Preface

Amphoteric metal is a metal susceptible to leaching in both acid and alkaline media, especially in aqueous solutions, generally in the form of oxides, such as aluminum, zinc, lead, etc. Zinc and lead are two of the commonest amphoteric heavy metals used in the world. As a result, a large quantity of hazardous wastes containing zinc and lead are being generated or stored at landfills and factories. The treatment and recycling of zinc and lead hazardous wastes have thus received great concern. Zinc and lead in these hazardous wastes may be generally extracted by leaching with acidic or alkaline solutions. For the acidic leaching process, though zinc and lead will be dissolved to an acceptable high level, the bulk materials, iron, calcium, etc., will also be dissolved completely, and the dissolved iron and other elements have to be precipitated from the leaching solutions. Moreover, a big fraction of zinc exists as zinc ferrites in the dust, which cannot be attacked effectively by acidic leaching processes. Therefore, the acidic leaching process seems not to be economically viable for the treatment of these wastes.

In contrast, considering that only the oxides of lead and zinc as well as part of aluminum will be dissolved in alkaline solution, it may be a cost-effective method to extract zinc and lead from the wastes by alkaline leaching processes. The thermodynamics and kinetics of alkaline leaching of zinc and lead hazardous wastes show that ZnO, $ZnCO_3$, and Zn_2SiO_4 can be dissolved by strong alkaline solution. Compared with ZnO and $ZnCO_3$, a higher concentration of OH^- is required to dissolve Zn_2SiO_4. ZnS cannot be leached by alkaline solution directly under atmospheric pressure. PbO, $PbSO_4$, and $PbCO_3$ can be dissolved in concentrated NaOH solutions, while the dissolution of PbS may be negligible. For the ZnS in solid wastes, the leaching rate of zinc in alkaline solution is greatly improved via chemical conversion with $PbCO_3$. In this book, the alkaline hydrometallurgy of zinc and lead hazardous wastes is fully described. The alkaline leaching process for the selective leaching of zinc and lead, selective separation between zinc and lead in the leaching solution using sodium sulfide, electrowinning of high-purity zinc powders from the purified leach solution, operational costs and mass balance analysis for all possible processes, flow sheets, and chemical reactions that take place in the

processes are provided in detail. The industrial application process and engineering design is also given. The main contents include zinc and lead hazardous wastes and hydrometallurgical processes, leaching of zinc and lead hazardous wastes, purification of leach solution of zinc and lead, electrowinning of zinc from purified alkaline solutions, chemical reactions taking place in the processes and proposed flow sheets, thermodynamic and spent electrolyte regeneration, alkaline hydrometallurgy of low-grade smithsonite ores, recovery of associated valuables from lean leach solutions, and industrial-scale production of 1500–2000 t/a zinc powder using alkaline leaching-electrowinning processes. The process is cost-effective and generates little secondary pollutants and has been applied widely in China.

The readers include solid waste engineers, managers, technicians, recycling coordinators and government officials, undergraduates and graduates, and researchers.

Shanghai, China

Zhao Youcai
Zhang Chenglong

http://www.springer.com/978-3-319-55157-9

Pollution Control and Resource Reuse for Alkaline Hydrometallurgy of Amphoteric Metal Hazardous Wastes

Zhao, Y.; Zhang, C.

2017, LI, 405 p. 339 illus., 150 illus. in color., Hardcover
ISBN: 978-3-319-55157-9