

Emerging Trends in Materials Science and Nanotechnology

April 26-27, 2018
Rome, Italy

Luca Panariello et al., Nano Res Appl, Volume:4
DOI: 10.21767/2471-9838-C1-009

NANO-CALCITE PREPARATION AIMED AT CONSOLIDATING STONES FOR CULTURAL HERITAGE APPLICATIONS

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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 microporosities, 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 agents. 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.

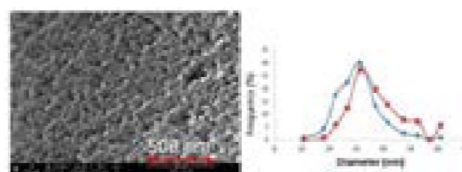


Figure 1: FESEM micrograph (left) and diameter distribution by light scattering measurements (right) related to a nano-calcite sample

Recent Publications

1. Shi X, Rosa R and Lazzeri A (2010) On the coating of precipitated calcium carbonate with stearic acid in aqueous medium. *Langmuir* 26(11):8474- 8482.
2. Shi X, Bertóti I, Pukánszky B, Rosa R and Lazzeri A. 2011) Structure and surface coverage of water-based stearate coatings on calcium carbonate nanoparticles. *Journal of Colloid Interface Science* 362:67-73.
3. Verganelaki A, Kilikoglou V, Karatasios I and 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.
4. Sassoni E, Graziani G, Ridolfi G, Bignozzi M C and Franzoni E (2017) Thermal behavior of carrara marble after consolidation by ammonium phosphate, ammonium oxalate and ethyl silicate. *Materials and Design* 120:345–353.
5. Pondelak A, Kramar S, Kikelj M L and Škapin A S (2017) In-situ study of the consolidation of wall paintings using commercial and newly developed consolidants. *Journal of Cultural Heritage* 28:1-8.