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Eco-Efficient Cementitious Materials for Construction Applications in Ireland

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Abstract : Concrete is the second most widely used material in the world and is made of cement, sand, and aggregates. Cement is a hydraulic binder which reacts with water to form a solid material. In the cement manufacturing process, the right mix of minerals from mined natural rocks, e.g., limestone is melted in a kiln at 1450 °C to form a new compound, clinker. In the final stage, the clinker is milled into a fine cement powder. The principal cement types manufactured in Ireland are: 1) CEM I – Portland cement; 2) CEM II/A – Portland-fly ash cement; 3) CEM II/A – Portland-limestone cement and 4) CEM III/A – Portland-round granulated blast furnace slag (GGBS). The production of eco-efficient, blended cement (CEM II, CEM III) reduces CO_2 emission and improves energy efficiency compared to traditional cements. Blended cements are produced locally in Ireland and more than 80% of produced cement is blended. These eco-efficient, blended cements are a relatively new class of construction materials and a kind of geopolymer binders. From a terminological point of view, geopolymer cement is a binding system that is able to harden at room temperature. Geopolymers do not require calcium-silicate-hydrate gel but utilize the polycondensation of SiO_2 and Al_2O_3 precursors to achieve a superior strength level. Geopolymer materials are usually synthesized using an aluminosilicate raw material and an activating solution which is mainly composed of NaOH or KOH and Na_2SiO_3. Cement is the essential ingredient in concrete which is vital for economic growth of countries. The challenge for the global cement industry is to reach to increasing demand at the same time recognize the need for sustainable usage of resources. Therefore, in this research, we investigated the potential for Irish wastes to be used in geopolymer cement type applications through a national stakeholder workshop with the Irish construction sector and relevant stakeholders. This paper aims at summarizing Irish stakeholder's perspective for introducing new secondary raw materials, e.g., bauxite residue or increasing the fly ash addition into cement for eco-efficient cement production.

Keywords : eco-efficient, cement, geopolymer, blending
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