4: Iodine – chemical leaching of gold

Iodine leaching had been widely used to recover gold in the late 1800s and early 1900s, then dwindled with the rise in popularity of cyanide leaching and mercury amalgamation, and the high cost of iodine. Unlike chlorination, recycling of leachate is of paramount importance for commercial viability of the method. High rates of recycling of iodine can be achieved although requiring additional plant layout. Fortunately iodine is a good lixiviant for gold so only very low concentrations of iodine are required. Three methods are noted below.

The Prichard method of iodine leaching was invented by Loius M. Pritchard of Idaho and patented in 1907 (US #861,535) and uses an excess of iodine dissolved in potassium iodide in aqueous solution. The gold so dissolved is recovered by adding mercury which reduces the gold in solution to a metallic state whereupon it forms an amalgam that is then washed free. But the Prichard method is unsatisfactory in failing to precipitate colloidal gold, and gold recovery is sometimes only 25%.

The Harrison method of iodine leaching was invented by George D. Harrison of Detroit and patented in 1942 (US #2,304,823). It was said to be effective with placer concentrates and difficult ores such as platinum ores and gold telluride ores. The lixiviant is an aqueous solution of iodine and potassium iodide, plus nitric acid to prevent the formation of insoluble gold salts.

An in-situ method of iodine leaching of gold ore was invented by Kent McGrew and Jack Murphy of Wyoming and patented in 1985 (US #4,557,759) as a safer alternative to in-situ cyanide leaching. The gold leached by the iodine is recovered by activated charcoal, and the iodine regenerated for re-use by electrochemical oxidation.

E-goldprospecting (www.e-goldprospecting.com) has a good account of the pros and cons of iodine leaching.

An updated tincture method of iodine leaching was invented in 2006 [40] and is dealt with in a later section.

Operation

The Harrison method in outline is as follows. First a test batch of 0.43 kilos of ore is reduced to a <50-75μ powder and leached without any preliminary roasting step.

1st stage – leaching gold into solution

To prepare the leachate, 3.8 kilos of solid potassium iodide are added to four litres of water and then 1.9 kilos of iodine crystals added. The water is agitated until all the crystals dissolve. Then 0.45 litres of concentrated nitric acid is added in small steps with agitation. The leachate consists of water, potassium iodide, hydroiodic acid, free iodine and potassium nitrate able to *"completely dissolve all tellurides and selenides, and sulphides of gold present"*.

The ore is added to the leachate and agitated for an hour to form a pregnant solution. This is filtered and the residue washed in a concentrated solution of potassium iodide to dissolve insoluble silver iodide, until no yellow precipitate remains. The wash water is thoroughly mixed with the filtered pregnant solution.

2nd stage – recovering gold from solution

Mercury is added to the pregnant solution to form amalgams of gold, silver and base metals. This residue is filtered off and to it is added a hot solution of four parts concentrated nitric acid and one part water to prevent the gold becoming colloidal. After cooling for 30 minutes, the gold is recovered in a furnace.

Some gold and other precious metals remain in the filtrate. This is treated with nitric acid (see patent for details) and the gold precipitated is recovered by filtration.

Adoption by placer gold miners

Iodine leaching is a neglected method for recovering placer gold and the author is unaware of any companies, recreational miners or artisanal miners doing so.

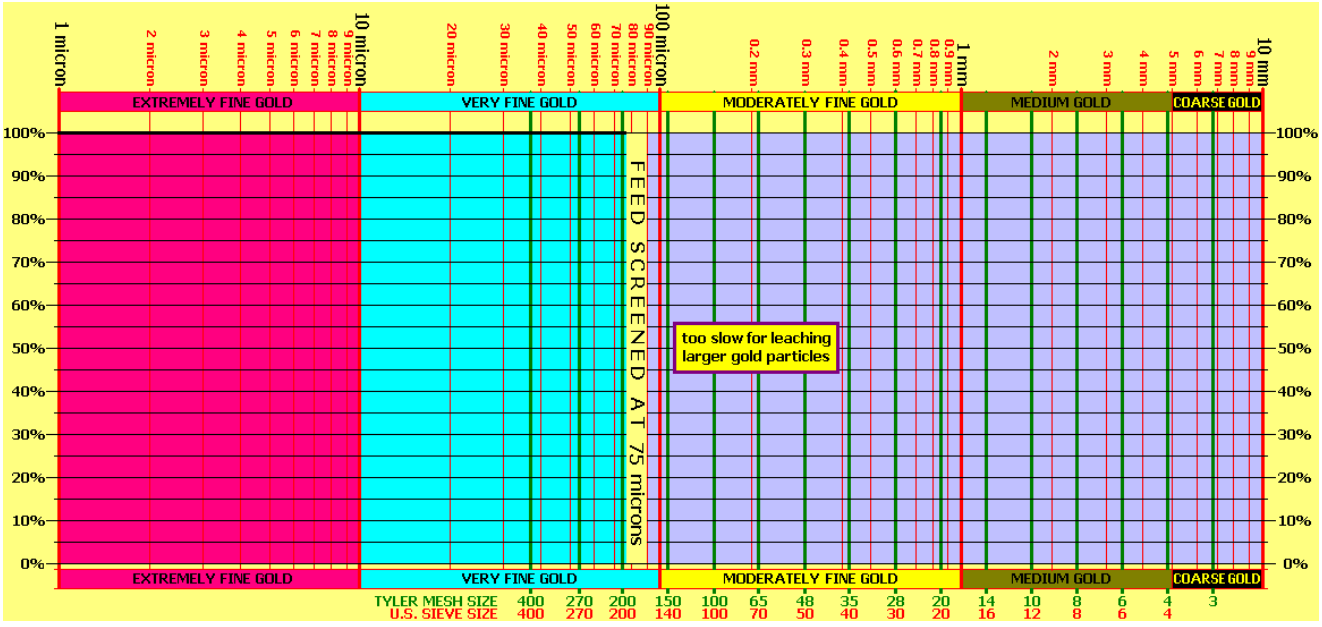

Figure 18. GOLD RECOVERY BY IODINE LEACHING

Iodine can dissolve (leach) >90% of gold smaller than about 75μ, but is too slow for leaching larger gold. (compiler: Robin Grayson)