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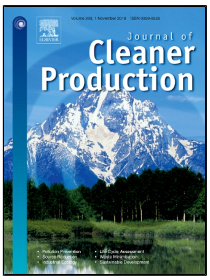

Macro- and Nanomaterials for Improvement of Mechanical and Physical Properties of Cement Kiln Dust-Based Composite Materials

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Abstract

In parallel with the progressing technological improvements witnessed in cement industry, nuclear industry also faces the need to address the prevailing issue of handling radioactive waste. Waste management is among the major environmental concerns all around the world, which need optimization in order to preserve our planet. The objective of the present study is getting rid of the hazardous waste cement kiln dust in an advanced fashion; in parallel, this material is upgraded by blending it with proper additives to produce a modified paste suitable for stabilization of radioactive waste in the future. This study presents an in-depth investigation covering incorporation of different additive materials individually or as mix of two constituents with cement kiln dust as the matrix material. Mechanical properties like compressive strength and porosity of the hardened cement kiln dust and modified composites were assessed. Moreover, the physical appearance of the produced blocks including Portland cement or some by-products such as slag and silica fume, as well as nano-materials (nano-sized alumina, silica, titanium dioxide, calcium oxide, zinc oxide) was evaluated. We demonstrate that adding merely 0.1 % of nanomaterials to 20% slag increases the mechanical integrity of the solidified cement kiln dust samples fourfold (more than 12 MPa). Based on the experimental results, a new composite of cement kiln dust and nano-silica are proficient materials with significant ecological and economical advantages for constructions applications, and should be suitable for safe stabilization of radioactive waste in forthcoming studies.

Key words: cement kiln dust, nanomaterials, by-products, waste management, hazardous wastes