A salt-storing modular mortar system developed for the salt loaded brick masonry of the Kampischen Hof, Stralsund (Germany)

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Abstract

Along the coastline of the Baltic Sea, cities like Wismar or Stralsund are characterised by an architectural style named “brick gothic”. Two issues are typical for this architectural style and geographical location:

1. Bricks fired at a low temperature are often not resistant to internal crystallization pressures resulting from frost or salt activity.

2. An important part of the building materials is contaminated with a mixture of chlorides and nitrates. Exposed to environmental conditions of which the relative humidity ranges between 50 and 75%, the crystallization cycling of salts is a major parameter of destructive activity of the bricks.

The monastery of the Middle Ages called Kampischer Hof in the city of Stralsund is one of the “brick gothic” monuments that was the subject of detailed investigation in the 1990s, funded by the German government. From the results, it was concluded that the high salt load was the major decay vehicle.

The design of a suitable mortar and plaster for the durable restoration of this type of brickwork was crucial. The mortar concept has to address and fulfil different restoration tasks, such as grouting, salt-buffering, plastering and restoring of detached brick surface material – and each of them should be capable of being applied in an extreme salt loaded environment.

Salt-storing mortars as a typically hydrophilic mortar system have been known since the 1990s. Beside their hydrophilic character, in contrast to the hydrophobic WTA-restoration plasters, a volume porosity >60%, a

consciously shaped pore size distribution influencing the capillary suction and a salt crystallization pressure resistant binder are key features of these mortars. Up to now, only mortars characterized by variations in mechanical strength were produced and applied. A first approach in adapting this mortar for special grouting tasks in Baku / Azerbaijan was presented by the author at SWBSS 2011. In this project, the very first steps towards adaptation of the pore structure to increase the salt storing or salt buffering capacity of the mortar have been addressed in order to fulfil the above mentioned restoration tasks. Depending on the specific properties of the mortar (salt storing or salt buffering), the amount of capillary active pores is different. To increase the capillary suction of the mortar, Roman cement was tested, known as a capillary-active hydraulic binder, resulting in a significant increase in the salt storage rate. Subtle differences in the binder matrix of mortars modified or not with Roman cement are not readily apparent when observed in the microscope (SEM) – but for the practised eye the influence of Roman cement on the structure is visible. Besides the tuning of the structure it is possible to produce this kind of plaster in different coloured versions so that it may be used as a brick supplementary mortar.

The work represents the first step in assessing the prospects offered by Roman cement as the primary binder of salt-storing mortars. However, much practical investigation is required to reach an optimised solution for a major European restoration problem.

Keywords: salt-storing mortar, salt storage, pore structure modelling, Roman cement