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FLOTATION OF HEMATITE

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This invention relates to the recovery of hematite by flotation.

Previously, high-grade hematite ores available near the surface in some parts of this country have been mined, concentrated in washing plants or by other gravity methods and marketed. The low-grade ores, such as those found in washing plant tailings and in a natural state near sources of high-grade ore, have been accordingly discarded. In many places the high-grade ores have now become practically exhausted, and in obtaining them it is necessary to dig shafts. Greater attention is therefore directed to the recovery of hematite from the previously rejected low-grade ores.

Earlier efforts have been made toward developing a satisfactory process for recovering hematite from low-grade ores by flotation, however, these processes have so far been somewhat unsuccessful because of the low proportion of the ore treated which is recovered in usable form, and the costly fine grinding which is necessary in carrying them out.

It is known that certain oils, fatty acids and similar materials can be made to develop selectivity for oxide minerals. Agents of these and similar types have been used in the past in the process of froth flotation as applied in separating mineral ores from accompanying gangue materials.

Flotation processes for separating mineral ores from gangue materials generally comprise a series of integrated steps, for example reducing ore particles in size to substantially free the ore from the gangue, preparing a pulp by the addition of water to the ore, adding and dispersing in the pulp reagents which have the desired selectivity for the ore, floating the ore, dewatering the concentrate and disposing of the tailings.

The pulp is usually formed in an agitating mixing device called a conditioner, and the necessary reagents added at the conditioner. Generally the pulp, completely mixed, enters a flotation cell, and upon the addition of air bubbles during agitation in the cell the ore adheres to the bubbles, rising with them to the surface, where it is held by a more or less stable froth. The froth and the ore are then mechanically withdrawn from the cell.

In the past, numerous difficulties have at-

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tended the concentration of hematite ores by flotation, for example, prior processes require fine grinding for selective flotation. Portions of the hematite contained in the ore are found present in the tailings, while the ore recovered contains a substantial proportion of impurities. Low solid content in the pulp is requisite, as high concentrations result in entrainment of slimes by a rising mat of floated material.

Flotation reagents are not always readily miscible with pulps, and lack of homogeneity of the mass entering a flotation cell can result in excessive need for reagents in achieving a given result, or can limit the grade and recovery of the floated material so as to render the process clumsy and impractical of efficient operation.

It is an object of this invention to provide a method for the recovery of hematite ores, and particularly low-grade hematite ores by flotation in which appropriate reagents may be uniformly dispersed throughout a pulp of high solid content, to effect an efficient recovery of high grade hematite without fine grinding of the ore.

Further objects and advantages of this invention will be apparent from the following description.

This invention comprises subjecting an ore containing hematite to a flotation process wherein a collector and a frother are used, in which process the collector is an oil carried in a soap-stabilized oil-in-water emulsion, and the frother is a soap.

In carrying out the process, particles of impure ore are introduced into a conditioner, where water is added with agitation to produce a pulp. A conditioning reagent is added to the pulp in the conditioner, the reagent preferred being sodium carbonate, although other agents such as potassium carbonate, sodium acid carbonate, calcium carbonate, ammonium carbonate, sodium hydroxide, etc., may be used.

A collecting reagent comprising an oil is added to the conditioned pulp, the oil being emulsified in water and the emulsion stabilized by a small proportion of a suitable soap. The oil employed may be a refined petroleum lube oil fraction of the type known as pale oil, of an approximate viscosity range of from 70 to 200 Universal Saybolt seconds at 100° F. Still other similar lube fractions of comparable viscosity, for example

turbine oil, spindle oil, etc., may be used.

The soap used for stabilizing the emulsion may be any suitable soap, for example cottonseed foots soap, others generally known as good emulsifying agents being equally suitable, including soaps made from animal fats, vegetable oils, and fish oils.

After dispersion of the emulsion throughout the pulp, a frothing agent comprising a poor soap is added to the mixture. Cottonseed foots soap has been found excellently adapted for use in the process. Other agents may be used for this purpose including corn oil foots soap and other soaps and soap mixtures having approximately the same fatty radicals, i. e. approximately the same proportions of saturated and unsaturated, long and short chain molecules, as cottonseed foots soap.

After the conditioning reagent, collector and frother have been added to the pulp and the mass made substantially homogeneous by agitation, the pulp is passed into a flotation cell where air bubbles are introduced during further violent agitation, the ore floated and the froth containing the ore removed from the cell.

The process makes possible the recovery of a large proportion of high-grade hematite from low-grade ore, and results in adequate flotation when pulps of high solid content are used, thereby achieving a high rate of recovery for each cell employed.

A small proportion of a solution of a neutral monoglyceride sulfate added in the pulp before the frothing agent serves to improve the grade of the material recovered, and such an agent is particularly applicable where rougher and cleaner cells are used in series, for use in the cleaner cells toward removing impurities in the last stage of concentration.

Removal of the froth with the ore particles may be accomplished in conventional manner, for example by overflow or through the use of sweeping vanes.

The process does not require fine grinding for successful operation, and has been found to operate satisfactorily when performed with ore of minus 20 mesh size i. e., which is sufficiently reduced in size that all particles thereof can be passed through a 20 mesh screen.

The following examples are included to illustrate but not to limit the invention:

Example I

2000 parts by weight of low-grade, impure hematite ore, containing 18.2% Fe_2O_3 and of minus 20 mesh size are mixed together and agitated with 3000 parts of water to form a pulp. To the pulp is added 1 part of sodium carbonate, followed by further agitation and the addition of 1.5 parts of an emulsion containing 5% of a lighter pale oil and 1% of cottonseed foots soap. During still further agitation 2.0 parts of cottonseed foots soap are added and the mixture then passed into a flotation cell where in the presence of violent agitation and air bubbles the ore is floated off in a surface froth and the froth removed from the cell. The hematite recovered from the froth represents 86.1% of the total iron oxide present in the impure ore and is of 80.2% purity.

Example II

2000 parts by weight of impure, minus 20 mesh hematite ore containing 18.2% Fe_2O_3 are mixed and dispersed with 3000 parts of water

in a conditioning tank. 1.5 parts of sodium carbonate are added and the mixture is continuously agitated in the entire conditioning step during which are added, separately and in order, 1.5 parts of the emulsion described in Example I, a solution containing 0.02 part of a sodium salt of a monoglyceride sulfate made from coconut oil and 1.5 parts of cottonseed foots soap. The mixture is then transferred to a flotation cell where air bubbles are introduced into the pulp during agitation, the ore floated off, and the froth containing the ore removed from the cell. The hematite recovered is of 84% purity and represents 84.5% of the iron oxide present in the impure ore.

I claim:

1. The method of concentrating iron ores by flotation which comprises forming a flotation pulp of the desired density, incorporating with the pulp a proportion of a flotation reagent comprising a mineral oil in emulsion in a soap solution, adding to the mixture a proportion of a poor soap having approximately the same fatty radicals as cottonseed foots soap and thereafter subjecting the pulp to froth flotation.

2. The method of concentrating iron ores by flotation which comprises forming a flotation pulp of the desired density, incorporating with the pulp a proportion of a flotation reagent comprising a mineral oil in emulsion in a soap solution, adding to the mixture a proportion of a neutral monoglyceride sulfate, adding a proportion of a poor soap having approximately the same fatty radicals as cottonseed foots soap and thereafter subjecting the pulp to froth flotation.

3. The method of concentrating iron ores by flotation which comprises forming a flotation pulp of the desired density, incorporating with the pulp a proportion of a flotation reagent comprising a refined, light mineral oil of the type known as pale oil, the oil being emulsified in an aqueous soap solution, adding to the mixture a proportion of a poor soap having approximately the same fatty radicals as cottonseed foots soap and thereafter subjecting the pulp to froth flotation.

4. The method of concentrating iron ores which comprises forming a flotation pulp of the desired density, incorporating with the pulp a proportion of a flotation reagent comprising a mineral oil in emulsion in an aqueous soap solution, adding to the mixture a proportion of cottonseed foots soap and thereafter subjecting the pulp to froth flotation.

5. The method of concentrating non-magnetic iron ores which comprises adding water to a powdered ore of minus 20 mesh to form a pulp of the desired density, adding and dispersing in the pulp flotation reagents, including an emulsion of a light, refined pale oil in aqueous soap solution as a collector and cottonseed foots soap as a frother, passing air bubbles through the pulp during agitation to float the ore in a froth, and removing the froth containing the ore from the surface of the pulp.

6. The method of concentrating non-magnetic iron ores which comprises adding water to a powdered ore of minus 20 mesh to form a pulp of the desired density, adding and dispersing in the pulp flotation reagents including a colloidal dispersion of a light pale oil in aqueous soap solution, a relatively small proportion of a sodium salt of a monoglyceride sulfate made from long chain fatty acids such as coconut oil and a larger proportion of cottonseed foots soap, pass-

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ing air bubbles through the pulp during agitation to float the ore in a froth, and removing the froth containing the ore from the surface of the pulp.

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