ELECTROWINNING OF METALLIC IRON FROM NON-CIRCULATED SULPHATE ELECTROLYTE USING GRAPHITE RODS RECOVERED FROM SPENT ZINC CARBON BATTERIES AS ELECTRODES

MWV-025

https://dx.doi.org/10.4314/just.v44i2.10s

James R. Dankwah, Alfred A. Amesimeku, Wisdom W. Sejarah, Esther Coleman, Sarah Cobbina

Department of Minerals Engineering, University of Mines and Technology, Tarkwa, Ghana

Abstract

The electrowinning of metallic iron from non-circulated aqueous iron (II) sulphate electrolytic bath was investigated using cylindrical graphite rods recovered from spent zinc carbon batteries as electrodes. The effects of current density, temperature, concentration of Fe2+ ions in the electrolyte, and inorganic additives (ammonium sulphate and sodium sulphate) on product quality, current efficiency, and specific energy consumption were investigated at voltages ranging from 2.8 to 3.0 V and Fe2+ ion concentrations of 20, 40, and 60 g/L. Results indicated that graphite rods recovered from spent zinc carbon batteries function effectively as electrodes even at room temperatures. Increasing the current density resulted in increased current efficiency, increased energy consumption, and deterioration in product quality evidenced by dendritic cathode deposits. Current efficiency increased with increasing Fe2+ concentration. Incorporation of inorganic additives improved product quality for both ammonium sulphate and sodium sulphate. Increasing the temperature from room temperature to approximately 40°C significantly improved current efficiency; however, deterioration was observed above 40°C due to a sharp increase in the hydrogen emission reaction (HER) at the cathode.

Keywords: Electrowinning, current density, current efficiency, specific energy consumption, inorganic additives.