MINING.

THE CHEMISTRY OF THE CYANIDE PROCESS.

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(CONCLUDED).

Testing of Cyanide Solutions.—It is a matter of importance to determine exactly what strength of cyanide solution is used in treatment of tailings. The ordinary method of testing depends on the fact that silver cyanide is soluble in excess of potassium cyanide, with formation of a double cyanide of silver and potassium:

$$KCy + AgNO_3 = AgCy + KNO_3$$
$$AgCy + KCy = KAgCy_2$$

When silver nitrate solution is added drop by drop from a burette to a solution of cyanide, a white precipitate is formed, which quickly redissolves. At a certain stage the precipitate becomes permanent, when in fact the whole of the cyanide has been converted into the soluble silver salt, and an additional drop of silver nitrate produces a permanent precipitate of the insoluble simple cyanide of silver:

$$KAgCy_2 + AgNO_3 = KNO_3 + 2\,AgCy$$

From these reactions 107·66 parts by weight of silver are equivalent to 130 04 parts of potassium cyanide. A convenient standard silver solution is one of such strength that every c. added to 10 c. of the solution to be tested corresponds to ·1% pure KCy.

This method gives good results when pure cyanide solutions are under examination, but when we come to test solutions containing zinc, it is difficult, if not impossible, to determine the end of the reaction. A white flocculent precipitate occurs at a certain stage, probably consisting of simple (insoluble) cyanide of zinc, formed by decomposition of the soluble double cyanide:

$$K_2\,ZnCy_4 + AgNO_3 = KAg\,Cy_2 + ZNCy_2 + KNO_3.$$

This precipitation occurs long before the whole amount of potassium cyanide has been converted into the soluble double salt of silver ($KAgCy_2$), for the solution, after the appearance of the flocculent precipitate, still gives the Prussian blue reaction with acidulated ferrous sulphate. A standard solution of iodine in potassium iodide may be used with great accuracy for determining the total amount of cyanogen in a solution, whether in combination with zinc or not, making use of the reaction:

$$KCy + I_2 = KI + ICy.$$

The color of the iodine is discharged so long as an excess of cyanide is present. The sharpness of the end reaction may be increased by adding a small quantity of starch to the solution under examination, which gives a permanent blue color as soon as an excess of iodine has been added.

What is most needed, however, is a rapid method of determining the amount of cyanide *available for dissolving gold*, for, as we pointed out above, the cyanide in combination with zinc is not available for that purpose.

The method of testing solutions containing zinc for "available cyanide," which was introduced by Mr. Bettel at the Robinson Gold Mining Company's works, is as follows: Two perfectly clean flasks of equal size are taken. To each of these is added a considerable bulk, say 50 cc of the solution to be tested, and 50 cc. of water. The liquid in both flasks will probably appear slightly turbid, but the degree of turbidity will be the same in each. Standard silver nitrate solution is run into one flask until the slightest possible increase in turbidity is observed on comparison with the liquid in the other flask. This point is taken as indicating the conversion of the whole of the free potassium cyanide into the soluble silver salt, and therefore as determining the amount of available cyanide present in the solution.

The amount of gold in the solution is generally found by evaporating a known bulk with litharge, fluxing the residue and cupelling the resulting lead button. Evaporation on lead foil may likewise be employed.

Poisonous Properties of Cyanide.—A few words may not be out of place as to the poisonous action of cyanide of potassium. Although one of the most rapid and deadly of known poisons when taken internally, its action as a blood poison is much less violent Nevertheless, when introduced into cuts it produces very painful sores. The men employed in the "clean-up" and in melting the slimes are subject to a peculiar eruption, especially on the arms, and complain of headache, giddinness and general depression. Ferrocyanide of potassium has been recommended as a remedy for the eruption; it may be taken internally and also applied as a lotion. Considering the dangerous nature of the substance, it is remarkable how few fatal accidents have occurred through the use of cyanide on a large scale. In cases of poisoning, precipitated carbonate of iron, obtained by mixing solutions of sodium carbonate and ferrous sulphate, may be used as an antidote. This forms internally an insoluble blue compound with the cyanide.

Hydrocyanic acid acts directly on the nervous system, causing instant paralysis; hence any treatment which will excite the action of the nerves, such as application of cold water to the spine, inhalation of *ammonia*, etc., may be tried in cases of faintness produced by breathing the vapor of the acid.

The disposal of waste cyanide liquors is a matter for serious consideration. Solutions containing ·1 or ·2% of potassium cyanide must occasionally be discharged and are likely to contaminate the water of the dams or streams which receive them to a dangerous extent. If some effective means of precipitating the zinc, or, better still, of dispensing with the use of zinc altogether, could be devised, there would never be any necessity for allowing cyanide liquors to leave the building.