Hydraulic Cement Comprising Amine-functionalized Nanoparticles

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The performance of cement composites has been traditionally improved by means of reactive additions, such as silica fume,[1] or inert reinforcements, such as steel bars or different types of fibres. This research project focuses on the production of a cement having improved properties, particularly strength, owing to the incorporation of organosilane molecules, and to the uses thereof. For this purpose, in this poster is related a method for obtaining nanoparticles of organosilane, specifically containing amine groups, and the addition thereof to cement in nanoparticle form, yielding an improved hydraulic cement in comparison with conventional Portland cement.

Previously, it was carried out the study and development of novel synthetic methodologies for the obtention of nanoparticles containing amine groups. A convenient single step (one-pot) method based on well-known Sol-Gel methodology,[2] particularly the Stöber method[3] was described for the preparation of these nanoparticles. As a result of this novel method, stable colloidal suspensions of monodisperse silica nanoparticles with pendant amines were successfully obtained; the size of these nanoparticles of 120 nm, as can be observed in the images obtained by Atomic Force Microscopy (AFM) (Fig 1).

The experimental results obtained have shown that nanosilica increases the strength of the cement paste about a 30% in cured samples (Fig 2).[4] At the level of the structure of the C–S–H gel, amine-functionalized silica nanoparticles increase the average length of the silicate chains and reduce their polymerization as calcium dissolves.

In addition, ^{29}Si CP/MAS NMR spectra of cement composites have been obtained (Fig 3). The information obtained provided a general and detailed picture of the nature of the cementitious matrix. This not only served to understand the effect of the use of reactive reinforcements, but it will also contribute to broaden the existing knowledge on the cement matrix.

References

[1] Bjornstrom, J; Martinelly, A; Matic, A; Borjesson, L; Panas, I; Chem. Phys. Lett. **392** (1–3) (2004) 242.
[2] Brinker. C.J.; Scherer G.W. (Eds.), "*Sol-Gel Science. The Physics and Chemistry of Sol-Gel Processing*", Academic Press, San Diego (1990)
[3] Stöber. W.; Fink. A.; Bohn. E.; *J. Colloid Interface Sci*., **26** *(*1968) *62*.
[4] Berriozabal. G; De Miguel. Y; Porro. A; Patent PCT_ES2008/000808

Figures

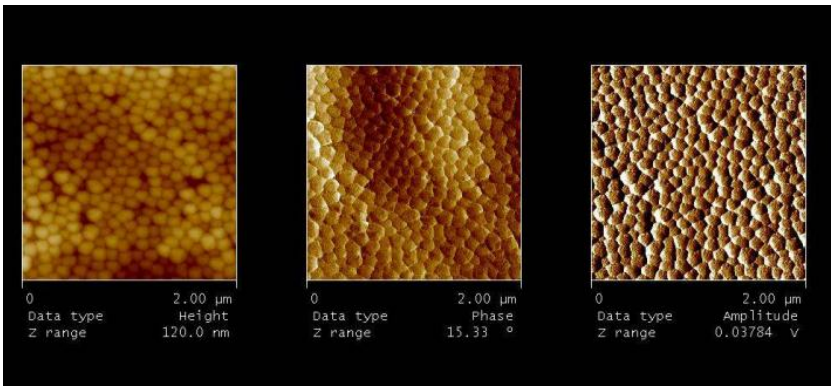

Fig. 1. AFM images of Aminepropyl-functionalized silica nanoparticles

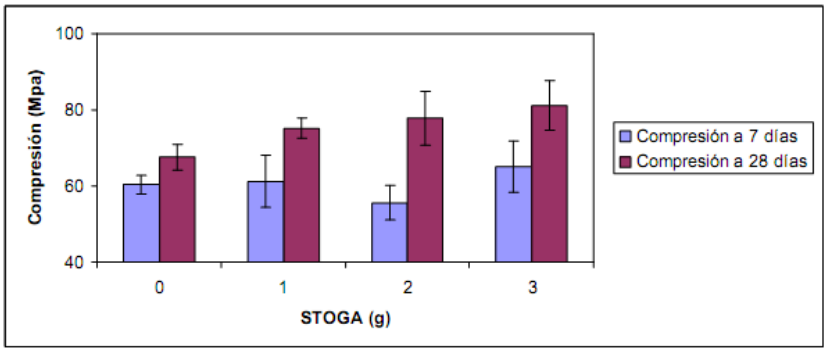

Fig. 2. Mechanical properties as measured by the compression tests.

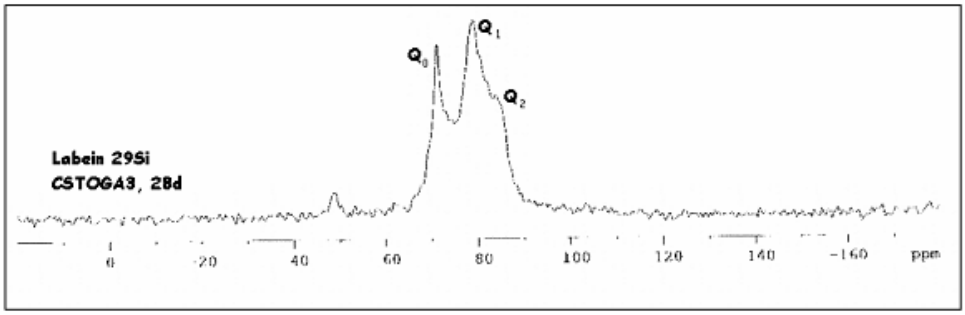

Fig. 3. ^{29}Si CP/MAS NMR spectra of cement composites