Selectivity Improvement in Extraction of Scandium from Bauxite Residue by Blending Organics

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1. Introduction

The demand of Scandium (Sc) in the industry is increasing despite its extreme price. Recent advances in wide range applications, e.g. Al-Sc alloy, highlight this rare element for the technological developments. Since it has rare resources, the major way to obtain Sc is from by-products and bauxite residue (i.e. red mud) has a great potential to become a significant reserve. It was reported that the annual growth of the bauxite residue was approximately 120 million tonnes [1]. The present project is part of the EU H2020 ETN Red Mud consortium which aims to recover valuable constituents of bauxite residue (BR) and targets on zero-waste strategy. This study aims to improve the selectivity of Sc during solvent extraction by blending different organics.

2. Experimental

The concentration of the PLS (pregnant leach solution) was determined considering preliminary experiments as well as the linked studies within the project. All solutions used in the study were prepared by reagent grade salts. Extractions studies were conducted with organophosphorus reagents, amine based organics and with the blend of these organics. The concentrations of the primary and the secondary extractant in synergistic cases determined as 0.1M and 0.05M respectively. In all cases organic-to-aqueous ratio (O/A) kept stable at 1:1.

3. Results and Discussion

Lots of effort had already been given to obtain Sc from various resources by solvent extraction and complete Sc extraction was achieved in various studies. However, the main problem during Sc extraction is the co-extraction of the impurity ions in the solution system which generates more complicated processes containing intense purification steps or alternatively, additional precipitation stages to produce a Sc concentrate prior to the solvent extraction operation [2].

Red mud is a resource which is rich in terms of Fe, Al, Ti as well as Ca and Si. In addition, it is a well-known fact that Sc usually behave as Fe in the solution. While the other impurities in the solution can be separated with the addition of a scrubbing step during a solvent extraction operation, Fe tends to remain in the organic with Sc. This generates the separation problem between Fe and Sc. In the presented study, Fe co-extraction was tried to be minimized by the usage of different organic mixtures.

Preliminary studies showed that, while one of the most widely used and selective organophosphorus reagent to extract Sc, D2HPA, co-extracted 20% of the Fe(III) in the solution, this co-extraction was decreased to 6-10% by the addition of 0.05M Cyanex 923 to 0.1M D2HPA in D85 kerosene. In other words, the selectivity of Sc over Fe can be doubled or even be tripled by blending D2HPA with different organics. To determine the best extractant for Sc extraction with the highest selectivity, different cases will be compared and analyzed. In addition, the dependency of selectivity against pH and the type of media will also be discussed.

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2. Yagmurlu B, Dittrich C, Friedrich B, Journal of Sustainable Metallurgy, **3**, 90-98 (2017)

Key words: Scandium, Bauxite Residue, Red Mud, Recovery