Nano-calcite preparation aimed at consolidating stones for cultural heritage applications

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Abstract:

The consolidation of stone of ancient monuments, such as middle age cathedrals, degraded because of natural ageing, is an important topic for European cultural heritage conservation. Usually tetraethyl-orthosilicate (TEOS) based treatments are used as consolidants because they lead to formation of stable amorphous silica inside stones pores. While generally effective, this treatment is more compatible with silicate stones and it shows a tendency to cracking upon drying. It shows also the tendency to induce damages because of the differential dilatation behavior with respect to host stone. To consolidate carbonatic stones, a carbonate based consolidant should be reasonably developed to improve compatibility with the host stone. Moreover, its nano-dimension facilitates penetration into the stone micro-porosities, with generation of a very high surface area resulting in a high reactivity inside pores. For these reasons nano-calcite may provide a good alternative to TEOS. Nano-calcite can be prepared by the carbonation of calcium hydroxide in water in the presence of interfacial agents2. This reaction is very cheap and well known, but the control of reaction parameters to achieve nano-scale dimensions is quite complex. The present work concerns the preparation of a water suspension containing nano-calcite through the controlled carbonation of calcium hydroxide in water in a pilot plant. The reaction was optimized by keeping into account a statistical approach based on a simplified Design of Experiment technique applied to the different reaction parameters. Thanks to this approach the role played by several parameters in determining the final morphology of the nano-calcite was investigated. The preliminary laboratory testing of nano-calcite onto a carbonate stone showed a good adhesion of nano-particles in the host stone, unveiling interesting potentiality of this treatment.

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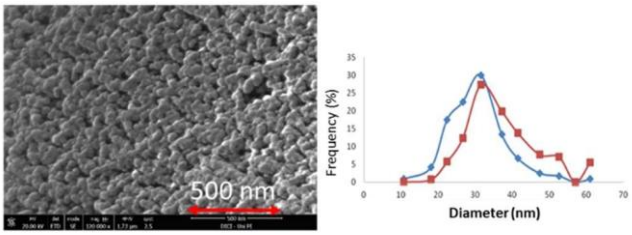
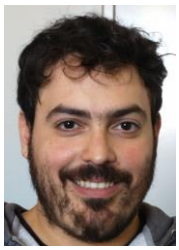


Fig. 1: FESEM micrograph (left) and diameter distribution by light scattering measurements (right) related to a nano-calcite sample

Recent Publications

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3. Verganelaki A, Kilikoglou V, Karatasios I & Maravelaki-Kalaitzaki P. 2014. A biomimetic approach to strengthen and protect construction materials with novel calcium-oxalate-silica nanocomposite, Construction and Building Materials 62: 8-17
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Biography:

Born in Livorno on 25th October 1988. Master degree in Industrial Chemistry reached on February 2014. Obtained professional qualification to chemist on December 2014. University Scholarship at the department of Chemical and Industrial Chemical about production of polymeric thickening additives for lubricating oils in collaboration with ENI S.p.A. University Scholarship at the department of Civil and Chemical Engineering about antimicrobial properties of modified polymer films for packaging. Nowadays Granted Researcher and PhD student about the production of nanocalcite suspension for culturage heritage application and toughening agent for plastics. Researches were focus on polymer science in particular nanometric composite.

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