RECOVERY OF SILVER (Ag) FROM PHOTO PROCESSING EFFLUENT BY CHEMICAL AND ELECTRO-WINNING METHODS

MASTER OF SCIENCE (BY RESEARCH)

ROHITHA. L.P.

UNIVERSITY OF MORATUWA
SRI LANKA

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Abstract

Industries such as mining and industrial minerals, metallurgical, photo processing, textile, leather and chemical produce wastewater containing heavy metals that are hazardous to man and the environment.

Photo processing waste effluents arise from X-ray, lithographic and photo processing operations. The photosensitive medium used in these operations is an emulsion of fine Ag halide matrix in gelatin. During fixing, the Ag^{+} is removed by the fixer solution. The developer and bleach solutions also contain the Ag heavy metal. The recovery of Ag^{+} from such wastewater may be done by electro-winning, metallic replacement, evaporation, ion exchange, reverse osmosis and electrodialysis. The aim of this research was to investigate the application of electro-winning technique for selective removal of Ag metals from photo processing effluent.

The laboratory scale electro-winning cell was a beaker of 12.7 cm in diameter and having a capacity of 250 ml. The anode was of stainless steel of size 7.5 x 4.5 cm^2. A carbon plate of 1 cm thick (7.5 x 4.5 cm^{2+}) of 99.5% carbon was used as the cathode. The circuit consisted of an electrolyte bath a precision type milli-ammeter and an adjustable resistant in series, and a voltmeter connected across the electrodes in the bath.

During the electrolysis, samples were taken after 5, 10, 15, 30, 60, 120 & 180 minutes intervals respectively at each of the current density values corresponding to 10, 20, 30, 35, 40, 45, 50, 55, 65, 70, 75, 80, 90, 100 & 110 From each solution three aliquots were pipeted out & analyzed In the electro-chemical method the electrowinned solution was filtered and the residue was treated with. Ammonium Nitrate reagent In the third approach the photo processing effluent was subjected to electro-winning process using a current: voltage ratio of 2.2 to 2.8.

In the first approach, industrial photo processing effluent having 2400-Pfm of Ag was subjected to electro-winning technique at current density of 82 mA/cm^2. However in three hours, only 14 % of Ag was deposited on the cathode and considerable amount of precipitate was visible at the bottom of the cell. This black precipitate resembled typical AgS precipitate and is thought to be formed due to oxidation of S203 to elemental sulfur that preferentially binds with Ag". The interference from S drastically reduced the recovery potential of Ag at the investigated process condition thus rendering the process technically aid economically non viable.

In the second approach, the same effluent was subjected to an electro chemical method giving 14 % of Ag deposition on cathode and 72 % of Ag was extracted from chemical methods. However the use of number of expensive chemicals and heating make this method economically less attractive. The use of very low voltage with a current: voltage ratio of 2.2-2.8 does not provide sufficient energy for oxidation of S203 thus avoiding S interference on Ag" reduction. Under this process condition, a remarkable Ag recovery of 86% was achieved at the current density of 82 mA/cm^2. The developed process conditions prove the technical feasibility of electro winning for Ag recovery and stimulate further investigations into optimization of cell configurations for industrial application.

DECLARATION

I here by declare that the work included in the thesis, in part or whole, has not been submitted in any form for any other academic qualification of any Institute.

UOM Verified Signature

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Rohitha L.P.S

Certified by

UOM Verified Signature

Dr S.L.J. Wijeyekoon

(Supervisor)

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