Immobilization of heavy metal contaminants in mining waste through enzyme-induced calcite precipitation biocementation

ABSTRACT

The presence of heavy metals affects the properties of soil due to a decrease in the dielectric constant, which increases the risk of contamination. Current conventional treatments are costly, slower, and environmentally unsustainable. Therefore, soil biocementation improvement using enzymatically induced calcium carbonate precipitation has gained attention due to its cost-effectiveness, sustainability, and environmental friendliness. This study investigates the effect of this technique on the retention and immobilization of heavy metal-contaminated mine waste sourced from Lohan Dam, Sabah, Malaysia, under different curing periods (1 and 3 days), degrees of compactions (70 and 80% of the maximum dry density), and curing temperatures (5 °C, 15 °C, and 25 °C) but at constant 1.0M cementation solution using inductively coupled plasma-optical emission spectrometry, acid washing test, and scanning electron microscopy. Results indicate that the treatment effect is immediate and able to increase the retention of heavy metals in the order of Ni> Cu > Pb, with the highest retention observed at 25 °C and higher retention at lower degrees of compaction. SEM images confirm the formation of calcite in soil particles. In conclusion, the optimum treatment conditions for a 1.0 M EICP cementation solution are 25 °C, 70% MDD, and 1-day curing