SYMULATION OF THE INFLUENCE OF SOLUBLE SALTS TO LIME BASED RESTORATION MORTARS

ŠĶĪSTOŠO SĀĻU IEDARBĪBAS MODELĒŠANA RESTAURĀCIJAS JAVĀM UZ KALĶU BĀZES

Jana Svare, Janīna Sētiņa, Linda Krāģe, Svetlana Kirilova, Tatjana Truboviča
Rīgas Tehniskā universitāte, Silikātu materiālu institūts
Genādijs Šahmenko
Rīgas Tehniskā universitāte, Būvmateriālu un būvizstrādājumu profesora grupa

Summary: Lime based mortars have different applications in the field of restoration of monuments, e.g. bedding, jointing, plastering, mending or filling the gaps and even desalination. Water-soluble salts are quite often present in historical constructions and are considered to be one of the main damaging and powerful reasons for deterioration of porous masonry. The influence of soluble salts to the properties of lime based restoration mortars was studied by simulating the cyclic salination processes. The main aim of investigations was to evaluate the resistance of lime mortars with and without different additives to the efficiency of salt crystallisation.

According to the previous research devoted to restoration mixtures as well as analysis of historical binders, several compositions for experimental model samples were elaborated. Keeping the ratio between binder and filler (sand) 1 : 3, either calcium (further marked as Ca) or dolomitic (further marked as D) lime was applied as a binder. Portlandcement (C), natural pozzolana (P) or trass (T) was used as an additive in amount of 12 % by the weight of binder.

After 2 month of maturing the model samples – cubes with each side of 40 mm were subjected to the series of investigations:

1. salt crystallisation by contamination with one of the following solutions: 1M NaCl, 1M $NaNO_3$ or 0,1M Na_2SO_4, followed by drying (altogether 8 cycles of immersion and drying);
2. measurements of physical and mechanical properties before and after salt crystallisation;
3. visual observation and microscopical evaluation (by stereo microscope Leica M 420) of the state of samples before and after each cycle;
4. analysis of soluble salts in the different depth of samples after salination (by wet chemical and XRD analysis);

Laboratory scale studies indicated that both the dynamics and rate of water absorption, ability to draw in solution of salts, resistance to salt crystallisation and compressive strength is in strong correlation with the porosity, density of the samples as well as the type of binder and additives (see tab.1.). Obtained experimental data can further serve as a data base for planning practical restoration activities in salinated environments and where application of lime based grouts is essential.

Jana Svare, RTU SMI
Āzenes 14/24, Rīga LV-1048
e-mail.: janasv@inbox.com

Linda Krāģe, RTU SMI
Āzenes 14/24, Rīga LV-1048
e-mail.: linda@ktf.rtu.lv

Table No.1. Physical/mechanical properties of model samples before and after exposure to salination cycles

Sample	Initial – before exposure	After 4 cycles of exposure in solution of salt			After 8 cycles of exposure in solution of salt		
		NaCl	$NaNO_3$	Na_2SO_4	NaCl	$NaNO_3$	Na_2SO_4
	1* 2**	1* 2**	1* 2**	1* 2**	1* 2**	1* 2**	1* 2**
Ca	1689 0.58	1677 1.3	1873 3.0	1519 0.6	1596 0.67	1802 1.9	1380 0.45
CaP	1798 2.2	12754 1.7	1830 2.5	1739 2.0	12734 1.6	1823 2.2	1630 1.4
CaC	1837 1.5	1831 2.4	1893 4.0	12751 1.5	1807 2.1	1893 4.0	1730 1.4
D	1688 5.6	1698 4.4	1772 5.3	1713 5.0	1723 3.1	1812 4.0	1690 4.3
DP	1637 5.5	1685 4.5	1749 5.1	1662 6.0	1708 3.5	1791 3.7	1534 5.4
DC	1674 7.0	1693 4.3	1751 4.5	1722 8.7	1819 4.2	1766 4.1	1687 7.2

1* - density, kg/m^3;
2** - compr.strength, MPa