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Optimising Pozzolanic Ash Extraction from Mumias Sugarcane Bagasse for Concrete Applications in Western Kenya

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Abstract

The construction sector in Western Kenya contends with the high cost and environmental footprint of cement. Sugarcane bagasse ash (SCBA) from the Mumias factory is an abundant agricultural waste with known pozzolanic properties, but locally effective parameters for its processing are not established. This intervention study aimed to optimise the calcination parameters for extracting pozzolanic ash from Mumias sugarcane bagasse. The objectives were to determine the ideal combustion temperature and duration to maximise amorphous silica content and the pozzolanic activity index (PAI) for use in concrete. Controlled combustion trials were conducted on bagasse samples using a muffle furnace. A factorial design varied temperature and residence time. The resulting ashes were analysed for chemical composition, loss on ignition, and particle size. Pozzolanic activity was assessed by measuring the strength activity index with Portland cement. Ash produced at 600°C for 2 hours exhibited the highest pozzolanic activity, achieving a 28-day strength activity index of 94%. Combustion above 700°C caused a significant reduction in reactive silica due to crystallisation, lowering the PAI below 75%. The calcination parameters significantly influence the pozzolanic quality of Mumias SCBA. Optimal ash for concrete supplementation can be reliably produced under controlled, moderate-temperature conditions. Local ash producers should adopt a controlled

combustion regime targeting 600°C for approximately 2 hours. Further research should assess the long-term durability of concrete incorporating this optimised SCBA. sugarcane bagasse ash, pozzolan, calcination optimisation, supplementary cementitious material, agricultural waste, concrete This study provides locally derived, optimal calcination parameters for producing pozzolanic ash from Mumias sugarcane bagasse, offering a standardised method to utilise this agricultural waste in concrete for Western Kenya.