

Having now particularly described and ascertained the nature of my said invention, and in what manner the same is to be performed, I declare that what I claim is,—

1. The process whereby the formation of irregular or spongy deposits of zinc during the electro-deposition of that metal is prevented, consisting in dissolving in a zinc-bearing solution a quantity of zinc-oxide, substantially as described.

2. The process whereby an electrolyte consisting of a zinc-bearing solution in which an oxysalt of zinc is present in solution is prepared direct from blende or a mixed blende and galena, substantially as described.

3. The process whereby zinc can be continuously deposited from a zinc-bearing solution electrolytically, substantially as described.

Dated this 24th day of August, 1896.

W. E. HUGHES,

Agent for the Applicant.

IMPROVEMENT IN THE TREATMENT OF ZINC- AND COPPER-ORES.

I, William Ernest Hughes, of 54, Lambton Quay, Wellington, in the Colony of New Zealand, patent agent, do hereby declare the nature of my invention for "Improvements in the Treatment of Zinc- and Copper-ores," and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

My invention relates more particularly to the treatment of zinc- and, or, copper-bearing ores, or metallurgical products containing in the form of oxides the zinc or copper, or either of these metals alone or in combination with other metals.

For convenience the term "ore" is used in the following specification, but it is understood to include raw or roasted ore, or metallurgical products containing zinc or copper in the form of oxides or basic or neutral sulphates or sulphites.

My invention consists essentially in the conversion of the zinc-oxide (ZnO) and, or, copper-oxide (CuO) contained in such ore into sulphate of zinc (ZnSO_4) and, or, sulphate of copper (CuSO_4) by means of ammonium-sulphate ($(\text{NH}_4)_2\text{SO}_4$) and, or, ammonium-sulphamate, according to the formula: $\text{ZnO} + (\text{NH}_4)_2\text{SO}_4 = \text{ZnSO}_4 + 2\text{NH}_3 + \text{H}_2\text{O}$, the ammonia being given off in a gaseous form, and the ammonium-sulphate subsequently regenerated as hereinafter described. The sulphate of zinc and, or, the sulphate of copper so formed are leached out by water. Any copper present in the solution is precipitated by metallic zinc (spelter) according to the reaction: $\text{CuSO}_4 + \text{Zn} = \text{Cu} + \text{ZnSO}_4$, or by other suitable means. The ammonia (NH_3) generated in the sulphatising operation is passed through the solution carrying the sulphate of zinc, precipitating the zinc as zinc-hydrate (ZnH_2O_2) and regenerating the ammonium-sulphate for the treatment of further quantities of ore. The reaction takes place according to the following formula: $\text{ZnSO}_4 + 2\text{H}_2\text{O} + 2\text{NH}_3 = \text{ZnH}_2\text{O}_2 + (\text{NH}_4)_2\text{SO}_4$.

In carrying my invention into effect the ore is mixed with its proper proportion of ammonium-sulphate and, or, -sulphamate, which I find in practice is about two units more or less of ammonium-sulphate and, or, -sulphamate to each unit of zinc in the ore, but do not bind myself to such proportions. The ore is then treated in suitable closed vessels and with or without the addition of water or steam, the contents of such vessels being raised to a temperature approximately 300° to 500° centigrade, or other suitable temperature. The reaction indicated then takes place, the zinc and copper being converted in soluble sulphates and free ammonia-gas being given off.

The product of this operation, consisting of sulphates of zinc and, or, copper, with gangue and, or, other insoluble residue, is leached with hot or cold water in suitable vessels. The soluble sulphates of zinc and copper are thereby dissolved, and are separated from the gangue and, or, insoluble residue, which may contain lead and, or, other metals. The gangue and, or, other insoluble residue can be treated by any well-known process for the recovery of its metallic contents.

Any copper contained in the solution is precipitated by metallic zinc or other suitable means, and removed for treatment by any well-known process before precipitation of the zinc or zinc-hydrate by the ammonia-gas. Any iron in the solution can also be precipitated, if desired, by any suitable means.

The ammonia-gas produced in the closed vessels during the first operation is recovered by being passed through suitable vats, towers, or other apparatus containing sulphate-of-zinc solution, preferably that obtained by leaching the product of the first operation. By the action of the ammonia the zinc in the solution is precipitated as zinc-hydrate (ZnH_2O_2), and ammonium-sulphate ($(\text{NH}_4)_2\text{SO}_4$) regenerated. The hydrate of zinc is separated from the solution of ammonium-sulphate by filter-presses or other suitable means, and, after washing, drying, and, or, calcining, may be used either as a pigment or zinc-ore.

The solution of ammonium-sulphate is evaporated down for recovery of ammonium-sulphate in the solid form for use in the treatment of further quantities of ore.

My process can be carried into effect in any suitable apparatus. One convenient form is shown in the accompanying drawings, but is not claimed as part of my invention.

Fig. I. is a longitudinal sectional elevation of the apparatus; Fig. II. a cross-sectional elevation of the same, upon the line X-X of Fig. I.

The ore having been mixed with the proper proportion of ammonium-sulphate and, or, -sulphamate, is placed in a hopper A having an adjustable door or opening B, by means of which the feed is regulated. From the hopper A the ore is drawn into the retort C by the action of revolving arms D carried on a shaft E. The arms D are preferably provided with adjustable shoes F, so that by altering their angle the material may be fed through the retort C at any desired rate. As the shaft E revolves the mixture is stirred and gradually carried through the retort C to the discharge-opening G. Through the discharge-opening G it falls into a closed hopper H provided with an adjustable door I, and again into a second closed hopper J having a door K. On the