



Partial replacement of cement in concrete using rice husk ash and raw Ebonyi shale

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The cement industry contributes significantly to global CO₂ emissions and faces rising costs, especially in developing countries like Nigeria. This study tends to investigate a sustainable alternative by partially replacing Ordinary Portland Cement with a binary blend of locally sourced admixtures which are Rice Husk Ash (RHA) and Raw Ebonyi Shale (RES) in equal proportions. An M15 concrete mix (1:2:4) with a 0.5 water-cement ratio was used. Cement was replaced at 5, 8, 11, 14 and 17% levels. Tests evaluated fineness, workability (slump), setting time, and compressive strength at 7, 14, and 28 days. Results showed the RHA + RES blend was coarser (39.85% fineness) than cement. The workability tends to generally decreased with higher amount of replacement, except at 5% (slump 40 mm vs. control 30 mm). In the settings time, the initial setting time was slightly faster (44 min vs. 38 min). Then on the strength test, compressive strength reduced as replacement increased and the 5% blend comes out to achieved the highest 28-day strength of 14.24 N/mm² which is like 85% of control's which is 16.74 N/mm². The study concludes that 5% replacement with equal parts RHA and RES is optimal, offering acceptable workability and strength while significantly reducing cement use, costs, and environmental impact. This approach promotes sustainable construction using abundant local waste and natural materials in Nigeria and the world at large.

Keywords: Rice husk ash (RHA), raw Ebonyi shale (RES), sustainable concrete, cement replacement, compressive strength.
