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Sustainable Biotechnology for Rare Earth Element Recovery

MEMPHIS JANE HILL, PHD AND DR. BRANDON R. BRIGGS, PHD

University of Alaska Anchorage

Rare earth elements (REEs) are critical components of green energy technologies, but current mining and purification methods require large quantities of acids, which pose great risk to the environment. As countries transition to low-carbon emission economies and the global demand for REEs depletes reserves, the world will need innovative methods for REE recovery from secondary resources. Bio-hydrometallurgical processes have the potential to concentrate and recover REEs from secondary sources at a circumneutral pH. Work presented here uses bacteria at circumneutral pH to concentrate REEs from solution and subsequently recover those REEs using sodium citrate. A culture media solution of fourteen REEs at known concentrations was incubated anaerobically with bacteria for one to seven days. REE concentrations remaining in solution were compared to REE concentrations in cell pellets. Cell pellets were washed with sodium citrate, and REEs remaining on the pellet were compared to REEs in sodium citrate solution. Cells from one milliliter of *Shewanella oneidensis* culture starting at an OD600 of 0.6 adsorbed an average of 509 total ng of REEs. After 6 days, cells removed an average of 93% of the REEs present in solution. In only 10 minutes, 0.5M sodium citrate recovered about 75% of REEs from cells and over 95% after 24 hours. This study elucidates the REE binding capacity of *S. oneidensis* and the REE removal efficiency via sodium citrate over time and highlights this method as a potential sustainable biotechnology for REE recovery.