

ALKALI ACTIVATED BINDERS COMBINED WITH CONSTRUCTION AND DEMOLITION WASTES: VALUABLE RESOURCES FOR GREEN BUILDING MATERIALS

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Research on Alkali Activated Binders (AAB), among them those from industrial by-products e.g. Pulverised Fuel Ash (PFA) from coal-fired power stations and Ground Granulated Blast-Furnace Slag (GGBS) obtained by quenching molten iron slag, gained considerable attention as an eco-sustainable alternative to Ordinary Portland Cement (OPC) for use in mortars/concretes. Alkali activated binders are materials with the potential to provide high-performance alternatives to conventional cements, while contributing to the sustainability and costs reduction of the built environment. These binders, compared with conventional cements, have a lower embodied energy and CO₂ footprint and also exhibit good physical, mechanical and durability properties. Alkali activated cements are capable of meeting or exceeding performance requirements specified in construction applications [1].

Construction and Demolition Wastes (CDW) management have been identified by the European Commission as a priority target. An effective way to release the environmental pressure of CDW is their recycling in the construction sector, thus limiting their disposal and avoiding, at the same time, the consumption of non-renewable resources for building materials development. These wastes, among the most significant waste streams in EU, includes materials such as concrete, bricks, tiles, gypsum, wood, glass, metals or plastics. EU members, according to the Waste Framework Directive 2008/98/EC, are obliged to take all the necessary measures to reuse, recycle or recover a minimum of 70% (by weight) of the non-hazardous CDWs by the end of 2020. RE4, an European project founded by the European Commission in the framework of H2020 Research and Innovation Program, specifically focus on the integration of CDW in the production cycle of building materials. The Project promotes new technological routes and solutions for the development of eco-compatible, cost-effective pre-fabricated components and elements with high degree of materials recycled from CDW [2].

This work outlines research activities, carried out in the framework of RE4 project, on the development of normal and lightweight alkali activated mortars consisting of a PFA/GGBS binder combined with fine aggregates recycled from CDW (e.g. mineral fractions, heterogeneous rigid plastics, mixed wood and plastics - a by-product from CDW recycling plants without specific applications and generally destined to landfills or incinerators). The aim of this study was the development and assessment of the PFA/GGBS binder compatibility with different CDW aggregates through cement-free mortars production. The materials, alumina-silicates precursors (PFA, GGBS) as well as CDW aggregates, have been fully characterized (e.g. morphological, chemical and physical testing). The design of the PFA/GGBS binder has been at first optimised and, then, combined with different CDW aggregates. The performance of the resulting mortars have been assessed both on fresh state and hardened state (e.g. slump flow, density, flexural strength, compressive strength). The innovative formulations developed in this study, integrating recycled materials used as both binders and aggregates, result in building solutions with improved sustainability and cost-efficiency.

[1] Alkali Activated Materials | State-of-the-Art Report, RILEM TC 224-AAM; Editors: Provis, John, van Deventer, Jannie (Eds.) 2014.

[2] RE4 "Reuse and Recycling of CDW materials and structures in energy efficient pREfabricated elements for building Refurbishment and construction" (call H2020-EEB-04, 723583) | Project web-site: www.re4.eu.