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Simple and selective precipitation of gold from aqua regia leachate using a quaternary ammonium salt

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PURPOSE OF THE ABSTRACT

Waste electrical and electronic equipment (WEEE) is the fastest growing waste stream of the early 21st century. In 2019, 4.4 million metric tonnes (Mt) of e-waste were produced in the EU alone, while global e-waste is projected to reach 75 Mt by 2030. [1] WEEE is therefore an abundant albeit heterogeneous waste stream, composed of up to 69 different elements.[1] Through this lens, WEEE can be viewed as a valuable urban ore and a source of precious metals and a variety of critical raw materials, namely gold, cobalt, and platinum group metals. Characterization of an aqua regia leachate of printed circuit boards revealed that despite being less than 1% of the total metals in solution, gold accounts for over 95% of economic value. This means that gold recovery and separation from other metals is of particular importance from an economic point of view.

In this work, the use of quaternary ammonium salt as a precipitating agent for the selective recovery of gold from an aqua regia leachate of printed circuit boards was investigated. A range of factors were screened for their effect in the precipitation of gold, namely the nature of the quaternary ammonium salt (counter-anion selection as well as the cation's apolar volume and geometry), precipitant concentration, acid concentration, temperature, and influence of other metal cations in solution. The concentration of a quaternary ammonium ionic liquid was found to be particularly important and studied in more detail. Finally, the optimal conditions determined were used to recover gold from the real leachate and the results compared to what was expected from the synthetic tests.

Gold precipitation using quaternary ammonium salts presents itself as a way of valuing WEEE in an urban mining and circular economy context. The main issue with traditional mining is the large quantity of waste left in waste dumps and open pits where rainwater leaches high concentrations of metals into waterways, harming animal and plant life and disrupting food chains. [2] This novel approach allows for the exploration of gold while avoiding the generation of more harmful waste, reducing its environmental impact.

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FIGURES

FIGURE 1

FIGURE 2

KEYWORDS

Hydrometallurgy | Electronic waste | Urban mining | Metal recovery

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