Electrochemical recovery of Ag from industrial tiosulfate solutions on flat electrodes

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ABSTRACT

Nowadays, the hydrometallurgical industry performs the precious metal recovery, like silver, from mines with low content of them. Being Mexico the main silver-producing country at worldwide level and due to the exhaustion of the mines, recovery of the silver from industrial wastes acquires high importance [1-2]. In this case, electrochemical recovery of silver from photographical and radiographic industry wastes has shown its convenience due to the low costs of the processes [3-4].

In a previous work, energetic conditions were found to carry out the silver recovery from effluent wastes of the photographical and radiographic industry (denominated EDFR) using an electrochemical study. The results of the previous study were applied to an electrochemical press reactor modified (denominated FP01-EP) to verify the silver recovery from the tiosulfate effluent of the industry, utilizing flat electrodes of Ti, stainless steel (A304) and high purity Ag. Studies of microelectrolysis and macroelectrolysis were performed on the electrochemical reactor and the results are shown in this work.

Microelectrolysis responses with voltammetric technique show that the potential ranges of the silver deposit found with the reactor are displaced to less cathodic potentials (see table 1) than the obtained in the previous study [1] due to the different hydrodynamic conditions of the reactor.

Table 1. Potencial ranges where silver deposit from EDFR solution, is observed in: a) laboratory and b) pilot scale

Sustrate	EDFR soln.	
	Lab. scale	Pilot escale
	E vs. ESS/mV	E vs. ESS/mV
A304	-850 to -940	-755 to -850
Ti	-880 to -1020	-760 to -840
Ag	-690 to -950	-705 to -923

The macroelectrolysis results controlling potential showed variable times of electrolysis and there is no tendencies on the silver recovery percentage with the reactor. Therefore, a transformation rate of Ag $(S_2O_3)_2^{3-}$ was fixed using currents between -0.05 A to -0.14 A for Ti and A304, and -0.02 to -0.10 A for silver. The results of this experiments allowed the determination of the maximum current to be applied on each material to obtain a maximum silver recovery before the reduction of the electrolyte.

The macroelectrolysis studies, on the maximum recovery current of 54 minutes, showed that the best material to perform the silver recovery from industrial wastes of photographical and radiographic uses on the FP01-EP reactor was the A304 electrode since the recovery percentage is higher than the other electrodes (see figure 1).

It is worth to mention that the recovery percentages are low and the studies have to be improved by seeking the operational conditions for the optimum recovery of the precious metal.
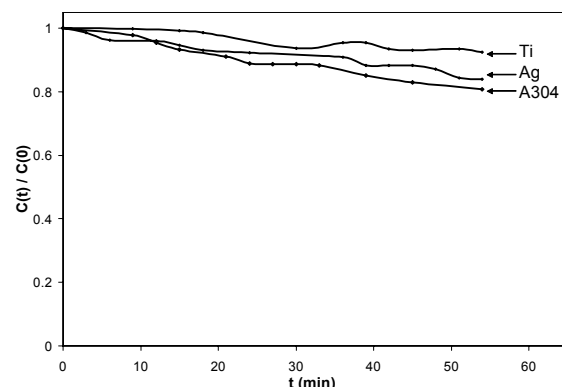

Figure 1 Variation of the normalized concentrations of the chemical species of silver present in the EDFR solution, in function of the electrolysis time when imposing a maximum current on the A304, Ti and Ag electrodes.

On the other hand, verification of the silver deposit was carried out on the A304 surface by means of MEB and Rx studies of the reduction products mechanically removed after 54 minutes of macroelectrolysis (Figure 2).
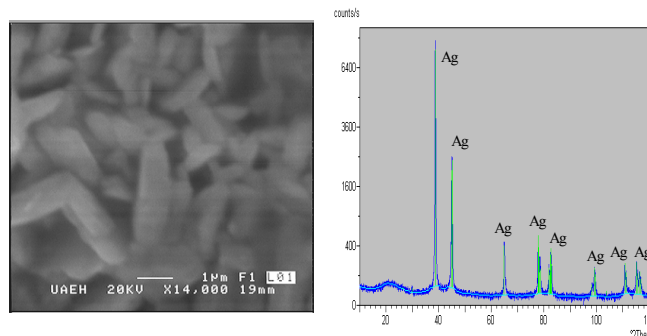

Figure 2. MEB Image of the A304 electrode after macroelectrolysis with 0.09 A of the EDFR solution and Rx obtained from the silver deposit found on the A304 electrode.

This results, allowed knowing the current conditions to be applied in the maximum obtaining of electrodeposited silver. However, as mentioned above, more studies are required varying the area and the flux rate to optimize this process.

AKNOWLEDGEMENTS

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