Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.15591

Siderophores assisted recovery of critical metals from mining residues

ROHAN JAIN[1], KATRIN POLLMANN[2], ARATRIKA GHOSH[3], SONIYA DHIMAN[3], PARTHA PRATIM MONDOL[3] AND PURVI JAIN[2]

[1]Helmholtz Institute Freiberg for Resource Technology, Helmholtz Zentrum Dresden-Rossendorf, Helmhol
[2]Helmholtz Institute Freiberg for Resource Technology, Helmholtz-Zentrum Dresden-Rossendorf
[3]Indian Institute of Technology Delhi

Presenting Author: r.jain@hzdr.de

Critical raw materials (CRM) such as gallium (Ga), germanium (Ge), indium (In) are necessary for the development of high-tech and low carbon emission technologies such as photovoltaics, fiber optics cable, liquid crystal display and light emitting diodes. The supply of these CRM is not assured in future due to several reasons. One of the ways to overcome this shortage is through CRM recovery from low concentrated mining/urban wastes. However, such a recovery is impeded because of high concentration of contaminants and very low concentration of the CRM. Thus, a sensitive and specific process is needed.

Siderophores are highly selective molecules towads Fe(III) and their this selectivitiy is also extended towards other CRM. Thus, the siderphores, desferrioxamine B (DFOB), has been exploited for the recovery of these CRMs from different wastes. The complexation of free DFOB with Ga and Ge was investigated. pH and ionic strength has no effect on the DFOB complexation with Ga while Ge showed much better complexity at low pH values and higher ionic stregth. There was again little to no effect of anions on the DFOB complexation with Ga while DFOB complexation with Ge increased with the increase in presence of anions. The EDTA was able to completely decomplex both Ga-DFOB and Ge-DFOB complexes.

For the technology development, DFOB was immobilized onto the solid-matrix with the free NH3 tail. The optimized length of the linker was needed for the successful immobilization of DFOB. Maximum of 3 - 6 mg of Ga/Ge/In per g of the DFOB immobilized solid matrix was achieved during batch adsorption studies. In the next steps, DFOB immobilized solid-matrix was packed in the column and the technology was demonstrated at 10 L/day and 100 L/day capacity with the real wastewater from the wafer manufacturing company. Maximization of the flow rate and identification of the upscaling parameters was carried out. Further, flowsheet were developed with pretreatment for the recovery of Ga and Ge from the mining residues. The GaLIophore techology is already patented and has potential to economically recover CRM from low concentrated wastes/wastewater with much lower environmental impact compared to traditional processes.