UNITED STATES PATENT OFFICE.

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CONCENTRATION OF ORES.

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To all whom it may concern:

Be it known that we, EDWIN EDSER, a subject of the King of England, residing at Brockley, London, England, and STANLEY TUCKER, a subject of the King of England, residing at London, England, have invented certain new and useful Improvements in the Concentration of Ores, of which the following is a specification.

This invention relates to improvements in the concentration of ores, and it refers more particularly to the froth-flotation process described, for example, in the prior Patents Nos. 835120, 962678, and 1064723.

The froth-flotation process of concentrating ores consists in mixing the ore with water to which is added a small proportion of a mineral-frothing agent, with or without other agents, and agitating and/or aerating the pulp so as to form a froth of the metalliferous particles of the ore, and separating the froth.

The present invention relates more particularly to differential separation, that is to the separation of one kind of metalliferous particles from another kind of metalliferous particles, both of which said kinds of particles have heretofore under certain conditions been floated together, and it has now been discovered that by employing a soluble soap, such as sodium oleate, as the mineral-frothing agent in certain proportions and together with sodium silicate, it is possible to obtain a differential separation of certain metalliferous particles from other metalliferous particles, the differentiations being dependent on the relative concentration of these reagents in the water and especially of the silicate of soda.

According to the present invention, therefore, a process for the differential separation of certain metalliferous particles from other metalliferous particles in a mixture containing them consists in agitating and or aerating the mixture in water to which has been added a small proportion of sodium silicate and a sufficient quantity of a soluble soap to produce a froth of the metalliferous particles first above alluded to free from said other metalliferous particles and separating the froth.

It has also been discovered that the quantity of the sodium silicate necessary to obtain a differential separation with any particular ore depends upon the amount of water in which it is dissolved, and thus after the separation of the froth containing one kind of metalliferous particles the liquor if diluted by adding a further quantity of water and reagitated and or aerated will yield a froth of the metalliferous particles not previously floated in the first instance when the concentration of the silicate of soda was greater.

Thus in treating a mixed galena-blende ore a certain proportion of sodium silicate in the circuit water causes the galena to be floated preferentially to the blende and gangue, while with a smaller proportion of sodium silicate to the water both the galena and blende float in preference to the gangue.

In carrying the present invention into effect the ore should preferably be in a freshly ground condition as it is found that a better separation is then obtained.

Among the soluble soaps which we have found suitable are sodium oleate, sodium stearate, sodium palmitate and sodium resinate, or mixtures of these soaps.

Examples of the present invention will now be described:—

Example I: 500 grams of a zinc-lead ore assaying Pb 19.54% and Zn 33.4% freshly crushed to 80 mesh was mixed in an experimental flotation machine with 1380 ccs. of soft water to which was added sodium silicate amounting to 16 lbs. per ton of ore, together with sodium oleate amounting to 4 lbs. per ton of ore. After agitating and aerating the mixture a voluminous froth was formed on the surface of the liquid. This froth was removed and its solid contents weighed 140 grams, and assayed Pb 51.8% and Zn 16.2%, giving a recovery of 74.3% Pb and Zn 13.6%.

After removal of this first froth additional soft water was added to the pulp until the total amount used was 2200 ccs., and the mixture was then again agitated and aerated for the formation of a second froth. This froth was removed and its solid contents weighed 268 grams, and assayed Pb 7.4% and Zn 45.4%, giving a recovery of Pb 20.3% and Zn 72.5%.

Example II: 500 grams of a Peruvian ore, ground to 80 mesh, and assaying 18.2% Pb, in the form of galena and 33.5% Zn, in the form of light-colored blende, was made into

a pulp with four times its weight of soft water, to which had been added 0.25% of commercial sodium silicate. Sodium oleate was then added in quantity amounting to 5 lbs. per ton of ore and the pulp agitated and aerated. A mineralized froth was produced, the solid contents of which weighed 147 grams and assayed 54.6% Pb and 15.5% Zn, giving a recovery of 88.2% Pb and 13.6% Zn. The residues weighed 353 grams and assayed 3.6% Pb and 41% Zn. In this test the froth was continuously produced in a sub-aeration machine so that it was necessary at intervals to make up the quantity of pulp by adding water containing 0.25% of sodium silicate.

In an experiment on the same ore and under exactly the same conditions but employing a circuit liquor containing 0.125% of sodium silicate, the froth formed weighed 421 grams and assayed 20.7% Pb and 35.3% Zn, giving a recovery of 95.6% Pb and 88.7% Zn. The residues weighed 79 grams and assayed 3.4% Pb and 24.0% Zn.

From these experiments it is seen that most of the lead was floated in both cases but a much smaller proportion of the zinc was floated in the case in which a larger concentration of sodium silicate was employed.

It has been found that the amount of sodium silicate necessary for the flotation of a given mineral is proportional to the quantity of water used, though the quantity may vary with different ores; for ores tested about 5 lbs. of sodium silicate per ton of water have been found suitable to float galena from blende whether the pulp be 8:1, 4:1 or 2:1. The latter is readily floated with the galena when about 3 lbs. of sodium silicate per ton of water are employed. The concentration of sodium silicate, however, which will give the cleanest separation of the galena from the blende will vary with the nature of the blende and of the ore, and can be easily determined by a laboratory experiment on the particular ore to be treated.

The sodium silicate is preferably added as a 40% solution made by mixing the commercial liquid sodium silicate (140° Twaddell) with water. It is important that the solution should not be allowed to stand for too long a time before use, as its properties are found to deteriorate in a few weeks.

The amount of soap required is proportional to the ore, and with the particular ores the treatment of which has been described above, it was found that 4 to 5 lbs. of soap per ton of ore was sufficient to bring about the flotation of the lead particles. The quantity, however, may vary with different ores, and it may be readily determined by a laboratory experiment.

The consumption of reagents can be economized by re-using the circuit liquor it only being necessary to make up the quantities of reagents contained therein to the proportions originally found necessary.

The present invention is particularly applicable to the separation of lead sulfid (galena) from zinc sulfid (blende) in a mixed sulfid ore, but it is to be understood that it may be employed for the separation of other metalliferous particles from one another; for example iron pyrites may be floated in preference to blende.

The term "ores" in this specification is to be understood to include all metallurgical products as well as crude materials.

It is to be understood that the present invention is applicable to the separation of two or more kinds of metalliferous particles from one or more kinds of other metalliferous particles.

What we claim as our invention and desire to secure by Letters Patent is:—

1. The process of differentially separating certain metalliferous particles from other metalliferous particles, which consists in adding the mixed particles to water to form a pulp, aerating the pulp in the presence of a small proportion of sodium silicate and a sufficient quantity of a soluble soap to produce a froth selectively bearing the first said metalliferous particles, and separating the froth.

2. The process of differentially separating certain metalliferous particles from other metalliferous particles, which consists in adding the mixed particles to water to form a pulp, aerating the pulp in the presence of a small proportion of sodium silicate and a sufficient quantity of a soluble soap to produce a froth selectively floating the first said metalliferous particles, separating the froth bearing the first said particles, diluting the liquor of the remaining pulp by adding a further quantity of water, aerating the mixture for the production of a second froth bearing metalliferous particles not previously floated, and separating said second froth.

3. The process of differentially separating certain metalliferous particles from other metalliferous particles, which consists in adding the mixed particles to water to form a pulp, aerating the pulp in the presence of a small proportion of sodium silicate and a sufficient quantity of sodium oleate to produce a froth selectively bearing the first said metalliferous particles, and separating the froth.

4. A process for the differential separation of certain metalliferous particles from other metalliferous particles, which consists in adding the mixed particles to water to form a pulp, aerating the pulp in the presence of a small proportion of sodium sili-

cate and a sufficient quantity of sodium oleate to produce a froth of the first said metalliferous particles, relatively free from said other metalliferous particles, separating the froth, diluting the liquor of the remaining pulp by adding a further quantity of water, aerating the resulting pulp mixture for the production of a second froth bearing metalliferous particles not previously floated, and separating said second froth.

5. A process for the differential separation of lead sulfid from zinc sulfid, which consists in adding a mixed lead-zinc sulfid ore to water to form a pulp, aerating the pulp in the presence of a small proportion of sodium silicate and a sufficient quantity of a soluble soap to produce a froth selectively floating the lead sulfid particles and relatively free from the zinc sulfid particles, and separating the froth.

6. A process for the differential separation of lead sulfid from zinc sulfid, which consists in adding a mixed lead-zinc sulfid ore to water to form a pulp, aerating the pulp in the presence of a small proportion of sodium silicate and a sufficient quantity of a soluble soap to produce a froth selectively bearing the lead sulfid particles and relatively free from the zinc sulfid particles, separating the froth, diluting the liquor of the remaining pulp by adding a further quantity of water, re-aerating said remaining pulp for the production of a second froth of zinc sulfid particles, and separating said second froth.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

EDWIN EDSER,
STANLEY TUCKER.

Witnesses:
ALBERT OWEN WILLIAMS,
WILLIAM JAMES WALTON.