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Heavy Metal Recovery using Manganese-oxidizing Microbes and Recycled Carpet Fiber

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The continued use of mined metals for the development and advancement of society requires innovative and cost effective remediation strategies that both protect the surrounding environment from harmful pollutants, and ideally, allow for recovery of valuable metals from waste streams. Microbially-mediated strategies that remove metals from aqueous waste streams via oxidation-reduction reactions and sorption show promise as eco-friendly solutions. Here we demonstrate the ability of an Mn-oxidizing fungal culture isolated from a high-salinity, mine impacted water to sequester heavy metals Mn, Co, Cu, and Ni efficiently. In addition we examined the potential of several “sponge” materials (polypropylene, nylon, and polyethylene terephthalate) derived from recycled carpet fibers to enhance the rate and extent of metal removal by the fungus. Polypropylene promoted the greatest amount of metal sequestration as compared to both other sponge substrates and the fungal culture alone. Metal sequestration increased from 30% to 85% for Mn and 60% to 80% for Co, after 72h incubation in the presence of the polypropylene and fungus as compared to the fungal culture only. Additionally, carpet fibers supported dense biomass growth on the substrate and promoted rapid Mn(II) oxidation rates. X-ray fluorescence (XRF) imaging of the biofilm shows a complex network of fungal hyphae with Mn oxide particles and Co, Cu, and/or Ni sequestered throughout.