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Screening dilute sources of rare earth elements for their circular recovery

Ana Teresa Lima, Gunvor Kirkelund, Freeman Ntuli, and Lisbeth M. Ottosen
Technical University of Denmark

Metals, including rare earth elements (REE), are the cornerstone of our current and future low-carbon urban infrastructure. This study looks at different waste resources and contaminated materials present in the urban setting as REE sources. Wastes and other dilute sources such as incineration ashes, sediments, and mine tailings are not only essential sources of REE in achieving a circular, carbon-neutral economy but may be the most realistic one. E-waste, being the most REE concentrated waste, faces serious reservations regarding handling in largescale facilities, and this waste is generally landfilled. After analyzing different residues, coal fly ashes and stormwater retention pond sediments present the most promising ones. While coal fly ashes have the highest critical REE contents from the studied wastes, the sediments collected from a stormwater retention pond showed the highest REE leachability. Critical REE Nd, Dy, and Er can mainly be found in sediments/soils near highways, coal ashes, and bauxite residue. Overall, coal fly ashes contain the highest critical REE contents found in the studied wastes but sediments collected from stormwater water ponds present the highest leachable REE. In fact, up to 100% of total REE found in these sediments are leachable at room temperature low pH. Future REE resource extraction efforts should account for REE speciation in wastes and not only total contents.