

The Effect of Fly Ash Based Geopolymer on the Strength of Problematic Subgrade Soil with High CaO Content

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Abstract:

The weak subgrade soil is one of the major challenges for civil engineering applications such as roads and foundations. This study aims to find out the influence of fly ash-based geopolymer on the strength of weak soil to fulfill the requirements of the subgrade layer in the pavement structure. Fly ash particles of class F was used as a raw material for geopolymer synthesis. The alkaline liquid consists of the Sodium hydroxide (NaOH) at 8 molar solution and Sodium silicate Na_2SiO_3 in liquid form and the ratio of NaOH: Na_2SiO_3 remained constant at 60:40 by weight. Low plasticity sandy silt was utilized in the study and stabilized using various proportions of fly ash (5, 10, 15, 20, 25, and 30%). Laboratory investigation involves the compaction properties of soil-fly ash mixtures in addition to the mechanical properties including the Unconfined Compressive Strength (UCS) test and the Indirect Tensile Strength (ITS) test. The UCS test results revealed that the compressive strength of the soil greatly improved after adding the fly ash-based geopolymer and 20% of fly ash content achieved the highest UCS at 28 days of curing time. The ITS test results exhibited a progressive increase in the tensile strength of the soil with fly ash geopolymer, which corresponds to a great resistance for cracking in the soil. Geopolymer gel was observed in the stabilized soil, as confirmed by the SEM analysis.