Research of chemical additives to prevent wet creep of plasterboards using holographic interferometry

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Introduction

Wet creep of plasterboards is a known problem in industry, and mostly in regions with high humidity. ILM laboratory proved that creep is related to the dissolution of gypsum ($CaSO_4$, $2H_2O$): the main component of plaster. Holographic interferometry, an alternative technique, is set to measure dissolution and diffusion coefficient of gypsum in bulk water. Chemical additives, are added to the water to reduce the diffusion coefficient as much as possible. The aim of this article is to identify the most efficient additive.

Experimental procedures

J.Colombani has developed an experimental methodology, involving interferometric holography. An hologram of a transparent cell (9.5 x 10 x 40 mm3) containing the solution is created by this technique. A piece of gypsum (obtained from he cleavage along (101) plane of the crystal) is immersed in the bottom of that cell. The evolution of concentration induce a change of the refraction index n of the solution, and so an optical path difference. Using a program created with Matlab, the dissolution with the creation of interference fringes can be followed. From the evolution of the fringes, it is possible to calculate the concentration evolution in the cell c(z,t). Interferometric holography presents advantages: the dissolution of the gypsum is analyzed in quiescent water, and the solid-liquid interface is directly observed, without introducing going into the cell.

The measurement leads to 3 parameters:
- D = diffusion coefficient ($m^2.s^{-1}$)
- k = dissolution coefficient ($mol.m^{-2}.s^{-1}$)
- c_{sat} = gypsum solubility in solution

The aim of this study was to find a chemical additive that can reduce the dissolution coefficient. Composition of solution: 99% water, 1% additive.

The active components of the additives are different, but works in the same way: the acid phosphonic or phosphonate groups are bounded with Ca^{2+} to build complexes. The phosphonates groups adsorb at the surface and hinder the detachment (and attachment) of Ca^{2+} and SO_4^{2-} (Pachon-Rodriguez and Colombani, 2012).

Conclusion

Two efficient additives were identified: CM 1201 and Vebe DP 885S. The dissolution coefficient is ten times lower than in pure water. The standard deviation is too big (±20%) because of too few experiments, so this study must be continued.

Figure 1 : Holographic interferograms of the dissolution of a gypsum single crystal in water 10, 60, 120, 180, and 360 min

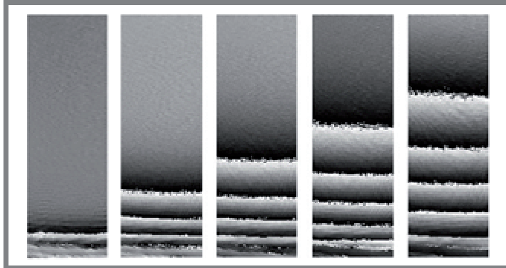
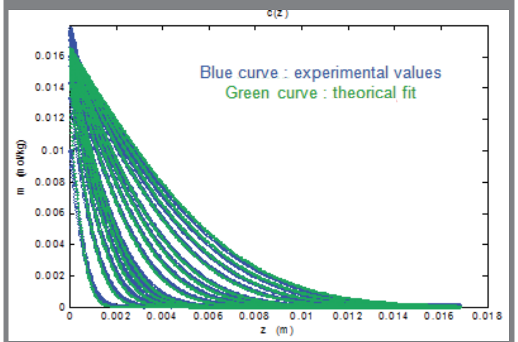


Figure 2 : Evolution of the dissolved gypsum concentration versus vertical position for the holographic interferograms of the experiment.



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