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CALCINATION OF ZINC SULFIDE CONCENTRATES

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This invention relates to the calcination or roasting of zinc sulfide concentrate in an oxidizing atmosphere to convert the zinc sufide to zinc oxide. The invention is particularly directed to the provision of a method for improving the oxidation of the zinc sulfide in the concentrate, and is based on the discovery that when a minor amount of a metallic sulfate is incorporated in the concentrate prior to roasting, the oxidation of sulfide-sulfur is markedly improved and the amount of residual sulfide-sulfur which remains in the resultant calcine is substantially decreased.

The zinc content of most ores, as mined, is generally too low for economical metallurgical treatment, and all processes developed for the winning of metallic zinc from its ores invariably require that the zinc minerals in the ore be concentrated to a point where they may be recovered economically. Because zinc sulfide, which is the most common zinc mineral found in zinciferous ores, cannot be reduced directly, these concentrates are roasted or calcined to produce zinc oxide (or sulfate) which, in turn, is more chemically reactive than zinc sulfide. In the electrolytic zinc process, for example, the zinc calcine is leached with dilute sulfuric acid to form an aqueous electrolytic solution of zinc sulfate, which is initially purified to remove certain deleterious impurities and then is electrolyzed to produce metallic zinc, using an insoluble anode.

The solvent employed in leaching the zinc calcine is the "spent" electrolyte which remains after the electrolysis of the zinc sulfate solution and which contains up to about 25 percent by weight of sulfuric acid. Since any residual sulfide-sulfur remaining in the zinc calcine is insoluble in sulfuric acid and represents a loss in zinc equal to approximately twice its weight, one of the major objects in roasting the zinc sulfide concentrate is to convert the zinc sulfide, as nearly completely as possible, into zinc oxide and sulfate. Only enough zinc sulfate should be formed, however, to compensate for acid losses in the cycle, since any excess will result in a build-up of acid in the system.

Using a range of roasting temperatures of 900° C. to 930° C., we have found that it is possible to increase the conversion of sulfide-sulfur in the calcine to oxide and to decrease the amount of residual sulfide-sulfur remaining in the calcine by adding a minor amount of sulfate ions in the form of a metallic sulfate to the zinc sulfide concentrate prior to roasting. Although any metallic sulfate may be used, particularly satisfactory results have been obtained by adding a minor amount of zinc sulfate to the zinc sulfide concentrates prior to roasting, the resultant calcine containing a much lower sulfide-sulfur content than can be obtained by roasting the concentrate absent the metallic sulfate under identical process conditions.

The invention contemplates the improvement, in a process in which a zinc sulfide concentrate is roasted in an oxidizing atmosphere to convert the zinc sulfide to zinc oxide, of incorporating a minor amount of a metallic sulfate in the zinc concentrate prior to roasting, whereby oxidation of the sulfur content of the concentrate is substantially improved and the amount of residual sulfide-sulfur remaining in the calcine product is substantially decreased. The actual concentration of the metallic sulfate added to the concentrate prior to roasting is, of course, dependent upon several factors, including the sulfide-sulfur content of the concentrate as well as the temperature at which the concentrate is roasted. Although there appears to be no critical upper limit on the amount of metallic sulfate added to the concentrate, there is no great advantage in using more than about 1 percent by weight (calculated as sulfate). In most zinc sulfide concentrates, substantially the full benefit of the presence of the metallic sulfate may be achieved by adding a total of about 0.5 to about 1 percent by weight, calculated as sulfate.

The improvement contemplated by the invention is particularly applicable in the electrolytic process for the recovery of zinc from its ores, in which a zinc sulfide concentrate is roasted in an oxidizing atmosphere to convert the zinc sulfide to zinc oxide and a minor proportion of zinc sulfate and the resulting zinc calcine is leached with dilute sulfuric acid to form an aqueous electrolytic solution of zinc sulfate from which metallic zinc is electrodeposited. By incorporating a minor amount of the electrolyte (equivalent to from about 0.5 to about 1 percent by weight of zinc sulfate) in the zinc sulfide concentrate prior to roasting, it is possible to increase the conversion of the sulfur content of the concentrate to oxide (and sulfate) and to decrease the amount of residual zinc sulfide remaining undissolved after the sulfuric acid leach.

To illustrate the applicability of incorporating a minor amount of zinc sulfate in the zinc sulfide concentrate prior to roasting in accordance with the invention, Table I sets forth the metallurgical results of a series of tests in which a zinc sulfide concentrate containing varying amounts of added zinc sulfate was roasted at a temperature of about 920° C. In each of these tests, an aqueous solution of zinc sulfate was added to an aqueous pulp of the zinc sulfide concentrate to uniformly distribute the sulfate throughout the concentrate. The pulp was then flash-dried and roasted in a fluosolids reactor.

TABLE I

Metallurgical Assays of Zinc Calcine

[Percent by weight]

Concentration of Sulfate (as $ZnSO_4$) in feed	Total Sulfur in feed	24 Hour Calcine		
		Total Sulfur	Sulfate Sulfur	Sulfide Sulfur
None	31.8	3.04	1.90	1.14
0.5	31.0	2.20	1.77	0.43
1.0	30.3	2.32	2.00	0.32

Analysis of the data in Table I illustrates the general rule that the addition of a minor amount of a metallic sulfate to the zinc sulfide concentrate prior to roasting results in an increased conversion of sulfide-sulfur in the resultant calcine to sulfate-sulfur (or oxide), and thereby decreases the amount of residual zinc sulfide remaining undissolved after the calcine is leached with sulfuric acid.

Although the foregoing tests demonstrate the effectiveness of employing minor amounts of zinc sulfate in the zinc sulfide concentrate prior to roasting, similar advantages are attained by dispersing any metallic sulfate throughout the concentrate prior to roasting. Consequently, the invention is applicable to the use of any metallic sulfate in the zinc sulfide concentrate to improve the calcining properties of the concentrate.

We claim:

1. In a process in which a zinc sulfide concentrate is roasted in an oxidizing atmosphere to convert the zinc sulfide to zinc oxide, the improvement which comprises incorporating from about 0.5 to about 1 percent by weight of zinc sulfate in the zinc sulfide concentrate prior to roasting to substantially improve oxidation of the sulfur content of the concentrate and to substantially decrease the amount of residual sulfide-sulfur remaining in the calcine product.

2. In an electrolytic process for the recovery of zinc from its ores, in which a zinc sulfide concentrate is roasted in an oxidizing atmosphere to convert the zinc sulfide to zinc oxide and the resulting zinc oxide calcine is leached with dilute sulfuric acid to form an aqueous electrolytic solution of zinc sulfate from which metallic zinc is electrodeposited, the improvement which comprises incorporating from about 0.5 to about 1 percent by weight of zinc sulfate from said electrolyte in the zinc sulfide concentrate prior to roasting to substantially improve oxidation of the sulfur content of the concentrate and to notably decrease the amount of residual zinc sulfide remaining undissolved after the sulfuric acid leach.

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