Sludge

Macro-micro investigation on stabilization sludge as subgrade filler by the ternary blending of steel slag and fly ash and calcium carbide residue

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Abstract

This study investigates the efficacious utilization of sludge as a subgrade filler through in -situ shallow stabilization, employing cementitious industrial waste materials including steel slag (SS), fly ash (FA), and calcium carbide residue (CCR) as binding agents. The primary emphasis lies in the evaluation of the macro unconfined compression strength of stabilized sludge over a seven-day curing period, facilitated by a quadratic polynomial response surface model to determine the optimal composite stabilizer (WZ01) proportions. Furthermore, an array of meticulous microstructural analyses encompassing X-ray diffraction, X-ray fluorescence, scanning electron microscopy, and energy -dispersive spectroscopy were undertaken to elucidate the development of internal cementitious products and the intrinsic mechanisms underpinning sludge stabilization in tandem with WZ01. The findings ascertain that the optimum WZ01 composition stands at SS: FA: CCR = 32:28:40. Prominent mineralogical constituents within the stabilized sludge encompass amorphous calcium silicate hydrate, calcium aluminate hydrate, and crystalline ettringite. The amelioration in stabilized sludge properties stems from intricate processes involving ion exchange, hydration reactions, and pozzolanic activities. Significantly, the WZ01 curing agent demonstrates heightened cost-effectiveness and environmental merits compared to conventional Portland cement.

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