

UNITED STATES PATENT OFFICE.

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PROCESS OF EXTRACTING ANTIMONY FROM ORES.

SPECIFICATION forming part of Letters Patent No. 459,023, dated September 8, 1891.

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To all whom it may concern:

Be it known that we, CURT SCHREIBER and HANS KNUTSEN, metallurgical engineers, of Broken Hill, in the Colony of New South Wales, have invented an Improved Process of Extracting Antimony from Ores, of which the following is a full, clear, and exact description.

Our invention relates to gold and silver bearing antimony ores. The treatment of this class of ores has hitherto been attended with great difficulties, while the expensive nature of the processes employed has rendered the extraction of the gold or silver unprofitable.

Various methods of treatment have been tried, but none have hitherto given entirely satisfactory results.

The usual method of roasting the ores before amalgamation is very expensive and permits considerable loss both of gold and antimony. The gold in antimony ore occurs in a metallic state and generally on the surface of the antimony at the points of contact with the quartz. The particles of gold become, in the roasting, coated with oxide of antimony, and as a result are withdrawn from the action of the mercury in the amalgamating process. In addition to this a portion of the antimony becomes amalgamated, and this, causing the mercury to sicken, renders it unfit for further reaction.

The process of roasting with chloride of sodium gives no better results. In it the vapor from the fuel or from the ore itself forms a basic chloride of antimony which, by coating the particles of gold, causes a similar difficulty in the amalgamating process.

Our improved process of treating auriferous and argentiferous antimony ores is based on the solubility of pure gray antimony ore in different reagents, and more particularly on the discovery that sulphides and oxides of antimony can be easily leached by stirring them in solutions of sulphides of alkalies or alkaline earths, and preferably in a solution of sulphide of sodium.

In order that our invention may be the better understood, we will now proceed to describe the same in detail.

In order to secure greater uniformity of

treatment, the antimony ore is first classified by hand picking into three classes, more or less—say No. 1 ore containing more than twenty-five per cent. of antimony, No. 2 ore containing five to twenty-five per cent., and No. 3 ore containing less than five per cent. The ore is then crushed to a suitable fineness, and the whole should readily pass through a sieve of not less than nine hundred meshes to the square inch. From the mill or stampers the ore is taken to the lixiviating pans or agitators. In these, with preferably sulphide of sodium as the leaching-fluid, we use the formula $Sb_2S_3 + 3Na_2S = 2SbNa_3S_3$, or, in other words, obtain the reaction of an antimony double salt in solution by the combination of three hundred and thirty-six parts sulphide of antimony with two hundred and thirty-four parts sulphide of sodium. We prefer to have an excess of sulphide of sodium—say in the proportion of twelve parts to seventeen parts sulphide of antimony—and when employing sulphide of baryta or sulphide of calcium in solution as a leaching-fluid take an amount of such salt proportionate to its respective molecular weight.

In practice we find that one cubic yard of solution, or, say, two hundred (200) gallons per ton, of ore is sufficient, but vary the strength according to the percentage of antimony the latter contains. By thus treating the three classes of ore specified above we obtain three resulting lyes, which, being of different concentrations, require to be treated in different ways.

In treating the ore so that we may obtain completely-saturated solutions, and as a consequence tailings entirely free from antimony, we employ a process of circulation of the leaching solution. In this way the ore is treated with three or more solutions—i. e., fresh ore is first leached with solution used twice previously, then with solution used once, and finally with fresh solution. The saturated solutions of antimony double salts thus obtained are then removed for recovery of the antimony in metallic form. For this purpose we make use of electrolysis.

The precipitation of antimony by electricity being one of the methods of estimating it quantitatively, we expect to obtain an equal

success by applying it on a large scale. Care must, however, be taken to regulate the strength of the currents according to the concentration of the lyes. The reaction in the
 5 baths are on the cathode on the following formula: $Sb_2S_3 + 3Na_2S + 6H = Sb + 6NaHS$, and on the anode $6NaHS + 3O = 3H_2O + 3Na_2S_2$. During the process we add from time to time to the solutions in the baths a quantity of
 10 hydroxide of sodium, the effect of which is to change the bisulphide of sodium into sulphide of sodium on the formula $4Na_2S_2 + 6HNaO = 6Na_2S + Na_2S_2O_3 + 3H_2O$.

In order to increase the conductivity of the
 15 solutions, we add to the electric baths a small quantity of common salt, and then allow the lyes to circulate continuously from cell to cell until the whole or nearly the whole of the antimony is precipitated. We have then in the
 20 baths a resultant solution of sulphide of sodium, which is returned to the lixiviating-pans for further treatment of fresh quantities of ore.

In practice we consider that all solutions
 25 which contain a certain quantity of the double salt of antimony will repay treatment by electrolysis. For this purpose we mix strong solution with the weaker ones and increase the strength of the weakest solutions
 30 by dissolving in them the sulphide of antimony which results from another part of the process.

While preferably making use of sulphide of sodium in the leaching solution, sulphide
 35 of baryta may also be employed, and in the case of sulphate of baryta (heavy spar) being

cheaply obtainable it can be employed with great advantage instead of sulphide of sodium. We are also of opinion that sulphide of calcium will answer the same purpose. 40

The ore under treatment being now quite free from antimony, can be easily amalgamated for the recovery of the gold or silver which it may contain. For this purpose we employ any known method of amalgamation; 45 but in practice prefer Molloy's electric pans, which are especially suitable for catching finely-divided and float gold.

We wish it to be distinctly understood that we do not confine ourselves to the exact formula given herein or to the exact proportions of the various alkalis or alkaline earths used in the process; but, 50

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is— 55

In the extraction of antimony from ore, the process which consists in subjecting the crushed ore to the action of a solution of sulphide of sodium and then precipitating the antimony in metallic form by electrolysis, adding hydroxide of sodium to the solution, substantially as and for the purpose specified. 60

In witness whereof we have hereunto set our hands in presence of two witnesses. 65

CURT SCHREIBER.
 HANS KNUTSEN.

Witnesses:

FRANCIS H. SNOW,
 CHARLES S. BURGESS.