Hydrometallurgy for sustainable recovery of rare earths from waste NdFeB magnets

Aarti Kumari[1*], Sushanta Kumar Sahu[2]

[1]*Department of Fuel, Minerals & Metallurgical Engineering, Indian Institute of Technology (Indian School of Mines), Dhanbad-826004, India. Email ID: aarti@iitism.ac.in*

[2]*Metal Extraction & Recycling Division, CSIR-National Metallurgical Laboratory, Jamshedpur-831007, India.*

Abstract

The rare earth metals are one of the important elements used in modern clean energy technologies such as electric vehicles, wind turbines *etc*. Due to its high economic importance, limited availability and supply risk, the end-of-life Neodymium Iron Boron (NdFeB) magnets has emanated as a potentials secondary resource of rare earths, which comprised of 25 to 30 wt. % of critical rare earth metals. Hydrometallurgical method is one of the most adopted method due to its easier operation, selectivity and higher metal recovery. The present investigation aims to develop sustainable hydrometallurgical methods for efficient recovery of rare earths from waste NdFeB magnets. The focus has been given to develop an energy efficient and environment friendly process for the recovery of rare earths using minimum consumption of chemicals. Two different methods (a) oxidation roasting-acid leaching and (b) chlorination roasting-water leaching methods have been studied in detail to investigate the conversion of magnet to a suitable phase which is more amenable for leaching. The roasted samples were characterized using XRD, SEM-EDS and ICP-OES analysis. The chlorination roasting-water leaching process found to be more effective and sustainable than oxidation roasting-acid leaching process. The lower chlorination roasting temperature and shorter roasting time are found as the major advantage of the process. At end, high pure rare earth oxide (purity ~ 99%) is produced and iron oxide is obtained in the residue. The paper also includes a comparative study of the above two methods considering the process efficiency, selectivity and environment sustainability.

Keywords: Hydrometallurgy, Rare earths, NdFeB magnet, Critical Minerals, Sustainability

*Corresponding Author E-mail Address: aarti@iitism.ac.in (Dr. Aarti Kumari)