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Separation of Rare Earth Elements from Aluminum Using Ion-Exchange Chromatography

Shabrina Nurfitriani, Hoon Choi, and Nien-Hwa L. Wang
Davidson School of Chemical Engineering, Purdue University

ABSTRACT

Demand of rare earth elements (REEs) has increased tremendously due to their key roles in electronics and emerging technology. Recently, new technology was developed at Purdue to extract REEs from coal fly ash. This study is focused on the separation of aluminum ions (Al), a major impurity in the extract, from REEs. The goal is to test the feasibility of an ion-exchange process for separating REEs from a highly-concentrated Al solution. First, we reduced the resin particle size to decrease dispersion and diffusion effects, to increase resin productivity, and to reduce the amounts of REEs and the ion-exchange resin required for column testing. Different methods of grinding the resin were tested. Grinding the resin in a container with constant stirring was found to be the best method to produce uniformly distributed small particles. The column packed with ground particles showed that porosity and column capacity was unchanged after grinding. Second, optimum loading pH was determined by measuring the effective capacities for an REE, Neodymium (Nd), and Al respectively at different pH values. Loading tests using mixtures of Al and Nd were done to verify if at the optimum pH, the largest REE capture efficiency and the least Al contamination was achieved. This process has potential for recovering REEs and high-purity Al from the extract of coal fly ash.

KEYWORDS

Ion-exchange chromatography, rare earth separation, Aluminum, coal fly ash