

Komal Habib: Critical Resources in Clean Energy Technologies and Waste Flows

Popular abstract

A broader implementation of clean energy technologies in future is a widely motivated scenario for meeting the climate change goals as well as to reduce our dependency on the non-renewable fossil fuels. However, the transition from the current fossil-based society to a future low-carbon society is fraught with the risk of shifting the supply security problem from one type of non-renewable resources (fossil fuels) to another type (metals), in particular the specialty metals such as rare earth elements e.g. neodymium and dysprosium. This PhD work presented an in-depth analysis of potential resource constraints for the emerging clean energy technologies in future, along with an insight into the resource criticality assessment methodologies, detailed material flow analysis (MFA) of critical resources, and recovery of critical resources from the waste streams. The key findings of this PhD study were:

- The demand of neodymium and dysprosium, driven by the clean energy technologies is estimated to be 10 times higher by 2050 compared to the present primary supply (mining). This implies that *either* a highly accelerated rate of mining is required to meet the future demand *or* a radical change in current technologies is required to avoid the technological dependency of neodymium and dysprosium in future.
- The suggested resource criticality assessment methodology in a technology specific perspective has clearly demonstrated that the current state-of-the-art wind turbine technology is not dependent on rare earths for its broader application in the future, as the rare earths based solutions can be easily substituted with a number of available alternatives independent of rare earths.
- The detailed MFA of neodymium and dysprosium has revealed that the amount of these metals is significantly lower, and is dispersed over a myriad of different products in the present waste flows, rendering their economically feasible recovery from waste.
- This study has revealed the complete loss of neodymium and dysprosium in the current waste electrical and electronic equipment (WEEE) treatment system, as it is not designed to recover these resources from waste. However, it is imperative to develop the commercial scale recovery technologies for these elements because their amount in the future waste flows is estimated to be considerably high.