

Physicochemical and Microstructural Characterization of Klias Peat, Lumadan POFA, and GGBFS for Geopolymer Based Soil Stabilization

ABSTRACT

Peat soils are highly heterogeneous and considered problematic because they have a high moisture content and low shear strength. It requires stabilization to enhance its engineering properties before it is transformed into a viable construction material. The use of geopolymers as stabilizer materials for weak soils has been on the rise recently due to their low carbon footprint compared to the use of conventional stabilizer materials like cement. Geopolymerization occurs as a result of the alkali activation of aluminosilicate materials. In this study, peat soil and the aluminosilicate materials Palm Oil Fuel Ash (POFA) and Ground Granulated Blast Furnace Slag (GGBFS) are characterized to assess their suitability as geopolymer precursor materials. A series of laboratory studies were carried out to determine the physicochemical properties of the materials, such as particle size distribution, moisture and organic content, specific gravity, pH, and electrical conductivity. Furthermore, the XRD, XRF, and FESEM tests were carried out to ascertain the mineral characteristics, elemental chemical composition, and morphological characteristics of these materials, respectively. The peat soil is classified as hemic peat with sufficient aluminosilicate content (Si/Al ratio of 2.11). The POFA is identified as Class F pozzolan with adequate Si+Al+Fe oxide content (67.9%), as stipulated by ASTM C618. The GGBFS material was found to be appropriate for geopolymer production, with a Si/Al ratio of 2.17, a hydration modulus of 2.38 (good hydration), and a basicity coefficient of 1.32 (alkaline material favorable for geopolymerization). Based on the geopolymer precursor material suitability assessment criteria, all the materials assessed were deemed suitable for geopolymerization, and the effectiveness of POFAGGBFS geopolymer to improve peat soil properties should be studied in depth. At present, there are limited studies pertaining to the use of alkali-activated POFA-GGBFS blends to improve peat soil properties. As a result of this material characterization phase, planned works involving the compressive strength testing program on alkali-activated POFAGGBFS-peat soil blends at ambient temperature will be carried out in the near future. The eventual aim of this research is to remediate the peat soil to be repurposed as road subgrade material.