Investigation of synergistic potential of Fly Ash and Foundry Sand Waste in Sustainable Concrete Production for African Infrastructure

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Abstract

The effective utilization of waste resources from one sector to another has contributed towards the sustainable management of solid waste, development of new products and advancement in the field of material science. This study investigates the feasibility and efficacy of incorporating industrial waste streams, specifically Type C Fly Ash (FA) and Foundry Sand Waste (FSW), into concrete formulations to enhance sustainability within the African construction sector. The research aims to evaluate the impact of these secondary materials on the mechanical properties and water absorption characteristics of concrete, thereby assessing their potential for practical application in infrastructure development. A rigorous material characterization approach, encompassing Fineness Modulus determination, Scanning Electron Microscopy (SEM), X-ray Diffraction (XRD), and X-ray Fluorescence (XRF) analyses, was employed to elucidate the physical and chemical properties of FSW. Concrete specimens were fabricated with varying FSW replacement levels (25% and 50%) while maintaining a constant 30% FA substitution and subsequently subjected to compressive strength, split tensile strength, and water absorption tests at 7, 14, and 28 days of curing. The research produced some interesting results, and it was observed that the strength of the concrete is reduced as more FSW is added to the concrete mix. However, the strength still meets the acceptable standard and proves suitable for application on light-trafficked roads.