Direct Leaching of Rare Earth Elements from Circulating Fluidized Bed Combustion Coal Fly Ash by Hydrochloric Acid

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ABSTRACT

Rare earth elements (REE) are used in many emerging technologies associated with consumer electronics, defense, new developments in the field of medical technology and green energy production sectors. Consequently, they have gained rapid momentum in terms of their strategic importance. The annual growth for the total REE demand is between 5% and 9% over the next 25 years and it is therefore projected that there will be shortages in the supply especially for the clean energy applications in the near future (USGS, 2017). In 2014, the Raw Materials Supply Group of the European Commission (EC Report, 2014) classified REEs as critical raw materials. This projected supply shortage of REE has fueled the quest to find alternative sources of REEs. A few studies have verified the potential of coal fly ash (CFA) as secondary resources of REEs (Franus, et al., 2015). The main advantage of using CFA as secondary resource of REE is that it does not need intensive energy requirement for comminution since it is already fine. In this study, a direct leaching of REEs from circulating fluidized bed combustion (CFBC) CFA using hydrochloric acid (HCl) was investigated. The leaching parameters that were considered are HCl concentration, leaching time and leaching temperature. Optimization of the said parameters was done via Response Surface Methodology (RSM). Results of the RSM showed that the optimum leaching condition is found at 3M HCl, 65^0C and 270 minutes with leaching recovery of 70.8%, 76.34%, 88.02%, 90.01% and 73.38% of each of the critical REEs namely Nd, Er, Eu, Tb and Dy are, respectively. The empirical model that was established accurately predicted the dissolution of REE with accuracy of 98.20%, 96.66%, 97.09%, 98.17%, and 97.78% for Nd, Er, Eu, Tb and Dy, respectively.