



Compatibility between stones for restoration study: preliminary accelerated ageing tests

Beck K. (1), Al-Mukhtar M. (2)

(1) Centre de Recherche sur la Matière Divisée, Université d'Orléans - CNRS-CRMD, France,
(2) 1B, rue de la Férollerie 45071 Orléans Cedex 2, France, e-mail: muzahim@cnrs-orleans.fr

This presentation is a part of a larger project concerning the understanding of monument deterioration processes by a multi-scales approach. It is interesting to notice that a part of the degradation of monuments built with a limestone often find their origins in an incompatible association between the original construction stone and the stone of replacement in restoration works. The replacement of the damaged stones is a crucial problem in the restoration of historical monuments. In fact, the question of the choice of compatible stones constitutes a major problem in France (quarry of the stones exhausted, no identification of quarry used during the construction). The idea is to find a new stone similar and compatible with the old stones if it is impossible to use exactly the same! The aim of the work presented in this paper is the determination of the criteria of compatibility between stones and principal parameters controlling degradation of stones. Among parameters influencing deterioration of stones, one can identify salts crystallization, moisture and water transfer through the pore network. Two French porous limestones having very closed main characteristics (total porosity, densities, mechanical resistance) are selected for this study: white tuffeau and Sébastopol stone. The white tuffeau is commonly used in most of monuments built along the Loire valley as the famous Loire Castles. The Sébastopol stone is extracted from a quarry near Paris and this limestone presents a total porosity practically identical to that of the tuffeau (higher than 40%) but a very different pore distribution. Accelerated ageing tests carried out by applying imbibition - drying cycles with pure water, and with water polluted by salts (NaCl and Na_2SO_4) in accordance with the European standard test EN 12370. The main applied parameters are, salt concentration, the range of applied relative humidity and the temperature. Various samples of isolated stones and stones linked together (tuffeau and Sébastopol) were thus tested

in order to observe the compatible or not-compatible characteristics of stones. Tested samples are then analyzed using mercury intrusion test, microscopic observation. The difference between the two stones in the mineralogical composition and in the pore space distribution implies different water transfer properties (permeability, capillarity, water retention ...), and this strongly affects the durability of the stones, the nature of the deterioration and the compatibility.