

economically carried out by employing the solutions at high temperatures. Also, that the oxidization of any reducing substances (such as may have been brought into the liquid during such operations as leaching the ore) prior to electrolyzing them materially assists in obtaining a good deposit, all of which matters are hereinafter more particularly set forth.

Taking the ordinary case of solutions of zinc-chloride or zinc-sulphate or mixtures of the two (preferably with alkaline sulphates or chlorides), I have found that if oxychloride or oxysulphate of zinc, or both, be present and there be no other reducing agent in the liquid the deposit is even and firm, and wholly free from spongy zinc, as long as these oxysalts are present in the solution. Also, the oxysalts, by absorbing the sulphuric acid or chlorine set free at the anode, avoid the necessity of employing separating diaphragms, and enable the solution to be operated upon for an appreciable time before it becomes unfit for the operation. The time during which a given current can be passed through the solution before it is rendered unfit for electrolysis is greatly extended by employing the solution hot, which is, no doubt, due to the greater solubility of the oxysalts in the hot solution.

I avail myself of this property of zinc by insuring that in the solution from which deposition is to take place there is a sufficiency of these oxysalts. The simplest method of obtaining this is by circulating the zinc solution hot, and mixing into it with a suitable agitator zinc-oxide, with or without zinc-sulphate or -chloride, or both, so that oxychloride or oxysulphate of zinc, or both, may be formed.

This solution is passed into the depositing-vats, where a firm and homogeneous deposit of zinc is obtained, and the acids set free at the anode are absorbed by the oxysalts. When the oxysalts are wholly or partially exhausted the solution is recharged with oxide of zinc, with or without sulphate or chloride of zinc, or both, as before, and may then be returned to the electrolysis vat, so that the process is a continuous one, the operation being preferably carried on with the solution at a high temperature.

The oxide and other salts of zinc employed may be either in a more or less pure form, having been previously removed from the ore by known processes, in which cases the zinc-oxide and salts are simply added to the solution periodically, and will in course of time completely dissolve therein, or the roasted or otherwise prepared zinc-ore may be added to the solution, when the zinc-oxide and zinc salts will be dissolved, leaving the other constituents of the ore as an insoluble residue. If the latter course be adopted, it is manifestly preferable to employ in the path of the circulating solution various other apparatus, such as settling-boxes for removing the solid residue, and zinc shaving-troughs for removing various other metals which may have gone into solution before the solution is again employed in the electrolysis vat.

From the above it will be seen that the process is a continuous one, and may be used directly or indirectly to recover zinc from any kind of ore or product.

In cases where previously-roasted ore is employed direct in the solution the ore may, if preferred, be added to the solution while still hot.

It is evident that oxychloride or oxysulphate may be made independently, and the electrolytic solution charged with them when so made, and other variations may be made in the arrangements and methods of carrying out the process without departing from the invention. My present invention can be advantageously applied in conjunction with the process for obtaining zinc-oxide from zinc-sulphate described in the specification of Hampe and Schnabel. Such process consists in subjecting an intimate mixture of finely-divided carbon and finely-divided zinc-sulphate to an even and correctly-gauged temperature of 650° C. for about two hours.

The zinc-oxide requisite for the formation of oxychloride or oxysulphate of zinc may be obtained by such process either directly from the ore, whether blende or mixed blende and galena, or from zinc-sulphate obtained from other sources. In obtaining the requisite zinc-oxide from blende or a mixed blende and galena I treat the ore, which is preferably previously roasted, with sulphuric acid, and obtain from the zinc-sulphate so formed zinc-oxide by the process described in the specification referred to.

Further, the method discovered by me, and described in the specifications of letters patent dated the 20th day of June, 1894, No. 6914, and the 18th day of October, 1895, No. 7985, whereby from a roasted zinc-ore I obtain by leaching the same with a ferric-salt solution (either ferric chloride or ferric sulphate) a zinc-bearing solution, can be advantageously employed in conjunction with my present discovery.

By applying my present discovery in combination with the processes referred to, as described in the specifications of the letters patent before mentioned, I am enabled to obtain directly from the ores, whether blende or a mixed blende and galena, a zinc-bearing solution containing the requisite quantity of oxysalt (whether oxychloride or oxysulphate) in solution. With this object in view, I leach a portion of the roasted ore with a ferric-salt solution, as described in the specification of letters patent dated the 18th day of October, 1895, No. 7985, and so obtain a zinc-bearing solution. To this solution I add from time to time, as required, zinc-oxide, obtained according to the process described in the specification of Hampe and Schnabel from other portions of the ore (preferably roasted). Having thus obtained a zinc-bearing solution and a quantity of zinc-oxide, which can be replenished from time to time, I prepare a solution of an oxysalt of zinc by the process described above in this specification. Should the ore from which the zinc-oxide is so obtained be a mixed blende and galena or an impure blende it is preferable to employ in the path of the circulating zinc-bearing solution apparatus such as settling-boxes for removing the solid residue which remains undissolved after the zinc-oxide has gone into solution.

The anodes employed may be insoluble, such as carbon, or they may be of a soluble metal, such as iron, in which case it is preferable to oxidize and remove the iron salt from the solution by use of a jet of hot or cold air, or otherwise. The acid set free can be absorbed by zinc-oxide or oxysalts, and the basic salts and oxides of iron thrown down may be collected and removed from the solution.