Hydraulic Conductivity of Mine Waste Treated Using Enzyme-Induced Calcite Precipitation Method Under Various Curing Conditions

ABSTRACT

The hydraulic conductivity of mine waste soil is considered moderately high attributed to the high percentage of pore spaces. One of the risks associated with this poor property is possible intrusion of contaminated acid drainage into the groundwater or river. Biocementation using enzyme-induced calcite precipitation is a relatively new, more inventive, and environmentally sustainable method compared to the other techniques in improving soil properties. However, limited available data on how this method can be applied in improving heavymetal contaminated mining wastes. This paper summarizes the effect of this treatment, including different cementation concentrations, degree of compaction, curing temperatures and curing durations in reducing the hydraulic conductivity of mining waste. Results obtained indicate a greater effect of 1.0M compared to 0.5M concentration, a degree of compaction of 80% compared to 70%, a curing temperature of 25 °C compared to 15 °C and 5 °C, and immediate reaction effect after 1 then slowed down after 3 and 7-day curing. When compared to control samples, the reduction in hydraulic conductivity ranged from 75.66 to 97.14%. The positive result is attained due to the production of calcite, $CaCO_3$ that biocemented the soil particles together and reduced the pore spaces, indicated by their content obtained, ranging from 2.0-5.15 % in the treated soil. Visual images through SEM and spectra of x-ray diffraction confirmed the presence of $CaCO_3$ in soil particles. This work contributed significantly to the study of the properties of copper mine tailings in Ranau, Sabah, including the first study on biocementation of copper mine tailings. The method could be used to reduce the hydraulic conductivity of mining waste soils contaminated with heavy metals. Various scenarios such as curing temperature, duration, cementation concentration and degree of compaction have been proposed to optimize the effectiveness of the treatment.