

## Study in salt weathering of reconstituted stones used in the Orval Abbey, Belgium

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The Orval Abbey, a major monument of southern Wallonia, Belgium, was partly destroyed and rebuilt several times between the Middle Ages and the present time. The oldest parts are made of natural stones of Bajocian limestones (BJ) and Sinemurian limestones (SN), and the most recent parts are mostly made of reconstituted stones. The making process of reconstituted stones is not known. According to the previous studies, the reconstituted stones are much more susceptible to weathering than the natural limestones. To investigate the reason behind the salt susceptibility of the reconstituted stones, field works and laboratory investigations such as Mercury Intrusion Porosimetry, Scanning Electron Microscopy coupled with Electron Dispersive Spectroscopy, Ion Chromatography, X-Ray Diffractometry were carried out. Results of the investigations revealed that sulfur and sodium, which were the main source of the formation of the damaging sodium sulfate, have been detected in mortars, the soil water and river water, and the reconstituted stones themselves. Results of field works indicated that the temperature and humidity conditions of Site 3, where reconstituted stones were mainly used, fluctuated drastically compared with those of other sites. This condition favors the cyclic transformation of thenardite to mirabilite, which is known as the main damaging mechanism of sodium sulfate. Moreover, MIP analysis unveiled the fact that the pore size distribution of the reconstituted stones favored the salt damage, i.e. it consisted of large fraction of microporosity. The calculated salt susceptibility indices of reconstituted stones were also very high compared to those of natural limestones.

Keywords: weathering, sodium sulphate, thenardite, Oval Abbey, reconstituted stone