Geopolymer-stabilized pond ash as viable pavement material

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Abstract

Huge quantities of pond ash (PA), left unutilized in ash ponds without any practical application due to its poor pozzolanic/cementitious properties. For effective utilization of PA as a subbase and base materials in pavements, it has been treated with conventional stabilizers such as cement, lime and gypsum. However, the environmental issues with conventional stabilizers raised the necessity of using alternative eco-friendly stabilizers. Hence, in this study, PA is stabilized with different proportions of geopolymer (3%, 6%, 9%, 12%, and 15%), and laboratory investigations are made to assess its mechanical and microstructural properties. Based on the results, the suitability of stabilized PA as a cementitious subbase (CTSB) and cementitious bases (CTB) of flexible pavement is assessed. Thereafter, pavement design is carried out using IITPAVE software for higher traffic load conditions. The stabilized PA achieved lower optimum moisture content, higher maximum dry density, and higher unconfined compressive strength (UCS) with the inclusion of geopolymer content due to the formation of cementitious products (C-S-H, C-A-S-H, and N-A-S-H) in the compacted matrix. As per IRC: 37-2018, PA stabilized with 3% and 6% geopolymer content satisfied the requirements of CTSB materials of flexible pavement, while 9%, 12%, and 15% geopolymer content satisfied the requirements of CTB materials. The overall thickness of the pavement is significantly reduced by using stabilized PA as CTSB and CTB materials when compared to granular subbase and base material. Hence, this study recommends the use of geopolymer-stabilized PA for sustainable construction practices.

Keywords: Pond ash; Geopolymer stabilization; Strength properties; Cementitious subbase and base; Pavement thickness.

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