Proceedings of the International Conference on Mining, Material and Metallurgical Engineering
Prague, Czech Republic, August 11-12, 2014
Paper No. 112

Purification of Platinum Metal Refinery Crystalliser Effluent Using Ion-exchange

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Keywords: Effluent, Crystalliser salts, Ion exchange, Resin.

Extended Abstract

Impala Platinum Metal Refinery (PMR) produces about 30tonnes of salt every month after crystallisation of effluent from the refining processes. These crystallised salts contain impurities (heavy metals) and are discarded. This poses a danger to the environment and it costs the company large amount money to correctly dump them. There is need to find ways of purifying these salts and find its alternative industrial uses. Major sectors identified using industrial salt were paper mills, pharmaceutical, textile, tanning and paint industrial sectors (Department of Minerals and Energy, 2001). Comparison of the salt composition with salt specifications required for these uses revealed that the salt needed further purification in order to find application in these industrial sectors. Two approaches were proposed; treatment of the crystallized salt to remove impurities and treatment of the crystallizer influent stream before crystallization to ensure a more pure salt is produced.

The first approach was investigated. It was noted that the salt is very soluble and readily dissolves in water, due to the high solubility of NaCl. Initially solvent extraction was considered (Xie et al.,2014). Preliminary results done by dissolving the salt 1 M EDTA showed that most of the metals in the salt could be removed by chelation with EDTA . However, this required another recrystallization step.

The salts were then purified using ion exchange in order to reduce the concentration of impurities and produce a saleable product (Dyer, 2013, Karas et al., 2014). Two types of resins were used in the study: a strong acidic, gel-type cation exchange resin in the Na-form and a weakly basic ion exchange resin for adsorption of cations and anions respectively.

The effluent obtained after ion-exchange was crystallised and the salt was analysed by XRF and XRD to obtain the elemental composition of the salt and dominant mineralogical phases. The effluent was found to be a complex mixture of heavy metals and anions with the dominant species being Na, Cl and S. The quantitative amounts of Na and Cl in the salt were 90% for anionic elution, 89% for both cationic elution followed by anionic elution, and cationic elution alone. It is recommended that the use of anion exchange resin alone is more effective since the bulk of the impurities are anionic in nature. The loading capacity of this resin was calculated based on batch adsorption studies and was found to be 22 g resin /L of effluent treated. For this resin the recommended optimum flow rate is 2-4 BV/h.

References

Dyer A. (2013). "Reference Module in Chemistry, Molecular Sciences and Chemical Engineering" Elsevier.

Karas F., Hnat J., Paidar M., Schauber J., Bouzek K. (2014) Determination of the ion-exchange capacity of anion-selective membranes. International Journal of Hydrogen Energy, 39, 5054–5062.

Reynolds T.D. (1982). "Unit Operations and Processes in Environmental Engineering" Boston: PWS Publishing Co.

Xie F., Zhang T., Dreisinger D., Doyle F. (2014). A critical review on solvent extraction of rare earths from aqueous solutions. Minerals Engineering, 56, 10 – 28.

Websites:
Web-1: http://www.dme.gov.za consulted 16 Sept. 2013