Exploring the Potential Use of Monoethanolamine-Based Lixiviants for Lead Extraction from Zinc Calcine and Zinc Leaching Residue

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The roasting-leaching-electrowinning (RLE) process is the main hydrometallurgical route in zinc metallurgy and produces more than 90% of the current worldwide zinc supply. Zinc calcine (ZC) obtained by roasting of zinc sulfide concentrates is leached in sulfuric acid and zinc metal is produced from the purified zinc sulfate electrolyte by electrowinning, while other metals, such as Cu, Pb and Ag are left behind in the zinc leaching residue (ZLR). Metal recovery from ZLR not only becomes of economic importance, but is also a solution to prevent environmental leaching of hazardous elements. Many efforts have been devoted to the recovery of valuable metals left in the ZLR, including the Waelz process, the sulfidization-flotation process and several hydrometallurgical methods [1-3].

In this study, we explored a new solvometallurgical approach for lead (Pb) extraction from ZC and ZLR. ZC contains 2.2 wt% Pb, which is mainly present as anglesite ($PbSO_4$) which has a low solubility in aqueous systems, whereas ZLR contains 5.6 wt% Pb as anglesite and plumbojarosite ($(Pb_{0.34}K_{0.19})Fe_3(SO_4)_2(OH)_6$). We investigated the use of monoethanolamine (MEA)-based lixiviants for the extraction of Pb from ZC. By doing so, Pb can be recovered in an early stage of the RLE process and will not pollute the subsequently produced acidic ZLR in the zinc production process. MEA is an alkaline organic solvent that can act as a bidentate ligand through its amine and hydroxyl functional groups. A series of mixtures of ammonium salts (i.e. sulfate, carbonate and chloride) with MEA were tested to improve Pb extraction. A solution of 0.5 M ammonium sulfate ($(NH_4)_2SO_4$) in MEA gave the best Pb extraction yields (85–93 %) with 7–28 % Zn co-dissolution after leaching for 12 to 24 hours at room temperature. In a separate investigation, the same lixiviant was also applied to extract Pb from ZLR. However, the process showed disparity, yielding less than 1% of Pb extraction after leaching at varied conditions. It is noteworthy that ZLR contains Pb as anglesite ($PbSO_4$) and plumbojarosite ($(Pb_{0.34}K_{0.19})Fe_3(SO_4)_2(OH)_6$), whereby only the anglesite phase could be extracted by the MEA-based lixiviant. Whilst the MEA–$(NH_4)_2SO_4$ lixiviant showed a promising performance for Pb extraction from ZC, containing Pb as anglesite, it was not able to effectively destruct the plumbojarosite mineral structure to allow for complete Pb extraction from ZLR.

References:

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