

IMPROVEMENTS IN RECOVERING GOLD AND OTHER PRECIOUS METALS FROM THEIR ORES.

I, Carl Moldenhauer, of Frankfort-on-Maine, in the Empire of Germany, do hereby declare that the nature of my invention for improvements in recovering gold and other precious metals from their ores, and the manner in which the same is to be used, are particularly described and ascertained in and by the following statement:—

This invention relates to extracting gold and other precious metals from their ores by means of a solution of cyanide of an alkali or an alkaline earth, and has for its object to render the process more expeditious and considerably cheaper than heretofore.

The invention consists, firstly, in adding to the cyanide solution an artificial oxidizing agent; and, secondly, in precipitating the extracted precious metal out of its cyanide solution by means of aluminium or alloys or amalgam thereof.

As to the first part of my invention, I have found that the dissolving action of the cyanide solution on the precious metal is highly expedited, and much cyanide is saved if an artificial oxidizing agent is added to the said cyanide solution. As such an artificial oxidizing agent, I use, by preference, ferricyanide of potassium or another ferricyanogen salt of an alkali or of an alkaline earth. In either case, the ferricyanogen salt is preferably employed in alkaline solution. The result of this addition of an artificial oxidizing agent is that the dissolving action of the solvent is rendered more energetic, and consequently a considerably smaller quantity of the solvent is required. Thus, by the addition of ferricyanide of potassium or other ferricyanogen salt in alkaline solution, as much as 80 per cent. of the potassium may be saved. The proportions preferred are from one-half to two parts of ferricyanide to one part of cyanide.

It may be remarked that the ferricyanide of potassium alone will not dissolve the gold, and does not, therefore, come under the category of the solvent heretofore employed in processes of extraction. It does not, therefore, render unnecessary the employment of the simple cyanide as a solvent, but only reduces the amount required owing to the capacity of the ferricyanide to act as an oxidising agent, consequently the cyanogen of the ferricyanide is not used to form the gold cyanide compound. I may also employ permanganate of potash as the oxidizing agent instead of the ferricyanide. The said permanganate of potash is also added in solution and in the same proportions as before—namely, from one-half to two parts of permanganate to one part of cyanide.

In lieu of permanganate of potash, any other suitable oxidizing agent can be used in carrying out my invention in practice, the invention not being restricted to the use of any special oxidizing agent, but includes the use of an agent that exerts an oxidizing action in the cyanide solution. The process can be carried out in a ball-mill lined with porcelain, wood, or other substance unattackable by the chemicals employed.

I may also use the cyanide solution and the oxidizing agent in combination, with a preliminary treatment of the ore with any acid or salt that renders the precious metal better adapted to the subsequent treatment of the cyanide solution.

The second part of the process consists in precipitating the dissolved gold or precious metal out of its cyanide solution by means of aluminium, aluminium alloy, or aluminium amalgam; but this can also be applied with advantage to sulphurised solutions containing free alkali—that is to say, solutions which contain gold in the form of sulphuret, or hyposulphide of gold.

Zinc has heretofore been employed in practice by preference in precipitating gold from the cyanide solutions obtained by leaching auriferous ores. The employment of zinc for this purpose is found, however, to be attended with serious disadvantages. Now, I have discovered that aluminium can be employed for this purpose in place of zinc, without the disadvantages attending the use of the latter.

Whilst zinc forms a combination with the bound or free compound of cyanogen and alkali contained in the cyanide solution, aluminium separates the gold very quickly from the cyanogen solution without entering into combination with the cyanogen, but simply reacting with the caustic alkali which is present at the same time. By the action of aluminium the cyanide of potassium employed for leaching the gold out of its ore is regenerated, which is not the case when zinc is employed. But the zinc does not confine itself to entering into combination with the cyanogen of the cyanogen compounds of the gold, but also acts upon the free cyanide of potassium contained in the solution, so that a great part of the latter is consumed; but this is not the case when aluminium is employed.

These results are of the greatest importance when the solution separated from the gold is to be employed in subsequent gold-extracting operations, as the whole of the cyanogen in the regenerated and liberated cyanide of potassium is enabled to renew its action; but the lyes resulting from the employment of zinc cannot be employed with the same advantage in subsequent operations for the extraction of gold. Numerous attempts have been made to regenerate the zinc, but are found to be inconvenient and costly. It is consequently evident that an important saving in cyanide of potassium is obtained by the employment of aluminium.

Aluminium acts in a like manner in a sulphurised alkaline solution—that is to say, in a solution containing the gold in the form of sulphuret of gold or hyposulphide of gold. It does not enter into combination with the sulphur in a solution of this description. This great and important advantage attending to the employment of aluminium, aluminium alloys, or aluminium amalgam, is combined with other advantages, as follow:—

Aluminium is far less subject to oxidization than is zinc, so that it can be sent from its place of production in the form in which it is to be used for the precipitation, whereas when zinc is employed it is considered to be an important advantage to reduce it to the required form at the place where it is employed, and immediately before using it. For the same reason, the repeated employment of the aluminium is admissible for continuous precipitation.

Finally, the quantity of aluminium required for precipitating the same quantity of precious metal is about four times less than the amount of zinc required to produce the same effect.