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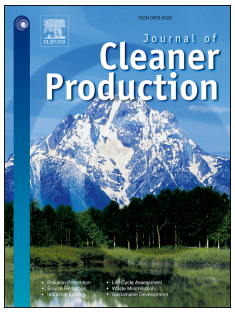

The environmental credentials of hydraulic lime-pozzolan concretes

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The environmental credentials of hydraulic lime-pozzolan concretes

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Abstract:

This research considers the compressive strength, embodied CO_2, embodied energy and binder intensity of hydraulic lime-pozzolan concretes, in comparison with those of Portland-cement based concretes of equivalent 28-day compressive strength.

Production of a lime-pozzolan concrete with a 28-day cube strength of approximately 50 MPa and an elastic modulus of 20GPa has demonstrated the feasibility of producing modern, structural grade hydraulic lime-pozzolan concretes. Furthermore, construction and testing of two reinforced lime-pozzolan concrete beams has demonstrated the possibility of producing structural elements with a finished appearance and flexural behaviour similar to Portland cement concrete. This paper reflects on the value of this new material's technological progress in the context of the industry wide search for low carbon cements.

Results of the research reported in this paper demonstrate that the use of aluminosilicate by-products, specifically ground granulated blastfurnace slag and silica fume, in combination with naturally hydraulic lime can realise savings in environmental impact; but that the savings are both future-orientated and highly dependent on the boundaries of the analysis. When considering only the secondary impacts of ground granulated blastfurnace slag and silica fume production, a ternary combination was observed to result in a lime-pozzolan concrete with a 28-day cube strength of 33MPa and an embodied-CO_2 of 95 $kgCO_2/m^3$, 64% lower than a CEMI, and 41% lower than a CEMIII/A concrete of equivalent strength. Both mass and economic allocation procedures were, however, shown to have a very detrimental effect on the environmental credentials of silica fume and thus also on hydraulic lime-concretes containing this pozzolanic addition.

It is recognised that technical performance alone cannot be used to assess or compare the merits of any new material. This paper focus on the production, environmental impact and long-term availability of individual constituents of this novel binder, with a view to addressing important questions about the viability and desirability of re-producing this novel cementitious system in a commercial setting. Such information is acknowledged to be critical in the dialogue about the potential adoption and development of this emerging binder technology.

Keywords: *Sustainability, hydraulic lime-pozzolan concrete, binder intensity, embodied CO_2, embodied energy*