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# Microbial Conversion of Manganese Carbonate to Birnessite during Biotreatment of Mn(II)-Rich Mine Drainage

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Manganese (Mn)-oxidizing bacteria are considered promising tool for remediation of Mn(II)-rich mine drainage. Diverse heterotrophic bacteria oxidize Mn(II) to Mn(III, IV) oxides under circumneutral conditions. It remains unclear, however, which groups of bacteria are responsible for key functions in the wastewater treatment. Given the organic substrate-limited environment, chemolithoautotrophs may contribute to the Mn(II) oxidation in mine drainage [1]. In this study, we investigated the involvement of autotrophic Mn(II) oxidizers in the treatment of artificial Mn(II)-rich wastewater by laboratory-scale bioreactor packed with limestone. 16S rRNA gene amplicon analysis revealed the presence of putative extracellular electron-transfer (EET) autotrophs, which have been identified by a shotgun metagenomic approach in a pilot-scale Mn(II)-oxidizing bioreactor [1]. The abundance of these bacteria increased when Mn(II) was supplied as the Mn carbonate solid phase, accounting for 53% of the total bacterial population. Several known heterotrophic Mn(II) oxidizers were also detected, albeit at low abundances. X-ray absorption near-edge structure spectroscopy and X-ray diffraction analysis revealed that the Mn carbonate was converted to the Mn(IV) oxide birnessite via the transient formation of an Mn(III) phase. The results suggest that metabolically diverse Mn(II) oxidizers are involved in the remediation of Mn(II)-rich mine drainage and further reinforce the significance of autotrophs with EET activity.

[1] M. Watanabe *et al.* (2024) *J. Environ. Chem. Eng.*, 12, 113314.