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An Evaluation of the Feasibility of Several Industrial Wastes and Natural Materials as Precursors for the Production of Alkali Activated Materials

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Abstract : In order to face current compelling environmental problems affecting the planet, the construction industry needs to adapt. It is widely acknowledged that there is a need for durable, high-performance, low-greenhouse gas emission binders that can be used as an alternative to Portland cement (PC) to lower the environmental impact of construction. Alkali activated materials (AAMs) are considered a more sustainable alternative to PC materials. The binders of AAMs result from the reaction of an alkali metal source and a silicate powder or precursor which can be a calcium silicate or an aluminosilicate-rich material. This paper evaluates the particle size, specific surface area, chemical and mineral composition and amorphousness of silicate materials (most industrial waste locally produced in Ireland and Saudi Arabia) to develop alkali-activated binders that can replace PC resources in specific applications. These include recycled ceramic brick, bauxite, illitic clay, fly ash and metallurgical slag. According to the results, the wastes are reactive and comply with building standards requirements. The study also evidenced that the reactivity of the Saudi bauxite (with significant kaolinite) can be enhanced on thermal activation; and high calcium in the slag will promote reaction; which should be possible with low alkalinity activators. The wastes evidenced variable water demands that will be taken into account for mixing with the activators. Finally, further research is proposed to further determine the reactive fraction of the clay-based precursors.

Keywords : alkali activated materials, alkali-activated binders, sustainable building materials, recycled ceramic brick, bauxite, red mud, clay, fly ash, metallurgical slags, particle size, chemical and mineral composition and amorphousness, water demand, particle density

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