RESPONSE SURFACE OPTIMIZATION AND KINETICS STUDIES OF LEAD LEACHING FROM FIRE ASSAY SLAG WITH ACETIC ACID

MWV-027

https://dx.doi.org/10.4314/just.v44i2.12s

Vincent Appiah[1], Bennetta Koomson[1], Lahoucine Atourki[2]

[1]Department of Materials and Metallurgical Engineering, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana

[2]Department of Physics at Mohammed V University, Morocco

Abstract

This work studies lead recovery from fire assay slag using acetic acid as a green lixiviant through process optimization and kinetic analysis. The slag was highly amorphous and predominantly aluminosilicate, with approximately 9 wt.% PbO. Response surface methodology with a central composite design was applied to investigate the effects of lixiviant concentration (0.5–2.5 mol/L), leaching time (60–240 minutes), and solid-to-liquid ratio (100–200 g/L) on lead leaching efficiency. The developed quadratic model was statistically significant and accurately predicted experimental responses. Optimal conditions of 2.1 mol/L acetic acid, 96 minutes, and 120 g/L solid-to-liquid ratio yielded 73.40% lead recovery. Kinetic evaluation using shrinking core models indicated that porous product layer diffusion control is the dominant rate-controlling step under the studied conditions. This work advances previous studies by integrating statistical optimization and kinetics studies for acetic-acid-based lead leaching from fire assay slag, providing a reliable approach for sustainable use of slag.

Keywords: Fire assay slag, leaching, Acetic Acid, Response Surface Methodology.