Abstract

Electrodialysis (ED) holds much promise in the purification and separation of sulfuric acid from spent acidic liquor wherein the type and cost of electrodes are the major affecting factors towards its economic viability at a large scale. Batch ED process with affordable electrodes such as graphite and SS 316L was studied and analyzed its effect on the quality of anolyte. Effect of major physico-chemical parameters such as initial catholyte concentration and current density on current efficiency, molar flux, the extent of acid separation and voltage requirements was investigated extensively. A cascaded ED system with graphite electrode developed in the present study could increase sulfuric acid concentration up to 28 wt. % with different commercial anion exchange membranes and the performance of the membrane was examined in terms of acid concentration, current efficiency, voltage requirements, and energy consumption. Proton leakage through anion exchange membrane, acid back diffusion, concentration polarization and solution conductivity were considered to be the limiting factors for acid enrichment. ED was also revealed to be a less energy intensive-process and its integration with evaporation was found to be more economical than standalone ED or EV to increase sulfuric acid concentration from 1 to 5 wt. %. Empirical equations were developed to predict molar flux and voltage requirements that could produce satisfactory results. This PhD thesis may provide useful insights to ED fundamentals, batch and cascaded process performance with a complete set of process parameters along with energy estimations for the sulfuric acid separation and enrichment.

Research Publications

3. Sheth B., Nath K., Concentration of sulfuric acid from spent liquor by cascaded electrodialysis using an interpolymer anion exchange (IPA) membrane (Under review) (*Asian Journal of Chemistry*).