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Testing the hardened properties of mortars prepared according to the Wet Packing Method: is this model truly successful?

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In a previous work [1], the workability of mortars with different binder-to-sand proportions was assessed by means of the "Wet Packing Method" (WPM), recently developed by Wong and Kwan [2]. By means of this model, it is possible to establish the optimum amount of water at which the packing density is achieved in granular mixtures, such as mortars. This allows preparing mortars with good workability, avoiding the errors made by using the less realistic indirect methods (e.g. determination of the bulk density of dry granular components and flow test).

Two types of mortars with calcitic lime and calcareous aggregate (CC) and different binder-to-sand proportions (by volume) were considered in this research, CC1:1 and CC1:3, because they showed (especially CC1:3) the best packing and the minimum amount of kneading water and the best workability of the fresh paste compared to other binder-to sand proportions.

The aim of this work is to verify the reliability of the WPM, i.e. to test out if CC1:3 is still the best mortar when it hardens, by studying the mineralogical, textural and mechanical properties of these two mortars after six months of carbonation.

The use of a lower amount of water during the preparation of CC1:3 gave place to a lower porosity (about 25%) with respect to CC1:1 (about 35%). The pores size distribution is the same in both mortars, because they have the same composition. The volume of the main pores ($0.1<r<1$ μm) in CC1:1 is twice that of CC1:3, whilst the small pores ($r = 0.03$ μm) have similar volume in both mortars, being a bit higher in CC1:1.

The carbonation degree (measured according to the decrease in portlandite amount) is about 40 % in CC1:1, both in the external and the internal zone. On the other hand, due to the lower porosity of CC1:3, CO2 diffusion within this mortar is harder, with the consequence that the interior of CC1:3 is much less carbonated than the surface.

By means of the mechanical study, we obtained lower compressive and flexural strengths for CC1:3 mortar because the increase in the amount of aggregate, even if the porosity decreases, reduces mortars mechanical strength [3].

On the basis of these results, we do not consider the WPM a satisfactory method to be adopted for the preparation of aerial lime mortars. In fact, although in a previous study on fresh mortar properties WPM was considered more realistic and effective than other methods for the achievement of an optimal mortar consistence, here its reliability has been put in doubt by the poor quality of CC1:3 mortar once hardened.

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