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EVALUATION OF CARBONATE AND PHOSPHATE BASED BIOCEMENT FOR IN-SITU BARRIER OPERATIONS

By

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ABSTRACT

In-situ recovery (ISR) refers to the hydrometallurgical method for extracting metals through specifically designed chemical interactions. ISR is being employed widely in mining for recovering an increasingly diverse range of metals including uranium, copper, nickel and gold. One of the foremost challenges in the ISR operation is to protect the surrounding geoenvironment and groundwater from the harsh lixiviants used in the process. Therefore it is critical to establish an environmentally conscious strategy to build barriers around.

This research aims to explore the potential of biogenically created carbonate (as limestone, magnesium carbonate) and phosphate (as hydroxyapatite, struvite) based barriers in various ISR-related environments. Created by natural biogeochemical activities of microbes in geological formations (microbialites, beach rocks), biocement has emerged as a potential biogeotechnical solution for a variety of engineering applications due to its significant advantages of low carbon footprint, low viscosity and recyclability. While majority of the research has focused on microbially induced calcium carbonate-based cement which faces challenges at low pH conditions, not much has been explored in developing low pH tolerant phosphate based biocement.

In this study, a range of microbial metabolic pathways, role of extra polymeric substances, substrates and their impact on formation of struvite and apaptite biocements has been demonstrated. The impact of biogenic phosphate and carbonate cements on acid and alkaline lixiviant tolerance has also been analysed. Overall, the outcome of this research has significantly improved our understanding of microbially induced biomineralisation process and widened the scope of biocement barriers as containment in ISR-related environments.

Keywords: In-Situ recovery, Biocement, Microbial carbonate, Microbial phosphate, lixiviant