Durability of matured hydraulic grouts in sodium sulphate crystallization, effects of preparation and microstructural characteristics

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ABSTRACT

This paper presents a post assessment investigation of the durability of matured hydraulic grouts to sodium sulphate crystallization, taking into consideration the composition and the mixing method that results to differenced microstructural characteristics.

Four different grout compositions are examined; the first three are based on Natural Hydraulic Lime (NHL 5) both without and with an addition of 10 and 20% natural pozzolan. The fourth grout is of a ternary composition containing Aalborg White Portland Cement, Pozzolan and Hydrated Lime (in 30:45:25 mass ratio). All grouts were produced with a fixed water to binder ratio of 0.8 and the addition of superplastisizer, in order to meet the criteria for application to both the consolidation of three-leaf masonry, as well as mosaic substrata. Two sets of grouts have being produced, the first in laboratory scale, using a low frequency ultrasonic mixer, while the second was produced using a worksite specialized equipment (i.e a Colloidal High Shear mixer). This post assessment investigation took place after the grouts had matured for a period between eight to nine years in a sealed high RH container.

Microstructural characteristics are studied by means of Backscattered Scanning Electron Microscopy (SEM) coupled with Energy Dispersive Spectroscopy (EDS) on polished grout samples, crystalline phases are identified by X-Ray Diffraction (XRD) and open water permeable porosity is measured by capillary absorption tests. Durability to cycles of Na_2SO_4 crystallisation is performed by applying controlled temperature conditions to both wetting and drying in order to achieve the conditions for mirabilite crystallization from highly suppersaturated solution within the pores.

The main contribution of this work is that it is based on matured specimens, which had already been studied in the past according to standard testing methods, contributing to a better understanding of the restoration materials performance in time.

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