SUSTAINABLE REUSE OF HEAP LEACH MINE WASTE AS CONSTRUCTION MATERIAL

MWV-033

https://dx.doi.org/10.4314/just.v44i2.17s

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Abstract:

The closure of the South and North Heap Leach Facilities at Gold Fields Ghana Limited created an opportunity to evaluate the reuse potential of heap leach residues as sustainable construction materials rather than adopting conventional reclamation approaches. This study presents a comprehensive assessment of heap leach materials sampled from multiple pad locations within the Tarkwa Mine. Laboratory investigations included X-ray fluorescence (XRF), compressive strength testing, sodium sulphate soundness, and alkali-silica reactivity analyses to determine the engineering and environmental suitability of the materials for construction applications. Results showed that the combined SiO2 + Al2O3 + Fe2O3 contents of all samples exceeded the ASTM C618 minimum requirement for natural pozzolans, indicating potential suitability as supplementary cementitious materials. Residual cyanide concentrations ranged from 0.14 to 0.30 mg/kg, significantly below internationally accepted limits, while heavy metal concentrations, including arsenic, chromium, and lead, remained within permissible environmental thresholds. Concrete specimens produced using the heap leach materials as aggregates achieved compressive strengths corresponding to concrete classes C7.5–C30 after 28 days of curing, with cement additions equivalent to 50–100% of the cement content required for conventional 1:2:4 concrete mixes. The findings demonstrate the feasibility of repurposing heap leach residues as alternative construction aggregates and supplementary cementitious materials, providing a sustainable mine closure strategy that supports waste valorization, resource efficiency, and circular economy practices in the construction and mining sectors.

Keywords: Heap leach waste, construction aggregates, pozzolan, compressive strength, alkali-silica reactivity, sustainable mining.