Available online at www.sciencedirect.com
SCIENCE DIRECT
Hydrometallurgy 82 (2006) 54 – 62
hydrometallurgy
www.elsevier.com/locate/hydromet

Hydrometallurgical treatment of tailings with high zinc content

Shirin Espiari [a], Fereshteh Rashchi [a,*], S.K. Sadrnezhaad [b]

[a] Department of Metallurgy and Materials Engineering, University of Tehran, PO Box 11365-4563, Tehran, Iran
[b] Department of Materials Science and Engineering, Sharif University of Technology, PO Box 11365-9466, Tehran, Iran

Received 24 September 2005; received in revised form 15 January 2006; accepted 23 January 2006
Available online 20 March 2006

Abstract

Zinc exists as smithsonite and hemimorphite in the lead flotation tailings from the Dandi mineral processing plant in north western Iran. In this research, zinc-rich tailings produced in the Dandi plant were characterized mineralogically and a leaching study was carried out to assess the effect of several parameters on the kinetics of zinc dissolution. Parameters studied included: sulfuric acid concentration, reaction time, temperature and slurry density. It was found that leaching is controlled by a single rate-controlling step with an activation energy of 23.5 kJ/mol. To overcome some of the filtration problems associated with polymerization of silicic acid, lime was added as a coagulant. The optimum pH, holding time and temperature required to maximize the filtration rate were determined.

Keywords: Lead–zinc oxide ores; Leaching; Kinetics; Silica coagulation

1. Introduction

Currently, zinc is produced mostly from zinc sulfide ores because sulfides are easy to separate from gangue and to concentrate by conventional flotation techniques. As new sphalerite mines are becoming more difficult to find, new processes to produce zinc metal from oxidized zinc ores are being developed. Oxidized ores contain zinc in various carbonate and silicates minerals such as smithsonite ($ZnCO_3$), hydrozincite ($2ZnCO_3 \cdot 3Zn(OH)_2$), zincite (ZnO), willemite ($ZnSiO_4$) and hemimorphite ($Zn_2SiO_3 \cdot H_2O$).

Recently, Sole et al. (2005) reviewed the first commercial application of zinc solvent extraction for a primary zinc ore containing ~10.6%Zn in Skorpion, Namibia. In the process an atmospheric leach in sulfuric acid is applied to remove iron, aluminum and silica from solution by precipitation. Zinc is then selectively extracted by solvent extraction.

Extensive work has been carried out on the treatment of zinc oxide ores by hydrometallurgical and pyrometallurgical methods. In particular, there are several processes for the treatment of zinc silicate ores. Leaching is the first step in the hydrometallurgical route and leaching kinetics is important from the economic point of view. Thomas and Fray (1981) studied leaching of oxide zinc materials with chlorine and chlorine hydrate. They found that the rate of leaching of the Adrar Turkish ore could be described using a shrinking core diffusion model, and that the rate of leaching was controlled by surface reaction. In all cases studied, lead was also leached with zinc. However, iron oxides remained virtually undissolved. Abdel-Aal (2000) investigated the kinetics of sulfuric acid leaching of low-grade zinc silicate ore. Abdel-Aal found that leaching of about 94%

* Corresponding author.
E-mail address: Rashchi@ut.ac.ir (F. Rashchi).

0304-386X/$ - see front matter © 2006 Elsevier B.V. All rights reserved.
doi:10.1016/j.hydromet.2006.01.005