UNITED STATES PATENT OFFICE.

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PROCESS OF REFINING SMELTER FUME PRODUCTS.

996,146. Specification of Letters Patent. Patented June 27, 1911.

No Drawing. Application filed December 1, 1910. Serial No. 595,134.

To all whom it may concern:

Be it known that I, ALEXANDER ROY, a citizen of Canada, residing in the city and county of San Francisco and State of California, have invented certain new and useful Improvements in Processes of Refining Smelter Fume Products, of which the following is a specification.

My invention relates to the general art of metallurgical refining, and is especially applicable to materials, which like smelter fume products, contain among other metals, zinc, arsenic, and copper.

The object of my invention is the economical production of commercially pure zinc hydroxid, zinc oxid and arsenious acid; also a marketable lead product carrying gold and silver, and also a copper product separate from all the other products. These results are more particularly apparent in the treatment of smelter fume products, and I shall describe my process in terms of and in connection with said products, though I am not to be understood as confining myself to this material.

In the treatment of smelter fume products, which usually contain gold, silver, copper, lead, zinc, and arsenic, no satisfactory process, as far as I am aware, has been devised for producing and recovering these metals commercially pure. By my process, I am enabled to do this, by steps which cheapen the work and produce the separate products at a low cost.

My invention though comprising in its entirety the production in commercial and marketable form of all the components of the material, is dependent essentially upon the separation of the zinc and the arsenic from the mass, and their separation from each other, by means of washing with water, preferably, boiling water. These separated out, give the opportunity of then separating out the copper, which in addition to the production of copper itself, leaves the remainder in the form of a marketable lead product carrying the gold and silver.

The nature of my process and the manner of carrying it out will now be fully understood by the following detailed description.

I first take the smelter fume product and wash it with water in order to dissolve out the zinc sulfate together with as small an amount of the arsenious oxid as is practicable, the zinc and arsenic occurring ordinarily as such compounds in the smelter fumes. In practice I use successive washings, until the water of the last washing shows no precipitate of zinc under the action of sodium sulfite at which time all the sulfate of zinc will be washed out, and only a small portion of the arsenious oxid as the latter is much less soluble in water than the former. In order that the process may be expedited and thorough, the water is best used at or about the boiling point. This step when complete, (a few hours will suffice) results in an aqueous solution which contains all the zinc sulfate and a small part of the arsenious oxid which were in the original product; and the residue of said product, which contains the greater part of the arsenious oxid, and the remaining components. I then take this residue and wash it with water (best at or about the boiling point) in order to extract all the arsenious acid. In practice I use successive washings until the water of the last washing shows no precipitate of arsenious acid under treatment with sulfureted hydrogen gas. This step when complete results in an aqueous solution of arsenious acid alone, and in a new residue. Then taking the zinc sulfate and arsenious oxid solution of the first step, I treat it with an alkali to precipitate the zinc as zinc hydroxid, the arsenious acid precipitating also. The alkali thus used may be any suitable one, such, for example, as magnesium oxid or barium oxid or lime water, but, in practice, I prefer to use lime water for economical reasons. Thereupon I collect this precipitate of zinc hydroxid and arsenious acid, and wash it with water, which is best at or about the boiling point, which washing has the effect of redissolving the arsenious acid, leaving behind the zinc hydroxid. I then take this aqueous solution of arsenious acid and add to it the aqueous arsenious oxid solution of the second step which was derived from the washing of the original residue, and I reprecipitate the arsenious acid from these combined solutions, by treatment with an alkali, preferably lime water. This precipitate thus accounts for all the arsenious

acid. I now take the zinc hydroxid previously obtained by precipitation and by separation from the arsenious acid by washing, and I distill it in well known manner, to convert it into zinc oxid. Taking now the washed fume-product or residue, I vaporize from it the zinc and then oxidize the zinc vapor to zinc oxid, thus leaving a last residue which contains the gold, silver, lead and copper. It may here be noted that any alkaline earth sulfate which may have been precipitated by the treatment of the zinc sulfate and arsenious solution with an alkali will not vaporize but will remain in the muffler. From this last residue, I now dissolve out the copper by treatment with sulfuric acid, or by any other usual method, and then precipitate said copper from the solution by iron or hydrogen sulfid, thus making a copper product, separate from the lead, gold and silver product, which latter, as a lead product carrying the silver and gold, is marketable.

In the best practice of the process as heretofore described, note should be taken of the fractional washing out of the arsenious oxid, it being observed that in the first step, but a small portion of the arsenious oxid is dissolved together with the zinc sulfate, and in the second step the remainder of the arsenious oxid is washed out. This results in a great saving, both of time and water, and is due to the fact that a very much greater volume of water is needed to dissolve the arsenious oxid than is required to dissolve the zinc sulfate. To make this clear, let us suppose that enough water be used to wash out at once all the arsenious oxid and zinc sulfate. This volume of water would necessarily be relatively large. Then later after precipitating from this solution the zinc and arsenious acid, another relatively large volume of water would have to be used to redissolve the arsenious acid. But by using only enough water (a relatively small volume) to wash out the zinc sulfate together with the minimum amount of the arsenious oxid in the first step, I am able to wash out in the second step the remaining arsenious oxid with only one relatively large volume of water, and to use only a relatively small volume of water to redissolve the small amount of arsenious oxid from the zinc precipitate.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is—

1. Those steps in the process of refining smelter fume products, and the like, which consist first, in washing out from the product the zinc sulfate and the arsenious oxid with water to form an aqueous solution thereof; second, in precipitating from said solution the zinc and the arsenic as zinc hydroxid and arsenious acid, by treatment with an alkali; and, third, in redissolving the arsenious acid from said precipitate with water.

2. Those steps in the process of refining smelter fume products, and the like, which consist first, in washing out from the product the zinc sulfate and the arsenious oxid with water to form an aqueous solution thereof; second, in precipitating from said solution the zinc and the arsenic as zinc hydroxid and arsenious acid, by treatment with an alkali; third, in redissolving the arsenious acid from said precipitate with water; and, fourth, in recovering the arsenious acid by treatment of the last named solution with an alkali.

3. Those steps in the process of refining smelter fume products, and the like, which consist first, in washing out from the product the zinc sulfate and the arsenious oxid with water to form an aqueous solution thereof; second, in precipitating from said solution the zinc and the arsenic as zinc hydroxid and arsenious acid, by treatment with an alkali; third, in redissolving the arsenious acid from said precipitate with water; and, fourth, in converting, by vaporization and oxidization the remaining precipitate, the zinc hydroxid into zinc oxid.

4. Those steps in the process of refining smelter fume products, and the like, which consist first, in washing out from the product the zinc sulfate and the arsenious oxid with water to form an aqueous solution thereof; second, in precipitating from said solution the zinc and the arsenic as zinc hydroxid and arsenious acid, by treatment with an alkali; third, in redissolving the arsenious acid from said precipitate with water; fourth, in recovering the arsenious acid by treatment of the last named solution with an alkali; and, fifth, in converting by vaporization and oxidation the zinc hydroxid into zinc oxid.

5. Those steps in the process of refining smelter fume products, and the like, which consist first, in washing out from the product the zinc sulfate and the arsenious oxid with water to form an aqueous solution thereof; second, in precipitating from said solution the zinc and the arsenic as zinc hydroxid and arsenious acid, by treatment with an alkali; third, in redissolving the arsenious acid from said precipitate with water; fourth, in recovering the arsenious acid by treatment of the last named solution with an alkali; fifth, in converting by vaporization and oxidation the zinc hydroxid into zinc oxid; and sixth, recovering the copper from the residual mass by solution and precipitation whereby a lead product is left carrying gold and silver.

6. Those steps in the process of refining smelter fume products, and the like, which consist first, in washing out from the prod-

uct with water, the zinc sulfate together with a relatively small portion of the arsenious oxid; second, in washing out from the residue, with water, the remainder of the arsenious oxid; third, in precipitating with an alkali the zinc and arsenic from the first solution, as zinc hydroxid and arsenious acid; and fourth, in redissolving with water the said arsenious acid.

7. Those steps in the process of refining smelter fume products, and the like, which consist first, in washing out from the product with water, the zinc sulfate together with a relatively small portion of the arsenious oxid; second, in washing out from the residue, with water, the remainder of the arsenious oxid; third, in precipitating with an alkali the zinc and arsenic from the first solution, as zinc hydroxid and arsenious acid; fourth, in redissolving with water the said arsenious acid; and, fifth, in combining the two arsenic solutions and precipitating the arsenious acid with an alkali.

8. Those steps in the process of refining smelter fume products, and the like, which consist first, in washing out from the product with water, the zinc sulfate together with a relatively small portion of the arsenious oxid; second, in washing out from the residue, with water, the remainder of the arsenious oxid; third, in precipitating with an alkali the zinc and arsenic from the first solution, as zinc hydroxid and arsenious acid; fourth, in redissolving with water the said arsenious acid; and, fifth, in converting, by vaporization and oxidation the remaining precipitate, the zinc hydroxid into zinc oxid.

9. Those steps in the process of refining smelter fume products, and the like, which consist first, in washing out from the product with water, the zinc sulfate together with a relatively small portion of the arsenious oxid; second, in washing out from the residue, with water, the remainder of the arsenious oxid; third, in precipitating with an alkali the zinc and arsenic from the first solution, as zinc hydroxid and arsenious acid; fourth, in redissolving with water the said arsenious acid; fifth, in combining the two arsenic solutions and precipitating the arsenious acid with an alkali; and, sixth, in converting by vaporization and oxidation the zinc hydroxid into zinc oxid.

10. The process of refining smelter fume products, and the like, which consists, first, in dissolving out therefrom by water the zinc sulfate and a portion of the arsenious oxid; second, in dissolving from the residue, with water, the remaining arsenious oxid; third, in precipitating from the zinc and arsenic solution, by means of an alkali, zinc hydroxid and arsenious acid; fourth, in redissolving with water the arsenious acid; fifth, in adding together the two aqueous arsenious solutions and subjecting them to an alkali to precipitate arsenious acid; sixth, in converting by vaporization and oxidation the zinc hydroxid into zinc oxid; seventh, in removing by distillation any zinc oxid from the residual mass; and eighth, in recovering the copper from the residual mass by solution and precipitation, whereby a lead product is left carrying gold and silver.

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

ALEXANDER ROY.

Witnesses:
WM. F. BOOTH,
N. A. ACKER.