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ALTERNATIVE GOLD REFINING PROCEDURE USING "ORGANIC AQUA REGIA"

By

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ABSTRACT

Artisanal small-scale gold mining (ASGM) is one of the most important incomes for miners in developing countries. Mercury (Hg) is mainly used for the extraction of gold (Au) from ore in the ASGM process. The use and emission of Hg cause environmental impact and health damage, and the Minamata Convention on Mercury propose the reduction and elimination of the use and emission of Hg from ASGM. However, as mentioned above, ASGM is very important income for the miners including their families and the developing countries. An alternative procedure is required to balance the reduction or elimination of Hg use and income keeping.

The authors suggest the application of organic aqua regia (OAR) for the refining of Au. This OAR consists of an organic solvent containing copper halide (CuX_2, X= Br or Cl). In the organic solvent like dimethyl sulfoxide (DMSO) or propylene carbonate (PC), the cuprous ion (Cu^+) is stable while the cupric ion (Cu^{2+}) is stable in water. The OAR can dissolve Au because Cu^{2+} liberated from CuX_2 performs as a strong oxidant. And dissolved Au can be recovered by the addition of water to OAR. The authors used this solvent for the recycling of Au from secondary sources like a waste of electric and electronic equipment (WEEE) and successfully recovered Au.

In this research, the authors applied this OAR for the refining of gold from ore, considering the utilization at ASGM sites. We used $CuBr_2$ or $CuCl_2$ as an oxidant and potassium bromide (KBr) or sodium chloride (NaCl) as a supplier of halogen elements. Ore containing 48 ppm of Au was treated by Br or Cl type OAR and the authors evaluated the extraction ratio from the ore under ambient temperature or 40 °C. After the extraction, the authors evaluated the recovery of Au by the addition of acidic water to the solvent. Sulfuric acid (H_2SO_4) or lemon juice were used for this recovery.

As a result, the authors successfully extracted most of the Au from ore. The ore used in this research was hard to treat by the conventional ASGM procedure using mercury. Thus, the OAR can be a candidate for the effective extraction of Au. In addition, extracted Au was recovered by adding acidic water like sulfuric acid or lemon juice. Considering the availability at ASGM sites, lemon juice is suitable for the precipitant media. However, the cost of this procedure was much higher than the conventional ASGM process. Optimization is required for the spreading of the OAR process.

Keywords: Organic aqua regia, artisanal small-scale gold mining, Minamata Convention on Mercury