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Novel mineralogical techniques for preservation of national monuments



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Humidity, environmental pollution, cleaning with aggressive products for the chemical composition of the rock, etc. give rise to the appearance of salts which cause stone decomposition, paint coats detachment, dust accumulation, etc.

The treatments used up to now to deal with the problem have been directed, almost exclusively, to preserve the beauty of the affected monument, assuming, with an almost fatalist attitude, that the damage will go on as an effect of passing of time. European experts joint in the SALTCONTROL project have collaborated in a new work line to deal with the problem: Blocking inside the stone the mineral salt crystallisation process that ends up destroying it.

One of the works carried out in the framework of SALTCONTROL is the doctoral thesis 'Damage prevention due to salt crystallisation in national heritage through the use of crystallisation inhibitors,' read by Encarnacion Maria Ruiz Agudo, under the supervision of Prof. Carlos Manuel Rodriguez Navarro; as well as several papers published by scientific journals such as Journal of Physical Chemistry, Environmental Geology, Scanning y Journal of the Japanese Association for Crystal Growth.

According to Ruiz Agudo (Centro Andaluz del Medio Ambiente - Department of Mineralogy and Petrology of the University of Granada) 'ornamental porous materials' damage due to salt attack is one of the most aggressive alteration mechanisms that affect constructed heritage. In the last decades, we have developed different methods to prevent or reduce the damage due to salt crystallisation in ornamental rock pores, almost all with little success.'

The thesis's research line and the above mentioned papers have followed the recent techniques that intend to use additives to modify the crystallisation process and prevent or reduce the damage produced in the rock. Up to now, most of the works in this field have assessed the efficiency of these treatments in slightly soluble salts, such as calcium and barium sulphates. The thesis 'has proved the effectiveness of this type of treatment in highly soluble salts, such as sodium and magnesium sulphates, as well as sodium nitrate, which can usually be found in historic buildings.'

The research work has been applied to the case of the effects of these treatments in the rock extracted in Santa Pudia's quarries (Escuzar, Granada), used in the construction of Renaissance buildings in Granada such as the Monastery of San Jeronimo, the Cathedral or the Royal Chapel. These buildings show strong alteration phenomenon due to crystallisation in sodium sulphate, magnesium and sodium nitrate.

The work has conducted to the carrying out of salt crystallisation tests in laboratory, which simulate alteration processes due to salt crystallisation in the bases on historic buildings' walls. 'Later,' says Ruiz Agudo, 'we prepared a method for the implementation of the treatment developed in practical cases of ornamental stone materials conservation. Finally, in a last phase of development of the research project, we applied such treatment in pilot areas on the Monastery of San Jeronimo (Granada), where there had been important problems due to salt crystallisation.'

The final result of the research work proposes the application of low-cost additives, which have proved to be very effective in the fight against the problems of ornamental porous materials. On the other hand, the research work 'involves a methodology to deal with the study of damage caused by salts and the selection of the most adequate type of additive for a specific substrate and type of salt. The object of the methodology is the study of the problem in situ, in order to carry out laboratory tests that allow to select the concentration, pH and the most appropriate application method and finally to go back to the building to test the treatment in pilot areas, which permits to guarantee the success in the application of salt crystallisation inhibitors inside stony materials, as we have proved in San Jeronimo.'

The research work is part of the SALTCONTROL project, financed by the 6th framework Programme of the EU for the period 2004-2007. Together with the University of Granada, other organisms have participated in the project: the University of Muenster (Germany), the University of Gant (Belgium), the University College of London, the University of Patras in Greece, the Technical University of Prague, the Architecture Conservation Centre TNO of Holland, the Andalusian Institute of National Heritage and the Technical University of Eindhoven.

SALTCONTROL's results have been successfully applied in the Monastery of San Jeronimo (Granada-Spain) and the Fortress of Teresina (Prague, Czech Republic).



Salts in the mural paintings of the upper section of the Church of the Monastery of San Jeronimo (Granada). (c) Universidad de Granada

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