11th International Conference on Advanced Materials
Rio de Janeiro Brazil
September 20 - 25
ICAM2009

Gypsum hemihydrate-cement blends: are they possible?

G. Camarini[(1)*], J. A. De Milito[(2)],

(1) LMC, LARES, of Campinas, Department of Architecture and Construction, School of Civil Engineering, Architecture and Urban Design, Cidade Universitária Zeferino Vaz, s/n, CP 6021, CEP 13083-970,
(2) Faculdade de Engenharia de Sorocaba – FACENS,
* Corresponding author.

Abstract: Calcined gypsum is a historical binder that was used already several thousands years ago. More recently its employ in construction has a significant grow, but its use is restricted to internal use due to its solubility. The aim of this work was to investigate the effect of cement addition to gypsum and observe the changes in mechanical properties and microstructure to improve gypsum performance. Results show an improvement of gypsum performance when cement is added to the mixture. SEM analysis showed a more compact structure which can result in a more resistant composite.

Portland Cement and hemihydrate ($CaSO_4$ ½H_2O) are binders used extensively in construction and for production of building components. Portland cement has a good performance when in contact with water. On the other hand, hemihydrate has limited use because it is sensible to water. Mixing hemihydrate and Portland cement is usually unfeasible because when in contact with water an expansive reaction can occur by the formation of ettringite or thaumasite, leading to deterioration of components [1].

Hemihydrate and hemihydrate-cement mixtures were studied in this work: 100% hemihydrate (A1 and A4) and 75% by mass of hemihydrate plus 25% of Portland cement (A2 and A5). Portland cement type CPIII (blastfurnace slag Portland cement) and calcium sulfate hemihydrate of β-type were used. The water/binder ratio was 0.70. Superplasticizer was incorporated into the A2 and A5 mixes in order to achieve proper dispersion of the binders and to improve workability. The mixes were hand-mixed during 1 min. and cast in cylindrical forms. After that they stayed in two environments: internal (indoors) and external (outdoors). Compressive strength tests were carried out at 28, 180 and 1080 days. Microscopic examinations were carried out on fresh fractures of specimens using a Scanning Electron Microscope (SEM) (JSM-5900LV). Compressive strength results are shown in Figure 1 and SEM images on Figures 2 and 3 [2].

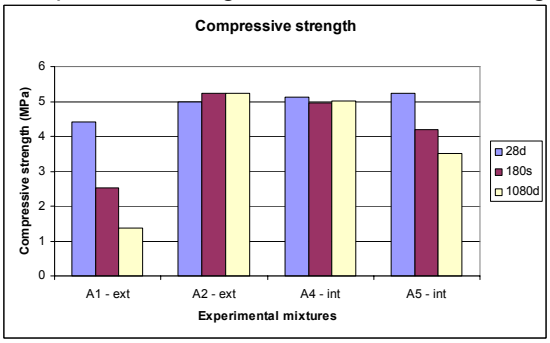
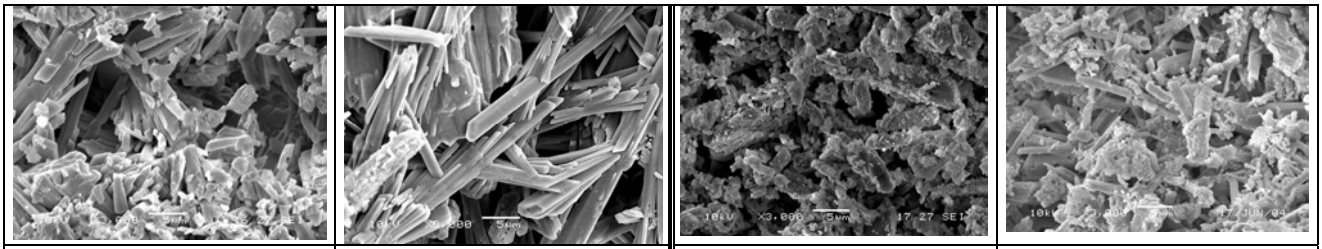


Figure 1: Compressive strength results

Compressive strength results show a significant difference between hemihydrate mixtures and hemihydrate-cement ones. Hemihydrate mixtures in external environment show a low performance and compressive strength diminishes with time. The same mixtures in internal environment also diminishes compressive strength, but with less intensity. When cement is mixed with hemihydrate, this blend performance in external environment is similar to the performance of the same mixture in internal environment.

SEM images show a difference between crystal structures and dimensions. Hemihydrate crystals when in contact with cement are covered with hydration products. With these results it is to suppose that these blends can be possible in external renderings.



1a	1b	2a	2b

Figure 1: SEM images of gypsum paste in external environment - A1 (1a) and internal environment - A4 (1b).

Figure 2: SEM images of gypsum-cement paste in external environment – A2 (2a) and internal environment – A5 (2b).

[1] K. Kovler. Cement and Concrete Research, Vol. 28, No. 3 (1998), pp. 423–437.
[2] J. A. De Milito. PhD Thesis, University of Campinas, 2007 (in Portuguese).