Geopolymer Technology: The Formation of Cost-Competitive Construction Materials by the Alkali-Activation of Coal Ash

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ABSTRACT

Inorganic polymers (referred to as geopolymers) have emerged as novel engineering materials with the potential to form the basis of a new and environmentally sustainable construction materials and building products industry. These materials are formed by the alkali activation of industrial by-products such as coal ash (Class F and/or Class C), and blast furnace slag. Geopolymeric materials derived from coal ash can exhibit superior chemical and mechanical properties to ordinary Portland cement counterparts. In addition to the formation of conventional pre-cast or architectural products, these high performance mineral binders are well suited for the encapsulation of mine tailings, the immobilisation of heavy metals, and the paste back-filling of mines. A key attribute to the technology is the robustness and versatility of the manufacturing process; it enables products to be tailor made from a range of coal ash sources and other alumino-silicate raw materials so that they have specific properties for a given application at a competitive cost (eg. high strength concrete; fire & acid resistant coatings etc). Despite these key technical and environmental attributes, it is the ability to add significant value to coal ash waste streams which drives the commercial development and uptake of the technology. The present paper discusses geopolymer technology with emphasis on the manufacturing of useful geopolymeric products from coal ash. The current challenges faced by workers in the geopolymer field as well as the commercial application of inorganic polymer technology are highlighted and discussed.

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