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Ecosystem Impacts of Critical Material Recovery and Processing: Ecotoxicity Testing on DGA Extractants

CAROLINE STRONG[1], GARY F VANZIN[1], YOSHIKO FUJITA[2], JUNKO MUNAKATA MARR[1], JAMES F RANVILLE[3], JANI INGRAM[4], DAVID REED[2], MICHELLE WALTON[2], PEYTON CHANDLER[1] AND SANTA JANSONE-POPOVA[5]

[1]Critical Materials Innovation Hub, Colorado School of Mines
[2]Critical Materials Innovation Hub, Idaho National Laboratory
[3]Colorado School of Mines
[4]Critical Materials Innovation Hub, Northern Arizona University
[5]Critical Materials Innovation Hub, Oak Ridge National Laboratory

Presenting Author: cjsgeochem@gmail.com

Modern clean energy technologies are heavily dependent on a number of materials such as rare earth elements (REE), lithium, cobalt, nickel, etc., whose current supply chains are not considered adequate to meet projected global demands. These materials are collectively termed “critical materials” or “critical minerals” (CM). Much attention has been paid to the development of new CM recovery and treatment processes, but there is some concern about the waste generated from these efforts. Our project goal is to help assess the potential toxicity and ecosystem effects of newly developed CM processing and recovery technologies to avoid the unintended generation of emerging environmental contaminants. Our experimental platform includes a series of ecological toxicity tests to assess the potential environmental impacts of new CM recovery or recycling technologies. We have most recently been examining complexing agents in the diglycolamide (DGA) family that are proposed for use in solvent extraction separations of REE, along with the process-relevant solvents, Isopar-L and 1-octanol. The most well-known DGA compound is tetraoctyl diglycolamide (TODGA), which has been demonstrated for actinide separations. The ecotoxicity indicators chosen for our studies include the wastewater bacterium *Nitrosomonas europaea*, the small crustacean *Daphnia magna*, and the bacterium *Aliivibrio fischeri*. Preliminary data on the ecotoxicity impacts of TODGA and other DGAs will be presented and compared to the ecotoxicity data for the current standard of CM recovery that uses reagent PC-88A (2-ethylexyl hydrogen 2-ethylhexyl phosphonate). This type of study can be used to identify critical material processing techniques with lower impacts and/or to motivate waste remediation strategies to reduce environmental toxicity. Our project benefits society by increasing our understanding of how critical material recovery can affect the environment.