh and larger, can be very economically concentrated by film flotation or tabling operations employing the reagent of the present invention, while the finer grades can be concentrated by froth flotation.

The invention will be further illustrated in connection with the following specific examples.

600 gram samples of Florida pebble phosphate rock in the form of deslimed classifier rake products were diluted to a pulp density of about 73% solids with tap water. Each charge of the ore was then conditioned 5 minutes with the following reagent mixture:

NaOH	lbs./ton	0.50
Fuel oil	do	4.00
Pine tar oil	do	0.16
Aliphatic alcohol esters of fatty acids		Variable

Each charge was then transferred to a Fagergren flotation machine and a concentrate removed by froth flotation. The concentrate was cleaned without using additional reagents. A comparative test was conducted in which fish oil fatty acid was used instead of an ester. The metallurgical results are given below:

Test	Clean conc.			Clean tail			Rough tails			Ester of fatty acid tested	Lbs./ton
	Percent weight	Percent B. P. L.	Dist. B. P. L.	Percent weight	Percent B. P. L.	Dist. B. P. L.	Percent weight	Percent B. P. L.	Dist. B. P. L.		
1	17.73	74.50	71.55	3.41	44.63	8.24	78.86	4.73	20.21	Glyceryl monoricinoleate.	5.00
2	19.30	75.41	76.42	1.51	54.10	4.29	79.19	4.64	19.29	Butyl acetyl ricinoleate	6.00
3	19.33	74.60	75.36	1.68	45.13	3.96	78.99	5.01	20.68	Glyceryl monooleate	5.00
4	27.01	73.46	93.44	2.81	6.34	0.84	70.18	1.73	5.72	Glycol oleate	5.00
5	21.35	73.67	81.43	3.90	15.71	3.17	74.75	3.98	15.40	Fish oil fatty acid	0.90

An examination of the results above show that good grade and recoveries of B. P. L. were obtained employing the reagents of the present invention as phosphate promoters in froth flotation methods. In tests 1, 2 and 3 the phosphate re-

coveries were somewhat lower than that of test 5 using a standard phosphate flotation reagent, fish oil fatty acid, but in each case a higher grade concentrate was obtained which is of very great importance in connection with phosphate rock. An increase of 1% in grade is equivalent to a 5% increase in recovery in evaluating phosphate rock values. In test 4 the phosphate recovery was 12.01% greater than that of test 5 and the grade was approximately the same.

The present invention is not limited to the use of any particular aliphatic alcohol ester of an unsubstituted higher fatty acid but includes broadly any aliphatic alcohol ester of an unsubstituted higher fatty acid or mixtures thereof among which are compounds such as mono- and diglycerides and glycols such as glyceryl monooleate, glycerol monoricinoleate, glycol oleate and esters such as butyl acetyl ricinoleate, butyl stearate and the like.

It is also to be understood that the process of the present invention is not limited to the use of the aliphatic esters of unsubstituted higher fatty acids with the reagent mixture comprising a non-frothing, water-immiscible liquid and a frothing liquid in the presence of an alkali, but broadly includes all processes of concentrating oxygen-bearing ores with any reagent combination or preconditioning or activating reagent, in which an aliphatic alcohol ester of an unsubstituted higher fatty acid is used as a promoter.

We claim:

1. A method of concentrating oxygen-bearing ore materials which comprises carrying out the concentration operation in the presence of an effective amount of a collector of the group consisting of monoglycerol esters of an eighteen carbon-atom-containing fatty acid, diglycerol esters of an eighteen carbon-atom-containing fatty acid, glycol esters of an eighteen carbon-atom-containing fatty acid, and butyl esters of an eighteen carbon-atom-containing fatty acid.

2. A method of concentrating oxygen-bearing ore materials which comprises carrying out the concentration operation in the presence of an effective amount of a collector comprising a monoglycerol ester of an eighteen carbon-atom-containing fatty acid.

3. A method of concentrating oxygen-bearing ore materials which comprises carrying out the concentration operation in the presence of an effective amount of a collector comprising a glycol ester of an eighteen carbon-atom-containing fatty acid.

4. A method of concentrating oxygen-bearing ore materials which comprises carrying out the concentration operation in the presence of an effective amount of a collector comprising a butyl ester of an eighteen carbon-atom-containing fatty acid.

5. A method of recovering the values from oxygen-bearing ores which comprises subjecting an aqueous pulp of the oxygen-bearing ore material to a froth flotation operation in the presence of an effective amount of a collector of the group consisting of monoglycerol esters of an eighteen carbon-atom-containing fatty acid, diglycerol esters of an eighteen carbon-atom-containing fatty acid, glycol esters of an eighteen carbon-atom-containing fatty acid, and butyl esters of an eighteen carbon-atom-containing fatty acid.

6. A method of recovering the values from oxygen-bearing ores which comprises subjecting an aqueous pulp of the oxygen-bearing ore material to a froth flotation operation in the presence of an effective amount of a collector comprising a monoglycerol ester of an eighteen carbon-atom-containing fatty acid.

7. A method of recovering the values from oxygen-bearing ores which comprises subjecting an aqueous pulp of the oxygen-bearing ore material to a froth flotation operation in the presence of an effective amount of a collector comprising a glycol ester of an eighteen carbon-atom-containing fatty acid.

8. A method of recovering the values from oxygen-bearing ores which comprises subjecting an aqueous pulp of the oxygen-bearing ore material to a froth flotation operation in the presence of an effective amount of a collector comprising a butyl ester of an eighteen carbon-atom-containing fatty acid.

9. A method of recovering the values from phosphate rock which comprises subjecting an aqueous pulp of the phosphate bearing material to a froth flotation operation in the presence of an effective amount of a collector of the group consisting of monoglycerol esters of an eighteen carbon-atom-containing fatty acid, diglycerol esters of an eighteen carbon-atom-containing fatty acid, glycol esters of an eighteen carbon-atom-containing fatty acid, and butyl esters of an eighteen carbon-atom-containing fatty acid.

10. A method of recovering the values from phosphate rock which comprises subjecting an aqueous pulp of the phosphate bearing material to a froth flotation operation in the presence of an effective amount of a collector comprising a monoglycerol ester of an eighteen carbon-atom-containing fatty acid.

11. A method of recovering the values from phosphate rock which comprises subjecting an aqueous pulp of the phosphate bearing material to a froth flotation operation in the presence of an effective amount of a collector comprising a glycol ester of an eighteen carbon-atom-containing fatty acid.

12. A method of recovering the values from phosphate rock which comprises subjecting an aqueous pulp of the phosphate bearing material to a froth flotation operation in the presence of an effective amount of a collector comprising a butyl ester of an eighteen carbon-atom-containing fatty acid.

13. A method of recovering the values from phosphate rock which comprises subjecting an aqueous pulp of the phosphate bearing material to a froth flotation operation in the presence of glyceryl monoricinoleate.

14. A method of recovering the values from phosphate rock which comprises subjecting an aqueous pulp of the phosphate bearing material to a froth flotation operation in the presence of butyl acetyl ricinoleate.

15. A method of recovering the values from phosphate rock which comprises subjecting an aqueous pulp of the phosphate bearing material to a froth flotation operation in the presence of glycol oleate.

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