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CONCENTRATION OF ORES

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This invention relates to improvements in the concentration of ores and more particularly to the flotation separation of ores containing cassiterite.

It is well known that cassiterite or tin oxide is extremely difficult to recover from ores by means of the usual flotation processes on a commercial scale, although the best known flotation processes have been repeatedly applied to it by those skilled in the art of flotation. So resistant is cassiterite to the well-known methods that in commercial operations it permits the sulphide minerals to be separated from it and removed in the froth during flotation operation leaving the bulk of the cassiterite in the residue.

I have found that the resistance of cassiterite to flotation is due to the conditioning of the grains of cassiterite by colloidal substances present in most cassiterite ores, and that by removing these substances cassiterite can be induced to float quite as readily as any other mineral.

My invention, therefore, contemplates the following process or method of treating ores containing cassiterite:

The ore containing cassiterite is ground to a sufficient fineness to release the mineral grains and mixed with water to form a pulp. This pulp is diluted to the proper degree (which is determined by experimentation) and sodium silicate or some other deflocculator is then mixed with the pulp in such a proportion that the colloidal matter will be separated from the crystalline matter and held in suspension as such in the liquid. This reaction takes place in a very definite manner and when the proper proportion of deflocculator is reached the crystalline grains will be released and settle rapidly out of the liquid.

The liquid containing the colloidal substances is then separated from the crystalline matter by well-known means such as filtration, decantation, elutriation, centrifugal force, etc. The crystalline matter is then mixed with clean water to form a pulp and the whole is violently agitated in the presence of a small portion of an acid, such as sulfuric acid, and a frothing agent such as pine oil, eucalyptus oil, etc. and the resulting froth, consisting principally of the sulphide contents of the pulp, is then removed and if necessary can be cleaned by similar treatment and the sulphides subsequently separated by well-known methods. The residue containing the bulk of the cassiterite in the ore is then violently agitated in the presence of a saponifiable substance, such as oleic acid, stearic acid or other fatty acid or grease, and a frothing agent such as cresol, pine oil, eucalyptus oil or the like with the result that the cassiterite will float and be contained in the froth which may then be removed and, if desired, cleaned in the usual manner.

The following is a typical example of the application of my new improved process to an ore containing cassiterite:

A sample of ore from the mines of the Patino Mines & Enterprises Consolidated, Inc. of Lallagua, Bolivia, was ground to pass 150 mesh approximately, and mixed with water in the ratio of twenty-eight parts of water with one of solids by weight and with about eight pounds of sodium silicate per dry ton of ore. The liquid containing the colloidal substances was then decanted off leaving behind the crystalline matter. This crystalline matter was then mixed with clean water to form a pulp which was agitated in the flotation machine together with 0.2 pound of sulfuric acid and 0.5 pound of pine oil per dry ton of ore. The resulting froth consisting principally of sulphides was removed. The residue was then agitated with 1.0 pound of oleic acid and 0.2 pound of cresol per dry ton of ore, and the resulting froth removed. This froth contained 92% of the tin in the original charge to the flotation machine and by cleaning produced a froth assaying 55% tin. The charge in the flotation machine assayed 6% tin and the tailings from the roughing operation assayed 0.3% of tin.

While I have described my improved process as specifically applied to the treatment of ores containing cassiterite I do not, however, wish to be limited to that particular ore, as my process is adaptable for use in the flotation of ores containing other metals.

Nor do I wish to be limited to the specific proportions set forth in the above typical example.

What I claim is:—

1. The process of concentrating ores containing cassiterite which consists in mixing the ore in a finely divided condition with water to form a pulp, adding to the pulp a deflocculator to cause the colloidal matter to separate from the crystalline matter and to be held in suspension in the liquid, then removing the liquid containing such colloidal matter, then adding water to the crystalline matter to form a pulp and agitating the same in the presence of an acid and a frothing agent to cause the sulphide contents of the pulp to float in the resulting froth, removing the froth, and then agitating the residue in the presence of a saponifiable substance and a frothing agent to cause the cassiterite to float in the froth.

2. The process of concentrating ores containing cassiterite which consists in grinding the ore to a sufficient fineness and mixing with water to form a pulp, then adding to the pulp a deflocculator to separate the colloidal substances from the crystalline matter, then removing the colloidal substances, then adding water to the crystalline matter to form a pulp and agitating the same in the presence of a small portion of an acid and of a frothing agent to cause the sulphides contained in the pulp to float in the resulting froth, then removing the froth containing such sulphides, then agitating the residue in the presence of a saponifiable substance and a frothing agent to cause the cassiterite to float in the resulting froth, then removing the froth.

3. The herein described process of concentrating ores containing cassiterite which consists in mixing the ore in a finely divided condition with water containing sodium silicate to cause the colloidal substances to be held in suspension in the liquid and permitting the crystalline substances to settle, removing the liquid containing the colloidal substances, mixing the crystalline substances with water containing a small portion of sulfuric acid and a frothing agent, agitating the mixture to cause the sulphide contents of the pulp to float in the resulting froth, removing the froth, agitating the residue in the presence of oleic acid and a frothing agent, and then removing the froth.

4. The herein described process of concentrating ores containing cassiterite which consists in mixing the ore in a finely divided condition with water to form a pulp, such pulp containing a deflocculator in the proportion of .4% of the ore to cause the colloidal substances to be held in suspension in the liquid and permitting the crystalline substances to settle, removing the said colloidal substances, mixing the crystalline substances with water to form a pulp, such pulp containing sulfuric acid in the proportion of .01% per dry ton of ore and a frothing agent, agitating the mixture to cause the sulphide contents in the pulp to float in the resulting froth, removing the froth, agitating the residue in the presence of a saponifiable substance and a frothing agent to cause the cassiterite to float in the resulting froth, and then removing the froth.

5. The process of concentrating ores containing cassiterite which consists in mixing the ore in a finely divided condition with water to form a pulp, adding to the pulp a reactive agent that will cause the colloidal substances to be held in suspension in the liquid and the crystalline matter to settle, recovering the crystalline matter and mixing the same with water to form a pulp, adding to such pulp a reactive agent to cause the sulphides to float, removing the resulting froth containing such sulphides, then adding reactive agents to cause the cassiterite to float.

6. The process of concentrating ores containing cassiterite which consists in mixing the ore in a finely divided condition with water to form a pulp, removing the colloidal substances and sulphides from the pulp, finally treating the residue to effect flotation of the cassiterite, and then removing the cassiterite.

This specification signed this 27th day of August, 1928.

ROYAL S. HANDY.