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EXTRACTION OF METALS FROM COMPLEX ORES.

SPECIFICATION forming part of Letters Patent No. 752,320, dated February 16, 1904.

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To all whom it may concern:

Be it known that I, JOSÉ BAXERES DE ALZUGARAY, a citizen of Argentina, and a resident of Lola Villa, Bromley, in the county of Kent, England, have invented certain new and useful Improvements in or Relating to the Extraction of Metals from Complex Ores, of which the following is a specification.

The object of this invention is to treat what are known as "complex" ores or other metal containing compounds for the purpose of extracting, as the case may be, cobalt, copper, lead, nickel, silver, zinc, and other heavy metals therefrom, and an essential feature of the invention consists in leaching the crushed ores with an acidulated solution of a chlorid of an alkali or alkali-earth metal and of a metal other than those of the alkali or alkali-earth series without the necessity for prior calcination or roasting of the metals contained in the complex ore being extracted by means of this invention successively or selectively, as will be hereinafter more particularly explained. The materials which have been found useful in solution are chlorid of sodium, calcium, or magnesium and proto and per chlorid of iron acidulated with a suitable acid. An acid which has been found exceedingly satisfactory in this connection is hydrochloric acid; but other acids or mixtures thereof which will yield free chlorin may also be employed. To the acidulated chlorid solution may be added, if desired, chlorid of manganese, formed by dissolving peroxid of manganese in hydrochloric acid.

In working this invention it has been found that complex sulfid ores are attacked and decomposed by the above-described mixture of acidulated chlorids in the following order: first, the sulfids of copper and silver; second, the sulfid of lead, and, third, the sulfid of zinc, while iron sulfid, if there is any, remains practically undecomposed even after prolonged treatment by the leaching solution. The mechanism of this reaction is that free chlorin is generated most probably by the dissociation of unstable intermediate chlorin compounds formed in the mixture, which free chlorin in the presence of the water acts as a powerful oxidizer.

For the purpose of testing the efficacy of the process which forms the subject of the present invention ores of an extremely intractable character have been experimented upon—such, for instance, as an ore containing on an average: zinc, 21.64 per cent.; lead, 19.37 per cent.; copper, 6.48 per cent.; iron, 5.39 per cent.; sulfur, 20.28 per cent.; but the invention is not confined to treating such an ore.

In carrying out the invention as applied to the treatment of ore represented by the above analysis the crushed ore is treated with an equal weight of the acidulated chlorid solution without previous calcination. On account of the well-known ready oxidizability of copper sulfid it will be found that after some five hours treatment about fifty per cent. of the copper will have been extracted and by continuing the treatment for from five to seven days a total percentage of from eighty-six to ninety-four per cent. can be obtained. Lead sulfid being less oxidizable, only some thirty per cent. of lead will be extracted during this stage of the process; but from the zinc sulfid, upon which the oxidizing mixture has little effect, only about 1.14 per cent. of the zinc will be obtained at this stage. It will thus be seen that after this first stage of the treatment practically all the copper contents are recovered; but it will be necessary to proceed further to extract the remaining lead and zinc. To this end the residual ore is well washed and dried, and it is then roasted at a low temperature. The action of the strongly-oxidizing acidulated chlorid solution on the crushed ore is such that the ore becomes partially disintegrated or rendered porous by the leaching operation, and therefore the roasting operation can be carried out at a relatively low temperature. The roasting operation is thus rendered much easier than under ordinary circumstances. In fact, about twenty-five per cent. of the sulfur contents are volatilized at a temperature ranging from 165° to 200° centigrade. The roasting of the ore containing the zinc and lead sulfids, otherwise a lengthy and difficult operation, after the treatment with the acidulated chlorid solution takes place with great rapidity and is

as easy as the roasting of arsenical pyrites and even easier.

The roasted ore will consist of a mixture of oxids, chiefly of zinc and lead, from which these metals can be extracted in the form of suitable salts, such as chlorids or sulfates, by a second leaching with a weak solution having a character consonant with the nature of the salt to be produced. The metals may be obtained as chlorids by leaching for a few hours with a weaker acidulated solution of the chlorids above mentioned, which converts the zinc into a soluble chlorid. From this solution the zinc may be precipitated with a suitable alkali earthy oxid, such as lime or magnesia. The zinc thus obtained will be distilled in the usual way for metal. The lead will precipitate as chlorid.

The copper obtained during the first stage of the operation may be separated by means of iron, the silver, if there is any, by means of copper, and such lead as has been dissolved will separate as a crystallized chlorid.

The acids may be added to the chlorid solution in the liquid state in suitable proportions or may be blown through the mixture of ore and chlorid solution in the gaseous state.

If sulfates are the salts desired, sulfuric acid will be used for the leaching solution at the later stage after the calcination. In this case the lead will remain as an insoluble precipitate of sulfate and separate in this form.

Instead of separating the metals in solution by other metals or reagents the solutions may be electrolyzed and the metals deposited at the cathode, as is well understood.

The ore subjected to treatment according to this invention may be treated in lump (which, however, requires a longer period of treatment) or in any degree of fineness; but it has been found on the average that thirty mesh answers the best. The leaching solutions at the several stages of the treatment may be warmed to a suitable degree. This will render the operation more rapid.

What I claim as my invention is—

1. In the treatment of complex ores, such for instance, as contain copper, lead, silver and zinc in comparatively large quantities, the process of extracting the said metals selectively which consists in leaching the ore with a solution composed of a mixture of a chlorid of an alkali or earth-alkali metal with a chlorid of a metal other than those of the alkali or earth-alkali series and an acid before calcination or roasting whereby the copper is obtained in solution, then washing and drying the ore, roasting the partially-disintegrated ore at a low temperature, extracting the metals from the roasted ore in form of salts by means of a second and weaker leaching solution having a character consonant with the nature of the salt it is desired to obtain, and recovering the metals in the usual way as herein described.

2. In the treatment of complex ores, such for instance as contain copper, lead, silver and zinc in comparatively large quantities, the process of extracting the said metals selectively which consists in leaching the ore with an acidulated chlorid solution, before roasting or calcination whereby the copper is obtained in solution, then washing and drying the ore, roasting the partially-disintegrated ore at a low temperature, and finally leaching the roasted ore with a weaker acidulated chlorid solution, whereby the zinc is obtained in solution, while the lead precipitates, and recovering from the solutions the copper with iron and the zinc with an earthy or alkali-earthy oxid, as herein described, and the silver by means of copper or of any suitable metal or reagent.

3. The process for extracting copper from complex ores containing copper, lead, silver and zinc in comparatively large quantities, which consists in leaching the crushed ore with a solution composed of a mixture of an alkaline chlorid, a metallic chlorid and an acid without calcination or roasting, and drawing off the solution and separating the copper in any well-known manner as herein described.

4. The process for extracting zinc and lead from complex ores containing copper, lead and zinc in comparatively large quantities, which consists in first leaching the ore in an acidulated chlorid solution whereby it is partially disintegrated and the copper is obtained therefrom in solution, then washing, drying and roasting the so partially-disintegrated ore, and finally leaching the roasted ore in a weak acidulated chlorid solution, whereby the lead precipitates as a chlorid, and the zinc enters into solution and is precipitated by means of an alkali-earthy oxid and is finally recovered by distillation in the usual way, all as herein described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

JOSÉ BAXERES DE ALZUGARAY.

Witnesses:
ALFRED S. BISHOP,
W. M. HARRIS.