

Recovery of Rare Earth Elements (REEs) from Coal Ash Using Acid Leaching: A Review of Leaching Conditions and Efficiencies

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Rare earth elements (REEs) are the set of 17 elements, 15 elements of the lanthanide series (57-71), including Scandium (21) and Yttrium. The demand for the REEs is increasing consistently due to their wide range of applications, from defense technologies, EV batteries, permanent magnets in wind turbines to motors in EVs, metal catalysts, and light-emitting diodes. Since the 1990's, China is dominating in REE mining being the largest supplier and becoming the major consumer. US has been relying on China to fulfill its REE demand. With the growing demand of REEs and its limited economically viable primary source, coal ash generated from the coal combustion power plant has been identified as the reliable secondary source to reduce the dependence on China. Coal ash with no economic significance, but creating a significant environmental hazard, could be a prominent source of REEs. Due to the minerology of coal ash, acid leaching has been identified as the suitable method of extracting REEs from coal ash, enhanced by prior physical beneficiation techniques based on the feedstock. This research focuses on reviewing and identifying the suitable acid leaching conditions and leaching recoveries of three different acids i.e., H_2SO_4 , HCL , and HNO_3 on coal ash sample from different regions of the world at various concentration of acids, leaching temperature and durations. Acid leaching of coal ash has come up as a promising method, as nearly 100% of leaching efficiency can be obtained. However, it requires further studies to characterize coal of different regions and develop an optimized process for economically recovering REEs in industry scale.

Keywords: Rare earth elements; Coal Ash; Minerology; Acid Leaching