

## **Geotechnical and Geochemical Assessment of Mine Wastes from Sabah, Malaysia for Biocementation Improvement**

### **ABSTRACT**

Mining wastes are known to be harmful to the environment especially when unregulated, untreated, or abandoned. The first step in their remedial action is the characterization of the geotechnical properties. The aim of this research is to investigate the properties of two Copper mine wastes obtained from Lohan and Bongkud in Sabah, Malaysia, for potential biocementation treatment. The methodology includes soil classification, determination of engineering properties, geochemical properties, and microstructure fabric. Classification results indicated that while both soils can be classified as SM and A-4 according to USCS and AASHTO respectively, Lohan waste has higher coarse-grained particles (69.8%) compared to Bongkud (58.1%). Both soils have a low liquid limit ( $LL < 50$ ), low plasticity ( $PI < 7$ ) and low liquidity ( $LI < 1$ ), and a close range of specific gravity (2.65-2.71). However, Bongkud has higher pH (5.27) and natural moisture content (28.14%) due to its higher organic content (1.27%). In terms of engineering properties, Lohan and Bongkud have MDD at 1640 and 1700 kg/m<sup>3</sup> and OWC at 16 and 15%, respectively, with low cohesiveness and a high angle of friction. With hydraulic conductivity,  $k$  falls within the range of 10<sup>-2</sup> cm/s, and these soils are classified as having a medium degree of permeability. Geochemical analysis indicated the presence of nine heavy metal elements with Pb (0.535 mg/L) and Ni (1.092 mg/L) exceeded the safety level in Lohan and Bongkud, respectively. SEM analysis shows both soils have a high degree of disorientation. In conclusion, both soils can be benefitted from biocementation treatment due to the SM classification, medium degree of permeability, and high heavy-metal contaminations.