Geochemical Evaluation of Contaminated Soil for Stabilisation Using Microbiologically Induced Calcite Precipitation Method

ABSTRACT

Abandoned mines contaminated with heavy metal wastes pose health risk and environmental hazard. Common methods in managing these wastes include pond storage, dry sacking, underground and ocean disposal and phytho-stabilisation but these does not address the associated risks regarding migration of contaminated liquid or when the soil structure is compromised during natural disaster such as earthquake. Due to these limitations, microbiologically induced calcite precipitation method (MICP) is an exciting alternative as it is sustainable and environmentally friendly. This research evaluates mine waste obtained from two sites; Mamut and Lohan Dam, both located at earthquake-prone Ranau Sabah, Malaysia, in term of their physical, mineralogy and morphological characteristics for stabilisation using MICP. Physically, mining wastes from Mamut are of well graded soil with sand (53.9%) and gravel (43.5%), classified as SW (USCS) and A-1-a (AASHTO). Meanwhile, waste from Lohan Dam are of sand (49.9%) and gravel (10.1%), classified as SM (USCS) and A-4 (AASHTO). Constant head test of the soils from the sites showed results of 3.607 x 10-1 and 3.407 x 10-2 cm/s respectively indicate high permeability. Mineralogy assessment using inductively coupled plasma atomic emission spectroscopy (ICP-OES) showed high level of iron (Fe) with 528.08 and 2931.38 mg/L respectively. Other heavy metals detected include copper (Cu), 24.39 and 4.33 mg/L, lead (Pb), 2.53 and 0.53 mg/L, manganese (Mn), 5.71 and 3.64 mg/L and arsenic (As), 0.71 and 0.31 mg/L; some higher than Malaysia's Ministry of Health and United Nations' Food and Agricultural approved standards. Morphological observation of the size, shape and soil texture under scanning electromagnetic (SEM) further indicate the necessity and suitability of both sites for stabilisation using MICP.