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TREATMENT OF ZINC SULPHIDE ORES.

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To all whom it may concern:

Be it known that we, EDWARD A. TAYLOR and GLENN A. KEEP, citizens of the United States, and residents of Cleveland, county of Cuyahoga, State of Ohio, have jointly invented a new and useful Improvement in the Treatment of Zinc Sulphide Ores, of which the following is a specification, the principle of the invention being herein explained and the best mode in which we have contemplated applying that principle, so as to distinguish it from other inventions.

The present invention relates to the treatment of zinc sulphide ores, which are commonly called complex zinc ores and contain the sulphides of zinc, lead, silver and other metals. Such ores are extremely expensive to reduce, and no methods of working the ores to separate the various metals have been put into successful practice due to the difficulty of treating such ores when they contain a high percentage of zinc. In commercial practice only those ores which contain about six per cent or less of zinc can ordinarily be successfully reduced.

The object of the present invention is a method for removing the zinc from such complex zinc ores, without affecting the other metals present, at a relatively low cost, after which of course the residue can be treated in any desired manner to separate out the various metal constituents. To the accomplishment of the foregoing and related ends, said invention, then, consists of the means hereinafter fully described and particularly pointed out in the claims.

The following description sets forth in detail one approved method of carrying out the invention, such disclosed mode, however, constituting but one of the various ways in which the principle of the invention may be used.

Our invention is based upon the discovery that hot relatively concentrated sulphuric acid exerts a preferential action upon finely ground complex zinc ores, acting on the zinc sulphides present with practically no action on the other metallic sulphides. It might of course be found that if the action of the acid on the ore is continued, or if a large excess of acid is present, then some of the other metal sulphides can also be dissolved, but by regulating very closely the amount of acid used, and the temperature at which the treatment is carried out, we have found it possible to effect a clean separation of the zinc, however, without any difficulty caused by the dissolving of any of the other metallic sulphides.

In carrying out our method we treat comminuted complex zinc ores containing the zinc in the form of zinc sulphide along with the sulphides of silver, lead, iron, copper and others, with relatively concentrated sulphuric acid. We have employed chamber acid having the specific gravity of 52° Baumé, which is equivalent to about a 60 per cent concentration, in an amount either equal to, or slightly in excess of the amount which is chemically equivalent to the zinc content of the ore. The treatment is best carried out by preliminarily heating the ore to a temperature of about 400° F. and the acid to a temperature of about 260° F., which will give a temperature of about 300° F. for the mixture. The action is extremely rapid when carried out under these conditions, all of the zinc sulphide present being dissolved in a very few minutes, and the resulting product is practically a solid where only the chemically equivalent amount of acid is used. The reaction which takes place is of course the formation of the zinc sulphate and of hydrogen sulphide gas, which may be collected or allowed to escape through the atmosphere. Where a slight excess of acid is used the resulting product is in the form of a thick slurry. The reaction which takes place in either case is indicated by the following reaction equation:—

$$ZnS+H_2SO_4=ZnSO_4+H_2S$$

We prefer to use a slight excess of acid as it leaves the product in a pasty mass which is somewhat easier to work with than the solid product, which is formed when the equivalent amount of acid is used. A sufficient amount of water must either be used along with the acid or must be added after the formation of the zinc sulphate to provide the seven molecules of combined water which are found in normal hydrated zinc sulphate, having the formula—

$$ZnSO_4.7H_2O$$

This has the effect of thinning out the mass, allowing any free acid that may be uncombined as zinc sulphate to re-act further by allowing better contact of such free acid with the zinc sulphide in the ore.

After the reaction between the zinc sulphide and the sulphuric acid has reached a maximum water is added in sufficient quantity to dissolve all the zinc sulphate, and the solution is then filtered and the insoluble residue washed free from soluble zinc salts. The insoluble residue may then be treated by any suitable method to separate the various metals from each other, and there are well-known processes for this purpose, which are entirely successful so long as there is no large amount of zinc present, the usual limit being six per cent zinc without penalty. In the present case of course the zinc is practically entirely removed as a separation of 94 per cent or better is obtained by the present method.

The zinc sulphate which is carried in solution is then crystallized by evaporation and may be used either as zinc sulphate, or it may be calcined at a temperature of 1500° to 1600° F. to produce zinc oxide with the evolution of sulphur dioxide, sulphur trioxide and oxygen, which may be collected for use in other methods, such, for example, as the manufacture of sulphuric acid.

It may happen that when an excess of acid is used some lead may also be dissolved as lead sulphate and carried in solution by the excess acid present. This does not happen if the chemically equivalent amount of acid is used, nor does it cause any difficulty in any event, since upon the addition of water to provide water of crystallization for the zinc sulphate, any lead sulphate present will be precipitated as lead sulphate.

Our improved method provides an extremely simple, but valuable means for removing the zinc from that type of ores, which at present cannot be treated by any known methods, and are hence not available, although they contain valuable amounts of such metal as zinc, lead, silver, copper and gold.

We therefore particularly point out and distinctly claim as our invention:—

1. The method of separating zinc sulphide from complex zinc sulphide-containing ores, which consists in treating comminuted complex ore with hot sulphuric acid in amount not less than the amount chemically equivalent to the zinc content of the ore.

2. The method of separating zinc sulphide from complex zinc sulphide-containing ores, which consists in treating comminuted complex ore with sulphuric acid in amount slightly in excess of the amount chemically equivalent to the zinc content of the ore at a temperature of about 300° F.

3. The method of separating zinc sulphide from complex zinc sulphide-containing ores, which consists in treating comminuted complex ore with sulphuric acid in amount slightly in excess of the amount chemically equivalent to the zinc content of the ore at a temperature of about 300° F., and then separating the soluble zinc sulphate formed from the insoluble residue of ore.

4. The method of separating zinc sulphide from complex zinc sulphide-containing ores, which consists in treating comminuted complex ore with sulphuric acid in amount slightly in excess of the amount chemically equivalent to the zinc content of the ore at a temperature of about 300° F., filtering out the insoluble residue, and then crystallizing the zinc sulphate solution.

5. The method of separating zinc sulphide from complex zinc sulphide-containing ores, which consists in treating comminuted complex ore with sulphuric acid in amount slightly in excess of the amount chemically equivalent to the zinc content of the ore at a temperature of about 300° F., adding sufficient water to provide water of crystallization for the soluble zinc sulphate, separating out the insoluble ore residue, and then crystallizing the zinc sulphate out of solution.

6. The method of separating zinc sulphide from complex zinc sulphide-containing ores, which consists in treating comminuted complex ores with sulphuric acid in amount slightly in excess of the amount chemically equivalent to the zinc content of the ore at a temperature of about 300° F., precipitating any lead sulphate formed during the action of the acid on the ore, separating the insoluble ore residue, and then crystallizing the zinc sulphate out of solution.

Signed by me, this 26 day of December, 1919.

EDWARD A. TAYLOR.

Signed by me, this 20 day of Dec., 1919.

GLENN A. KEEP.