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LEACHING OF METALS FROM WASTE PRINTED CIRCUIT BOARDS (WPCBs) USING SULFURIC AND NITRIC ACIDS

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Abstract

This study aims to understand the acid-leaching behavior of metals from 2 to 4 mm waste printed circuit boards (WPCBs) containing $22.0\% \pm 1.1$ Cu, $6.7\% \pm 0.2$ Ca, $0.68\% \pm 0.02$ Sn, 0.59 ± 0.01 % Pb, $2.71\% \pm 0.08$ Al, $0.22\% \pm 0.01$ Fe, etc.. Copper leaching was increased for sulfuric acid concentrations up to 1.2 mol/L and hydrogen peroxide concentrations of 10.0 vol% for a pulp density of 100 g/L at 50°C over 4 h, whereas for the same concentrations of sulfuric acid and hydrogen peroxide copper leaching was decreased from 75.7 to 56.7% with an increase in pulp density from 25 to 125 g/L. Under the same optimum conditions and a 100 g/L pulp density, the leached copper concentration was 16.66 g/L (75.7%) and the concentrations of Pb, Al, Fe, and Ca were 0.1 g/L, 0.64 g/L, 0.13 g/L, 0.79g/L, respectively. Above 50°C and 500 rpm, the amount of leached copper decreased. With nitric acid, 98.3% copper leaching was obtained under the optimum conditions of 3 mol/L nitric acid and an agitation speed of 800 rpm at 60°C for 5 h at 25 g/L pulp density. Under optimum conditions and 100 g/L pulp density, the concentration of Cu in the leachate was 21.12 g/L (96%), and the concentrations of Pb, Al, Fe and Ca were 0.52 g/L, 0.91 g/L, 0.13 g/L, 1.70 g/L, respectively. At the same pulp density, nitric acid enabled better leaching of copper and other metals than sulfuric acid with 10.0 vol% hydrogen peroxide. The solid precipitates obtained in the leach liquors of PCBs included stannic oxide and calcium aluminum oxide in nitric acid and gypsum in sulfuric acid.

Key words: hydrogen peroxide, metal(s), nitric acid leaching, sulfuric acid leaching, waste PCBs

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