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Strategies for optimizing the scalable microbial synthesis of vivianite

LORDINA EKUA ESHUN, JONATHAN RICHARD LLOYD, VICTORIA COKER AND SAM SHAW

University of Manchester

Presenting Author: lordina.eshun@manchester.ac.uk

Vivianite *($Fe_3(PO_4)_2Â·8H_2O$)* has been reported to form as a secondary mineralization product during the microbial reduction of phosphate-containing Fe(III) minerals [1 – 3]. The phosphate-rich nature of vivianite makes it a suitable sink for phosphorus, which is a scarce and irreplaceable resource, and a major contributor to eutrophication in surface water bodies. There is, therefore, interest in synthesizing vivianite by Fe(III) reducing bacteria such as *Geobacter sulfurreducens* and *Shewanella putrefaciens,* to treat phosphate-rich waters, recovering the phosphate for re-use in agriculture. In this study, factors including presence and absence of phosphate and electron shuttle, the buffer system, pH, microbial load, and the type of Fe(III)-reducing bacteria that influence the formation of vivianite under laboratory batch systems have been investigated. The rate of Fe(II) production, and its interaction with the residual Fe(III) and other oxyanions (e.g., PO_4^{3-}, CO_3^{2-}) was found to be the main driving factor for secondary mineral formation. Magnetite was formed in treatments with zero phosphates whereas vivianite and green rust were formed in treatments containing phosphate. No significant differences were observed in the extent of Fe(III) bioreduction between treatments with *Geobacter sulfurreducens* and *Shewanella putrefaciens.* However, vivianite and green rust were abundant in treatments with *Geobacter sulfurreducens* and *Shewanella putrefaciens* respectively.

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