

# UNITED STATES PATENT OFFICE

2,608,298

## SELECTIVE RECOVERY OF MOLYBDENUM SULFIDE BY FLOTATION

Nathaniel Arbiter and Orel E. Young, Morenci,  
Ariz., assignors to Phelps Dodge Corporation,  
New York, N. Y., a corporation of New York

No Drawing. Application April 6, 1948,  
Serial No. 19,424

12 Claims. (Cl. 209—167)

1

This invention relates to the separation by selective flotation of sulfide minerals from ores containing sulfides of other metals. More particularly, this invention is applicable to the separation of sulfide minerals, such as molybdenite, from flotation concentrates containing sulfides of other metals such as iron and copper.

Molybdenite ( $\text{MoS}_2$ ) is the major source of the metal molybdenum and is found in sufficient amounts for economic recovery in a variety of ores, many of which include the sulfides of other metals such as copper and iron, as well as the molybdenite. Usually in such a mixed sulfide ore, the molybdenite is present only as a minor constituent, and in such cases its separation constitutes a real problem. The cost of such a separation has to be kept low in order to be competitive.

One method that has been used is to subject a flotation concentrate of the mixed sulfides to a further flotation step with the addition of a reagent such as dextrin to depress the flotation of the molybdenite. The concentrate from this operation is then refloatated to separate a further amount of molybdenite, and the combined tailings containing the molybdenite have to be subjected to further treatments such as dewatering, roasting at 300° F. or above, repulping and additional cleaning.

Another method that depresses the copper and other metal sulfides involves a heat treatment, such as steaming in order to obtain a separation of the molybdenite from the copper and iron sulfides. Any such heat treatment adds to the expense of the process and requires the use of extra equipment. Also, a steaming treatment to produce depression of copper and iron is only effective when the original concentrate treated was obtained by using a xanthate as a collector.

One object of our invention is the provision of a method of recovering a sulfide mineral such as molybdenite from a flotation concentrate containing a small amount of the sulfide mineral and relatively large amounts of other metal sulfides by a simple flotation process involving the addition of inexpensive reagents in small amounts to depress effectively the sulfides of the other metals and allow the desired sulfide mineral or minerals to be recovered in the froth.

Another object of this invention is the provision of such a selective flotation method in which the depression of certain metal sulfides is accomplished without any heat treatment by the addition to or formation in the pulp of a polysulfide and a thiosulfate along with one or more water soluble metallic salts.

2

We have found that a combination of a polysulfide and a thiosulfate in a flotation medium, particularly when used in the presence of one or more water soluble metal salts, has a sufficient selective depressing effect on the flotability of certain metal sulfides, such as the sulfides of copper and iron, to permit other sulfide minerals, such as molybdenite, to be separated or concentrated in a froth. Such a treatment is effective when applied to a mixed sulfide flotation concentrate, even though the unthickened concentrate before such treatment contains the usual quantities of organic collector and frothing agent. In fact, such a treatment may be even more effective when applied to a repulped concentrate. The collector is either destroyed in some manner or rendered sufficiently ineffective by these reagents to permit efficient selective flotation in the treatment of such a concentrate. Also, we have found that some of the frother which may be in such a concentrate is likewise either destroyed or rendered innocuous by the presence of these reagents without any further treatment. In fact, it is usually necessary to add additional frothing agent in order to obtain froth of the type needed for the selective flotation treatment of the concentrate.

We have further discovered that the combination of a polysulfide and thiosulfate operates successfully, although either one alone in relatively pure form does not produce the same results. Any of the various polysulfides and thiosulfates that are sufficiently soluble in water, such as the salts of the common alkali and alkaline earth metals and of the ammonium radical, can be used for this purpose. One simple and economic method of preparing such a mixed polysulfide and thiosulfate reagent is by heating sulfur with an aqueous solution or suspension of alkali metal or alkaline earth metal hydroxide. The reaction product of such a treatment is a mixture containing substantial proportions of both the polysulfide and thiosulfate. For example, an aqueous suspension of lime may be heated with sulfur to form a mixture of calcium polysulfide and thiosulfate which is very effective as a selective depressing reagent in the treatment of mixed sulfide flotation concentrates. While our invention is not limited thereto, a good working range of proportions in preparing such a reagent is a product made by heating a mixture containing by weight on a dry basis 60 to 40% of  $\text{CaO}$  with 40 to 60% of sulfur.

Other methods may be used for preparing the mixture of polysulfide and thiosulfate. For example, the relatively pure compounds can be