

as long as any metal can be extracted, after which it may be necessary again to apply cold water to cool the ore before admitting the hyposulphide of calcium, so that too much base metal may not be extracted with the silver. Hot water, if applied at first, increases the solubility of the silver-chloride in the solution of base chlorides and salt; but after these are in the main removed by means of cold water, it may be used with advantage. If, however, it were immediately followed by the hypo., more base metal would be extracted than would be the case if the ore were cooled, for, as before remarked, there are base-metal compounds in the roasted ore which are insoluble in both hot and cold water, but which are soluble in the hypo., especially if it is warm. Lead-chloride is almost insoluble in cold water, but dissolves readily by the aid of heat. The sulphate is not dissolved by water, hot or cold. Hence it is better that lead should be chloridized in the roasting, because it can then be removed by washing. If lead is extracted in silver-leaching it cannot, like copper, be retained in *matte* when melting, but inevitably goes into the bullion, because its sulphide is easily reduced by iron at a red heat, while copper-sulphide is not."

Precipitation of Metals.

Silver.—The liquid containing the silver-solution that was drawn from the vat containing hyposulphide of calcium, is now in another vat ready for precipitation, which is effected by a strong solution of sulphide or polysulphide of calcium. It throws down silver and other metals as sulphides in the form of dark-brown or greyish-black mud, which soon turns black. At the same time it restores the hyposulphide of calcium which was altered in dissolving metals, so that it can be used again. The greatest care has to be exercised not to use more of the calcium-sulphide than is necessary to precipitate the metals, because if too much be used the excess remains unchanged, and, being mixed with the leaching solution for re-use, it converts some of the silver-chloride in the ore into sulphide, which cannot be leached out.

In precipitating the silver the solution containing the silver should be quickly stirred before the calcium-sulphide is poured in. The calcium is then allowed to run in as long as it is seen to cause a distinct precipitation. The solution is then stirred vigorously for a few minutes with a circular motion, and afterwards the motion reversed and a short time allowed for partial settling. A sample is then taken out in a glass, and a little more calcium-sulphide added. If a considerable precipitant is produced more calcium-sulphide is added to the solution, and the same stirring and testing repeated. When the calcium only produces a slight precipitation the solution is left in the vat undisturbed for a few hours.

If in the test calcium-sulphide produces no precipitate, too much may have been used; therefore another sample is tested by adding a few drops of sulphate-of-iron solution, which instantly gives a black precipitate if there is the least excess of calcium-sulphide. If neither of these tests gives a precipitate the quantity of the precipitant is right; but if it is found that an excess of calcium-sulphide has been used, it must be counteracted by an addition of silver-solution, or some sulphate of iron may be used instead. However, experience shows that as soon as enough calcium-sulphide has been added a white cloudiness appears in the silver-solution. After the solution has stood for a few hours the liquid is siphoned off, and the silver-sulphide, along with any base-metal sulphides, is removed, and washed with hot water, and dried.

The dried precipitate is then roasted in a reverberatory furnace to burn off the sulphur, beginning with a sufficient heat to set the sulphur on fire, and gradually increasing this temperature to such a degree that the metal will stand without melting. During this roasting process it must be continually stirred and kept in as long as any trace of sulphur remains. Afterwards it is taken out and is ready for melting.

Mr. C. H. Aaron describes the process of melting the silver which is usually adopted in America, as follows: "This is done in black-lead crucibles in a wind-furnace, with coke or charcoal for fuel. If the precipitate, before roasting, contained but little base-metal sulphide, the silver is seen in form of threads traversing the roasted mass, which, however, still contains a considerable quantity of sulphur. The crucible, containing some scrap-iron, is filled and placed on the fire, standing on a piece of brickwork; for, as the melting occupies a considerable time, even a thick layer of the best coke does not last long enough to prevent the crucible from settling down to the grate. A little borax is added, and the whole is heated until there is no room in the pot for more material, when it is refilled by means of a scoop and funnel. As in the case of the gold, the refilling is done before the mass in the crucible has become fluid, in order to avoid loss by projection. As fast as the scrap-iron disappears more is put in; but if such addition is made after the full fusion, the iron is first heated.

If the roasted precipitate contains much copper or iron more borax is required, and a little clean sand is useful, especially if the roasting has been excessive. Some charcoal is also added. When the pot is full of thoroughly melted matter and pieces of iron, a test is made by placing the red-hot end of an iron rod in it. If, after a few minutes, on withdrawing the rod, it is found that part of it is melted, more time must be allowed. When iron is no longer consumed, the melting of that quantity of precipitate is finished, and slag and *matte* are dipped out by means of a red-hot assay-crucible, held with crooked tongs, and poured into a mould or iron pan. The pot is now again filled with roasted precipitate, taking the precaution to add it slowly, until the melted mass is somewhat chilled. When all the precipitate has been worked up, or the pot contains a sufficient quantity of metal, a part of the slag and *matte* is removed as before, and the remainder is poured into a warmed and greased mould. The overflowing of the slag and *matte* is of no consequence if the mould is large enough to contain the silver, which will go to the bottom, in consequence of its greater specific gravity.

After removal from the mould it is usual to place the bar in a tub of water for the purpose of cooling it; but when there is *matte* upon it this must not be done until the *matte* also has solidified, otherwise an explosion will occur. If the melting has been properly conducted the *matte*