THE USE OF WASTE BRICKS AND TILES AS A PRECURSOR FOR ALKALI ACTIVATED BINDERS

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Construction and Demolition Waste (CDW) accounts for 25 % to 30 % of all waste generated in the European Union. The most common treatment of (CDW) in Europe, other than disposal, is backfilling with a very small amount being effectively reused. In an attempt to optimize the use of construction and demolition waste (CDW), potential recycling and reuse routes exist, with the most popular method being to use CDW as recycled aggregates in concrete. The remit of the RE^4 project is to develop innovative concepts for pre-fabricated energy-efficient buildings that can be easily assembled and dissembled for future use, containing up to 65 % in weight of recycled materials from CDW. One such solution would be to use bricks and tiles (BT) waste, collected from CDW, as a precursor for alkali activated binders. Presented here is the preliminary work carried out on alkali activated BT mortars, determining the most suitable activating solution to maximize strength development.

Two sources of recycled waste have been collected from Northern and Southern Europe. They were manually sorted and were found to contain 14 % and 27 % by weight of bricks and tiles waste respectively. Upon separation, the BT waste from both sources were ground together to form a fine powder to be used as a precursor for alkali activation.

Mortars were prepared to measure strength evolution (measured on 50 mm cubes), fixing the sand to binder ratio at 2.75. The activating solution made use of both NaOH and Na_2SiO_3, varying the alkali dosage M+ (M+ = Na_2O/BT) and alkali modulus AM (AM = Na_2O/SiO_2). The original water/solids (w/s) ratio was fixed at 0.37 and was increased in increments up to 0.45 to assess its impact on strength and workability. All specimens prepared with BT as the sole precursor were cured at 70°C to allow for setting and hardening. Mortars, prepared replacing up to 80 % of BT waste with GGBS by weight, were also tested and cured at ambient temperature.

Fig 1. Hand picked BT from CDW waste

Fig 2. Tested Mortar Cube Prepared from Ground BT Waste

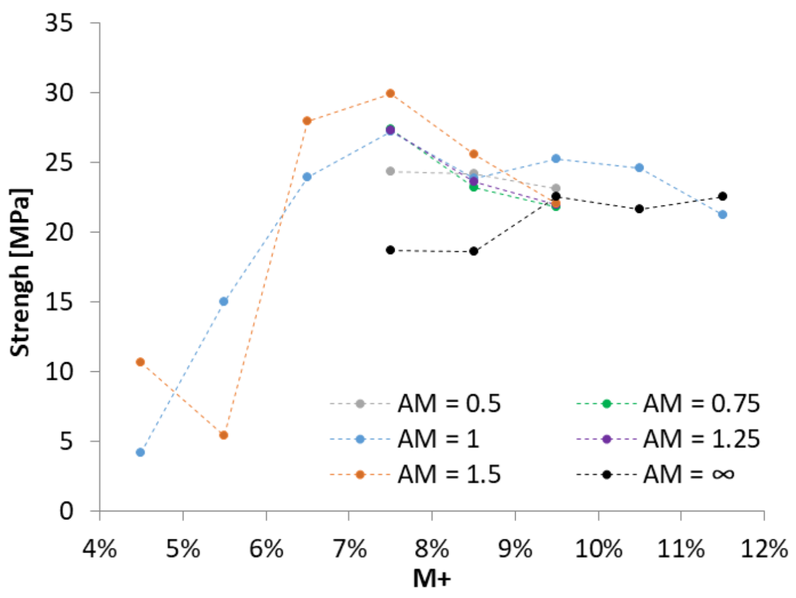

Fig 3. Effect of M+ for a Fixed AM on Strength (at 28 days)

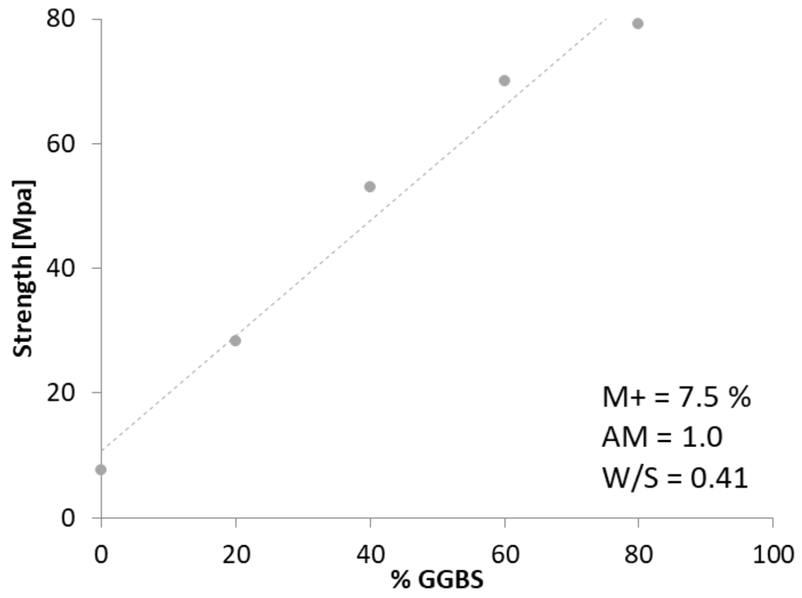

Fig 5. Impact of GGBS Loading on Strength (at 28 days)

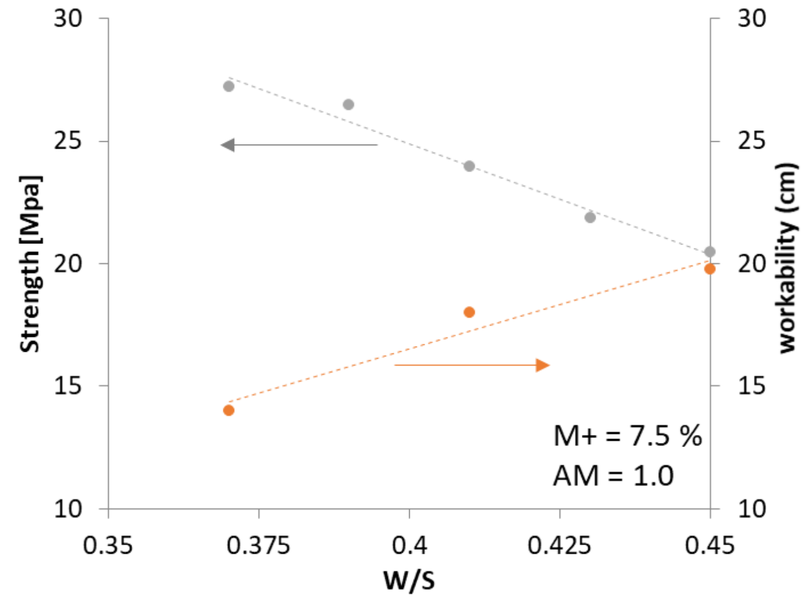

Fig 6. Impact of W/S on Strength and Workability (at 28 days)

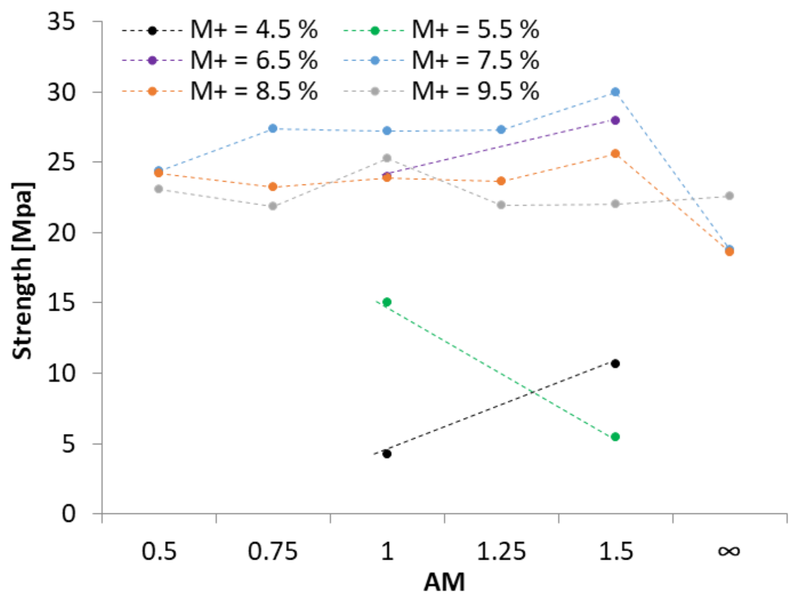

Fig 4. Effect of AM for a Fixed M+ on Strength (at 28 days)

• Influence of Activator

- For a fixed alkali modulus (0.5 < AM < 1.5) strength remained low for M+ ≤5.5 %. Strength increased to an ultimate value with increasing M+ up to 7.5 % and decreased thereafter.
- For mortars prepared with only NaOH as the activator (M+ = ∞), strength was typically lower for M+ =7.5 % and 8.5 %, but increased marginally at higher M+ values (≥9.5 %).
- The optimum activator was achieved with an **M+ of 7.5 % and an AM set at 1.5,** with mortar cubes reaching a strength of 30 Mpa.

• Influence of GGBS Loading

- The addition of GGBS allowed for setting and hardening of mortars at ambient temperatures.
- Strength increased linearly with GGBS loading, with a blend containing 80 % GGBS reaching 80 Mpa.

• Influence of W/S

- Strength decreased from 26 to 20 MPa as the W/S increased from 0.37 to 0.45.
- Workability increased with W/S, with the diameter of mortar pastes increasing when measured using the flow table test.

RE4

REuse and REcycling of CDW materials and structures in energy efficient pREfabricated elements for building REfurbishment and construction

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