United States Patent Office 3,441,401 Patented Apr. 29, 1969

3,441,401

METHOD OF REMOVING FATTY ACID COATING FROM HEMATITE CONCENTRATE

Rodney L. Stone, Allentown, and William M. Aubrey, Jr., Bethlehem, Pa., assignors to Bethlehem Steel Corporation, a corporation of Delaware

No Drawing. Filed Oct. 26, 1966, Ser. No. 589,513
Int. Cl. C21b 1/14; B03c 1/00; B03d 1/10
U.S. Cl. 75—5 4 Claims

This invention relates in general to a method of preparing, pelletizing and indurating iron ores containing magnetite and hematite.

It is well known in the art that low grade magnetite iron ores containing hematite may be upgraded by separating the hematite and gangue particles from the magnetite particles by magnetic separation. The hematite particles are then separated from the gangue material by froth-floatation in which the hematite particles are coated with a fatty acid collector reagent, for example, oleic, linoleic or linolenic acid, and removed from the froth-flotation cells as the float product. The gangue material is not coated and sinks to the bottom of the cells and is removed as the sink product.

Unfortunately, the fatty acid collector which coats the hematite concentrate is tenacious and is difficult to remove by conventional methods from the hematite concentrate. As a result, when pellets made from such concentrates or from mixtures of such concentrates with magnetite concentrates, and containing as little as 2% hematite, are subjected to rapid heating to high temperatures, for example 2300° F. to 2400° F., during the induration step, they tend to explode or spall. As a result, it has not been possible heretofore to pelletize and indurate hematite concentrates recovered by the froth-floatation method above described in a shaft furnace and only with difficulty in a grate-type furnace.

It is therefore, the object of this invention to provide a method of removing the fatty acid coating from hematite concentrate, thereby making it possible to utilize anionic floation as an economical method of recovering hematite concentrates which can be satisfactorily pelletized and indurated.

Broadly, the invention includes subjecting a low grade siliceous magnetite ore which contains hematite to magnetic separation for removal of the magnetite concentrate, treating the magnet tailings from said magnetic separation by froth flotation for recovery of the hematite, treating the hematite concentrate with leonardite, mixing the magnetite concentrate and treated hematite concentrate, filtering the mixture and then pelletizing and indurating pellets formed from the filtered magnetite-hematite mixture.

In a more detailed description of the invention, medium and low grade siliceous magnetite ore which contains hematite, pyrite, apatite, is crushed and wet ground to a relatively fine size which is suitable for separation of the magnetite concentrate from the hematite concentrate and siliceous gangue by magnetic separation. The magnetite concentrate now is of a fineness suitable for pelletizing, for example a specific surface area of between 1200 cm.^{2}/gram and 1500 cm.^{2}/gram.

The non-magnetic slurry from the magnetic separators contains hematite, siliceous gangue, pyrite and apatite. The slurry is treated in conventional manner in froth-flotation cells to remove the pyrite. The slurry is then deslimed and again treated in a conventional manner in froth-flotation cells to remove the apatite. The slurry which now contains hematite and siliceous gangue is thickened and passed to froth-flotation cells wherein an anionic fatty acid collector for example oleic, linoleic or linolenic acid is added to the slurry. The fatty acid collector coats

the hematite concentrate thereby causing it to float and pass out of the froth-flotation cells as the "float" portion. The siliceous gangue is not coated by the fatty acid collector and sinks in the froth-flotation cells and is removed therefrom as the "sink" portion.

The hematite concentrate is too coarse for pelletizing at this stage and must be ground to a suitable fineness, for example such that the specific surface area of the concentrate is between about 1200 cm.^{2}/gram and 1500 cm.^{2}/gram.

We have found that by adding a mineral, leonardite, to the hematite concentrate during such grinding thereof, the fatty acid collector is removed from the hematite concentrate thereby making it possible to mix the hematite concentrate with the magnetite concentrate to form pellets which may be indurated without danger of exploding or spalling in the indurating furnace. Leonardite is a dark-brown earthy type friable solid which is though to be a derivative of lignite and has a high content of oxygen.

The amount of leonardite so added may be as little as 45 pounds per ton of hematite concentrate. It is preferred, however, to use about 50 pounds of leonardite per ton of hematite concentrate.

The slurry of hematite concentrate and leonardite from the grinding mill is mixed with the ground magnetite concentrate. The mixture is then filtered to reduce the moisture in the concentrate to the degree necessary for satisfactory balling, for example 8% to 10% moisture. The magnetite- hematite concentrate remains in the filter as filter cake and substantially all of the leonardite passes through the filter with the water. The magnetite-hematite concentrate is then pelletized. If desired, a binder such as 0.6% bentonite may be added to the concentrate for pelletizing. The pellets are indurated in a suitable furnace at suitable temperatures for example about 2100° F. to about 2400° F., preferably temperatures approaching 2400° F.

In a specific example of the invention, 320 tons per hour of a siliceous magnetite-hematite ore were ground to a fineness such that 75 to 80% of the ore passed through a 325 mesh screen. This ground ore was further processed by magnetic separation to remove the magnetite concentrate at a rate of 270 tons per hour from the hematite and siliceous gangue. The magnet tailing slurry containing the hematite and siliceous gangue was then fed to a pyrite flotation circuit and an apatite flotation circuit where about 2.4 tons per hour of pyrite concentrate and about 7.1 tons per hour of apatite concentrate were removed from the slurry. About 0.03 pound of sulfuric acid and 0.1 to 0.2 pound of a refined fatty acid collector (oleic acid) were added to the slurry in the final froth-flotation cells. The flotation pH was about 6.0. Approximately 20 tons per hour of hematite concentrate containing about 64.0% iron, was recovered as the "float" product, while 9.0 tons per hour of siliceous gangue was removed as the "sink" product. The slurry of hematite concentrate was then charged at the rate of about 5 tons per hour to a grinding mill. Leonardite was added to the hematite concentrates in the grinding mill in amounts varying from 45 pounds to 90 pounds per ton of such concentrates. It was found that 45 pounds of leonardite per ton of hematite concentrate was sufficient to remove substantially all the fatty acid collector from the concentrate. During grinding the size of the hematite concentrate was reduced from a specific surface area of about 650 cm.^{2}/gram to a specific surface area suitable for pelletizing or about 1400 cm.^{2}/gram. The magnetite concentrate which had been ground to a size suitable for pelletizing namely about 1400 cm.^{2}/gram was mixed with the slurry of hematite concentrate and leonardite and passed to a filter where a portion of the water and

substantially all the leonardite were removed from the slurry. The filtered magnetite concentrate-hematite concentrate was then formed into pellets of about 0.50" in diameter. The pellets were indurated at 2350° F. in a vertical shaft furnace. No problems with exploding or spalling pellets were encountered.

We claim:

1. A method of producing indurated pellets of magnetite-hematite concentrate recovered from a low grade magnetite ore containing hematite, pyrite, silica and apatite comprising:

(a) wet grinding the ore to a fineness suitable for magnetic separation,

(b) magnetically separating the magnetite concentrate from the siliceous-bearing hematite,

(c) adding an anionic fatty acid collector to the slurry and removing the hematite concentrate as a "float" product from the siliceous gangue,

(d) grinding the hematite concentrate slurry to a fineness suitable for pelletizing,

(e) adding not less than 45 pounds of leonardite per ton of hematite concentrate during the grinding thereof,

(f) mixing the recovered magnetite concentrate with the leonardite and hematite concentrate slurry,

(g) filtering the magnetite concentrate-leonardite-hematite concentrate slurry to remove substantially all the leonardite therefrom,

(h) pelletizing the magnetite-hematite concentrate, and

(i) indurating the pellets.

2. A method as claimed in claim 1 in which the specific surface area of the hematite concentrate of step (d) is within the range of 1200 cm.^{2}/gram to about 1500 cm.^{2}/gram.

3. A method as claimed in claim 1 in which the amount of leonardite added in step (e) is from about 50 pounds to about 90 pounds per ton of hematite concentrate.

4. A method as claimed in claim 1 in which the temperature of step (i) is about 2100° F. to about 2400° F.

References Cited

UNITED STATES PATENTS

2,665,004	1/1954	Zukosky	209—10
2,766,883	10/1956	Chapman et al.	209—166
3,149,958	9/1964	Ward	75—5
3,266,887	8/1966	Kramer et al.	75—5 X
3,331,505	7/1967	Mercade	209—166

FOREIGN PATENTS

1,253,093	12/1960	France.
1,374,894	8/1964	France.

L. DEWAYNE RUTLEDGE, *Primary Examiner.*

E. L. WEISE, *Assistant Examiner.*

U.S. Cl. X.R.

75—1; 209—10, 166