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Looking at Europe’s flamboyant cathedrals, it is easy to forget that even stone does not last forever. Without effective conservation, gargoyles erode, stained glass shatters, and choir stalls eventually rot. EU-funded researchers have produced innovative compounds to protect our cultural heritage.

The [Nanomatch](1) project has developed nano-structured compounds for the preservation of stone, glass and wood in historical buildings. These products consist of nanoparticles suspended or dissolved in solvents that evaporate once applied. The substances deposited this way then react with ambient air and moisture, transforming into a filler material that reinforces the support.

A product for the consolidation of glass will soon be on the market. Several other products — designed to consolidate stone or counter the acidification of wood — are also essentially ready, says project coordinator Adriana Bernardi of the Institute of Atmospheric Sciences and Climate of the Italian National Research Council (CNR).

However, she notes, a few more tweaks are needed to prepare them for large-scale commercialisation. She expects this process to take another two or three years.

**A healthy injection of stone**

Nanomatch set out to address a major conservation challenge: the degradation of calcium-based stone. In many cases, polymer-based products are used to consolidate this type of stone, explains Patrizia Tomasin of the CNR’s Institute for Energy and Interphases, one of the project’s key scientists. “But none of these really solve the problem,” she notes. “They deteriorate, and they can actually make the problem worse.” There are other types of new consolidants, she adds, but few of the products that are currently on the market penetrate very far into the stone.

Specific difficulties linked to polymer-based substances include discoloration over time, which means that the repairs can be quite noticeable. They are also difficult to remove if further treatment is...
needed, adds Luc Pockelé of R.E.D. srl, who was in charge of the project’s market research.

Nanomatch developed an elegant solution to this consolidation challenge: a calcium-based product that diffuses into the tiniest fissures and partly evaporates, depositing nanoparticles that react with air and moisture to bind the carbonate structure of the stone. It’s not quite liquid stone, but it’s a liquid that transforms into stone. “At the end of the process,” says Tomasin, “our product has the same composition.”

This innovation was tested in four study sites around Europe, Bernardi adds. Treated and untreated samples of various types of stone were exposed to the elements at the Basilica of the Holy Cross in Florence, the Cathedral of Oviedo, Cologne Cathedral and the Stavropoleos Monastery in Bucharest so that the performance of the consolidant could be observed.

The results were encouraging, says Pockelé, even compared to the more advanced products that are currently available. The consolidant developed by Nanomatch is highly soluble, he reports, depositing a particularly large amount of molecules even in very thin fissures deep inside the stone.

A healing touch for glass and wood

Nanomatch also finalised the development of a consolidant for glass, says Bernardi, a process that was initiated by an earlier project dedicated to stained glass windows.

Several of the partners from this predecessor project were involved in Nanomatch as part of the team that demonstrated the efficiency of the substance and adapted it for high-humidity environments. The new consolidant is used to reinforce glass with micro-fractures. It is based on the same principle as the substance proposed for stone, but it uses aluminium particles rather than calcium.

In addition, Nanomatch has applied the calcium-based compound on wood, another building material of crucial importance to our cultural heritage. This treatment protects wood from acidification, Pockelé reports, and can also be combined with a biocide to guard it against various tiny, destructive organisms.

Below pictures of calcium carbonate coatings on pores from calcium alkoxides
The project ended in October 2014, and the consortium is now considering how to make its compounds available to prospective customers. The glass consolidant should soon be on the market, Bernardi reports.

More fine-tuning will be needed to prepare the other compounds for commercialisation, says Pockelé, notably to optimise evaporation speed. However, he adds, samples are already available to restorers upon request.

See also:
CORDIS [3]

Project:
Nano-systems for the conservation of immovable and moveable polymaterial Cultural Heritage in a changing environment

Project Acronym:
NANOMATCH

Project website: