Rare Earths Recovery from Secondary Resources: Opportunities, Challenges and Environmental impacts

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Extended Abstract

Rare earths are not as rare as the name suggests, they are relatively abundant in the earth`s crust, but their concentration is less in ore deposits, in particular heavy rare earths. Commercially, REEs are extracted from the *bastnasite, monazite and xenotime* ores.[1,2] The extraction of REEs from mineral ore (primary source) is a complicated multi-step process with a huge amount of toxic waste released during the processes. The recovery of REEs from secondary sources such as Coal Fly Ash (CFA), recycling and extracting tailings can serve as a promising alternative in addition to traditional mining. Further, the recovery of REEs from secondary sources will not only address the imbalance in supply and demand of certain REEs, but it will also help in reducing the environmental damage due to toxic wastes such as ore tailings, industrial waste, e-waste, CFA, etc.[3-6]

Coal is still the worlds most important and reliable source of energy, which on combustion generate byproducts such as fly ash, bottom ash, etc. According to various reports, coal and its byproducts contain a significant amount of rare earths and other strategic metals such as gallium, germanium, indium, tellurium, etc. Some coal contains a higher concentration of heavy rare earths than light rare earths and vice versa. Heavy rare earths are much less abundant and more valuable than light rare earths. The recovery process of REEs from CFA is far less intensive than that of mining and extraction of REEs from mineral ores.

Recycling is one of the ways to address the issues like an imbalance in supply & demand, supply risk, economic and environmental issues. With the increasing adoption of clean technologies,

the demand of rare earths is expected to increase, which in turn will boost the recycling potential globally in coming years. The effective urban mining of e-waste or other end-of-life rare earth products are also important for low carbon and circular economy. The development of circular economy is important to address the concerns associated with the non-renewable sources and environmental concerns. For example, the recovery of rare earths from lamp phosphors will also close the materials loop for mercury, which is hazardous to people and the environment. It is important to establish an effective recycling ecosystem for the end-of-life products containing rare earths.

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