

Recycling of Exhausted Batteries and EAF Dusts by Leaching with Several Aqueous Media

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Abstract. Zinc is a base metal present in several products of general use, and therefore found in numerous residues and end-of-life products. The two main sources of zinc containing wastes are spent Zn-MnO₂ portable batteries and electric arc furnace (EAF) dusts from steelmaking plants. The recovery of metals from these residues by appropriate recycling processes is mandatory due to environmental, economic and resource conservation issues.

Concerning the similar composition of both residues, their simultaneous processing can be envisaged. The research herein described consists on the hydrometallurgical treatment of zinc bearing waste, where several leaching routes for solubilising metals, mainly zinc, are studied.

The leaching of shredded batteries and EAF dusts was carried out using three different leaching solutions containing sulfuric acid, hydrochloric acid or ammonium chloride. The acid leaching of zinc in the oxide form (zincite) using both acids, was very efficient and quick, allowing the recovery of practically all Zn contained in batteries and about of 80% of Zn in dusts. Regarding to the leaching media the behaviour of lead oxides present in dusts was different, being insoluble with H₂SO₄ and partially soluble with HCl (40-90% yield, depending on conditions). For battery waste stream, manganese is also other important metal, which oxides were only partially soluble in acid media, attaining a maximum leaching yield of 90% Mn. Iron, considered a contaminant in both residues, was partially leached and required further purification steps. The use of an ammoniacal medium (NH₄Cl) was very selective for zinc, being iron practically insoluble. However, the maximum zinc leaching yield attained for both residues was only near 60%. Under these conditions, manganese contained in batteries was very insoluble while lead from dusts was leached up to 70% due to the relative solubility of lead chloride.

This research showed that hydrometallurgical treatment can provide versatile solutions for recycling metals from Zn waste. Ammoniacal leaching allows high selectivity for zinc but less recovery efficiency is attained, while acid leaching allows higher metal recovery yields but unwanted elements like iron are co-dissolved.

1. Introduction

Zinc is the fourth most widely used metal in the world being its main application in galvanising treatments (anti-corrosion coatings on steel), which accounts practically half of its demand, and also in the alloys production like brass and others (30%), die casting (8%), chemicals, including primary batteries (9%), construction materials and pharmaceuticals [1].

Since zinc is extensively used and spread in many products and applications, it also appears in several residues and end-of-life products. A correct and sustainable management of these wastes is therefore important in order to assure the offer of this metal to the markets, and also to avoid negative environmental impacts.