

### 6: Thiocyanate – chemical leaching of gold

Thiocyanate leaching was invented in the 1890s but was largely ignored due to the popularity of iodine and bromine leaching, and the rise of cyanide leaching.

Thiocyanate leaching is particularly effective on difficult sulphide-rich refractory hardrock gold ore. This is because thiocyanate leaching requires an extremely acidic environment and breaking down the sulphides in the ore generates highly acidic solutions.

The Kendall method of thiocyanate leaching was invented by Edward E. Kendall of New York State and patented in 1899 and 1901 (US #625,564 and #671,704). Ammonium or potassium thiocyanate is used to leach silver and gold, and the pregnant solution directed to an agitated trough where potassium sulphide is added to precipitate silver sulphide that is recovered by settling and filtering. The supernatant liquid is directed to a reaction tank for gold recovery using comminuted zinc metal.

The Barrick method of thiocyanate leaching was invented by Kenneth T. Thomas, Christopher Fleming, Andrew R. Marchbank and David Dreisinger of Canada and patented in 1988 (US #5,785,736), the patent assigned to Barrick Gold Corporation of Toronto.

The Wan-LeVier method of thiocyanate leaching was invented by Rong Yu Wan and K. Marc LeVier of Colorado and a patent was applied for in 2004 (US #0197249ki). Acid thiocyanate solution is used to leach precious metals as a precious metal-thiocyanate complex. The leach solution may contain a large molar ratio of ferric iron to thiocyanate. The precious metal is removed from the pregnant thiocyanate solution by transferring the precious metals to precious metal-cyanide complex and then loading this onto absorbent material. The residual cyanide in the thiocyanate leach solution is converted to thiocyanate for further leaching.

E-goldprospecting ([www.e-goldprospecting.com](http://www.e-goldprospecting.com)) has a good account of thiocyanate leaching.

#### Operation

The Wan-LeVier method is summarised as follows. The thiocyanate is sourced from specialised suppliers.

#### Preparation – oxidation of sulphides

The ore is finely powdered by milling and added to a heap leach facility. Bio-oxidation of sulphides is accomplished by *Thiobacillus ferrooxidans*, *Leptospirillum ferrooxidans*, *Sulfobocillus thermosulfidooxidans*, *Sedula Metallosphera* or *Acidianus brierley* as in US patents #5,246,486, #5,332,559, #5,834,294, #5,127,942 and #5,244,493. Bio-oxidation takes about 90 days – much faster than with cyanide leaching as acidic products are not a problem.

#### 1<sup>st</sup> stage – leaching gold into solution

The leach solution is first conditioned to adjust the concentration and molar ratio of dissolved thiocyanate and dissolved ferric iron, acidity and temperature. The leachate is extremely acidic, ranging from pH 1 to 3.

The leach solution is introduced to the milled ore and leaching takes from days to months in a heaped leach facility, or hours in a heated pressurised autoclave.

#### 2<sup>nd</sup> stage – recovering gold from solution

The pregnant thiocyanate leach solution contains dissolved gold in the form of gold-thiocyanate complex, and the pregnant solution is removed for further processing to recover the dissolved gold.

Residual solids depleted in gold may be subjected to additional metal recovery operations or to further treatment for disposal in an appropriate manner.

#### Adoption by placer gold miners

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

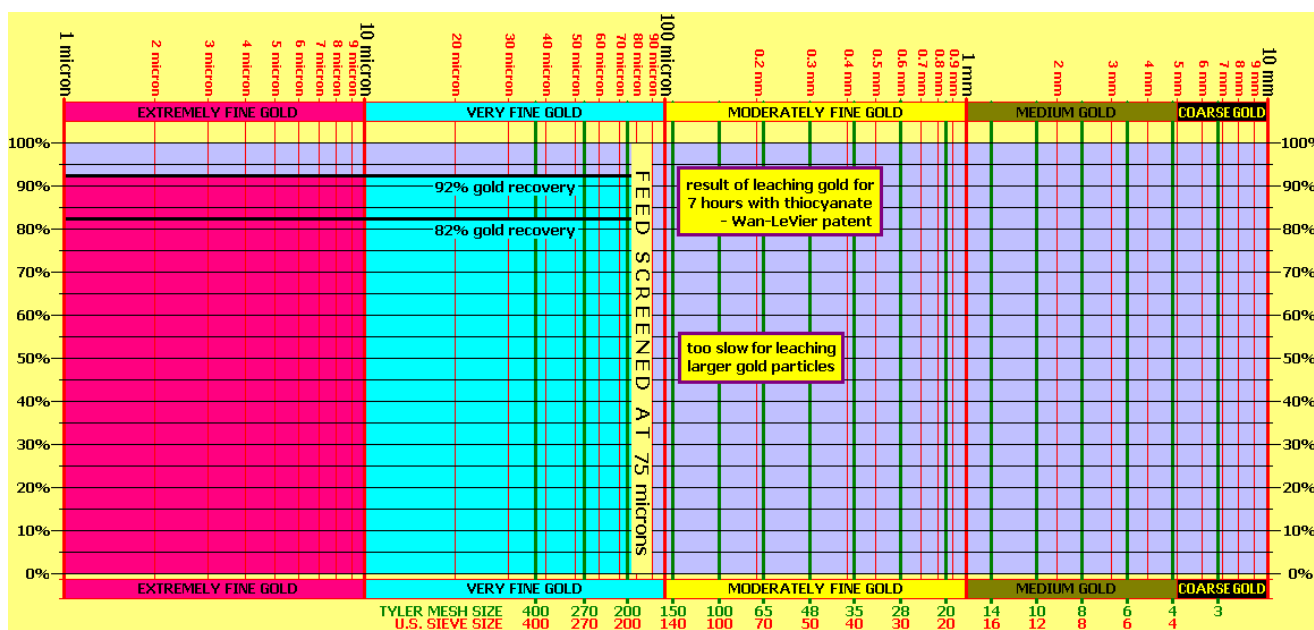


Figure 20. GOLD RECOVERY BY THIOCYANATE LEACHING  
Thiocyanate can dissolve (leach) >90% of gold smaller than about 75µ, but is too slow for leaching larger gold. (compiler: Robin Grayson)