

ALKALI ACTIVATION FOR MANAGEMENT OF CONSTRUCTION AND DEMOLITION WASTES COMING FROM EARTHQUAKE

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The synthesis of room temperature alkali activated (AA) bricks based on construction and demolition wastes (C&DW) coming from 2016 central Italy earthquake rubble is reported in this contribution (Figure 1). This waste consists of inert debris, which can be exploited as precursors in the production of AA bricks and mortars due to its content of $\text{SiO}_2 + \text{Al}_2\text{O}_3 > 60\text{wt}\%$. Typology (based on Na and K) and correct molarity of alkaline activators, particle size (from 2 mm up to 250 mm) of C&DW and eventual addition of metakaolin were investigated. In particular, it has been evaluated the range from 25 to 40 wt% of the activating solution with respect to the solid matrix. Compressive strength and adhesion with concrete by means of three-point flexural tests were measured to evaluate the possible applications.

The experiments showed that Na-based activating solution, added in 25-30wt%, lead to the proper consolidation to obtain bricks or binder. On selected composition, chemical-physical characterization was performed, pH and conductivity to evaluate the chemical stability, porosity, density and SEM analysis to evaluate the physical properties. Furthermore, the possibility to lightweight the material by means of the addition of silver skin, the integument surrounding the coffee beans which, after the roasting process, becomes a by-product, has been studied. The amounts of 2.5 or 5wt% of coffee silver skin in AA bricks have been studied. The addition of silver skin leads to a decrease of density, an increase of porosity favouring the lightness of the material with a corresponding decrease of mechanical properties such as compressive strength.



Figure 2 – C&D waste before and after alkali activation

From the results of this investigation, the following considerations can be drawn:

- no separation pre-treatment of C&DW was necessary, a representative mix was successfully activated;
- no thermal treatment was applied on the C&DW mix; - the only treatment consisted in simple hammer-mill grinding;
- low % of Na-based activating solution (commercially available and low-cost) was used;
- curing step in air and at room temperature was sufficient to reach good consolidation after 28 days;
- lightweight materials can be obtained by using 2.5 wt% of biomass residue.