Model study of alkali-activated waste binder for soil stabilization

ABSTRACT

This study assesses the laboratory investigation to evaluate the feasibility of using alkaline activation technique for engineering improvement of soils. The originality of this paper stems from the novel two-stage approach. The first stage investigates the effectiveness of locally available precursor in the alkaline activation process by focusing on soil strength improvement. As such, in presence of high alkali solutes (Na-based and Ka-based alkaline activators), palm oil fuel ash (POFA) was used as a precursor due to its amorphous nature and high silica-to-alumina ratio. In the second stage of this study, geotechnical model procedure of interaction between a strip footing model and stabilized soil by column technique and the most effective percentage of POFA was performed. According to the test results, applying alkaline activators to soil induced low strengths of up to 159 kPa after 7 days curing. When the POFA content used in alkaline activation increased from 0 to 15%, the UCS values increased up to 226% after similar curing duration. This assertion reflects the fact that the addition of POFA enriched the reactive Si and Al in the matrix, which allowed stronger Si–O–Si and Al–O–Si bonds to form. Curing condition, type and quantity of the alkaline activators were also shown to have significant strengthening effects on the treated soil. In this respect, the use of moderate 10 M NaOH and 10 M KOH were found to be viable as the best concentration for strength improvement of investigated soil when economy and practicality were considered. In terms of using alkali-activators, the use of the NaOH for soil treatment is beneficial in terms of lower cost, since the price of KOH solution is higher than that of the NaOH solution. Results of the second phase showed that a considerable settlement reduction up to 192% of treated columns by means of alkaline activation could be achieved.

Keyword: Soil stabilization; Alkaline activation; Waste materials; Deep mixing method