



## Cement render and mortar and their damages due to salt crystallization in the Holy Trinity Dominicans monastery in Cracow, Poland

**Mariola Marszałek**, Krzysztof Dudek, Adam Gaweł, and Jerzy Czerny  
AGH-University of Science and Technology, Mineralogy, Petrography and Geochemistry, Kraków, Poland  
(mmarszal@agh.edu.pl)

The presented investigations are focused on a part of the 13<sup>th</sup> century Church of the Holy Trinity Dominicans monastery in Cracow, Poland, and include the wall façade of the 17<sup>th</sup> century Myszkowski chapel. The chapel was probably designed by Santi Gucci Fiorentino and built by his workshop. Southern façade of the chapel is made of Tertiary limestone blocks that make characteristic rusticated wall. Lower part of the façade is covered with cement and the basement is made of irregular fragments of Jurassic limestone and Cretaceous sandstone partly replaced and bound with cement mortar. The façade revealed clear signs of damage ranging from dark gray soiling of the surface, scaling to efflorescences. The last ones – mainly on the border of limestone blocks and the cement in the part of the basement.

Laboratory tests included mineralogical, chemical and petrophysical analyses. Optical microscopy, scanning electron microscopy (SEM-EDS), micro-Raman spectroscopy and X-ray diffractometry (XRD) were used for analysing materials and deterioration products of the cement render and mortar. The petrophysical properties of the materials have been performed using mercury intrusion porosimetry. The secondary minerals detected include mainly gypsum  $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ , thenardite  $\text{Na}_2\text{SO}_4$ , aphthitalite  $(\text{Na},\text{K})_3\text{Na}(\text{SO}_4)_2$ , darapskite,  $\text{Na}_3(\text{SO}_4)(\text{NO}_3) \cdot \text{H}_2\text{O}$ , nitre  $\text{KNO}_3$ , nitratine  $\text{NaNO}_3$ , ettringite  $\text{Ca}_6\text{Al}_2(\text{SO}_4)_3(\text{OH})_{12} \cdot 26\text{H}_2\text{O}$  and monosulphite  $\text{Ca}_4\text{Al}_2\text{O}_6\text{SO}_3 \cdot 11\text{H}_2\text{O}$ . Lower blocks of the façade covered with cement contain chiefly gypsum, ettringite and monosulphite, cement from the basement – gypsum and nitre; while efflorescences – thenardite, aphthitalite, darapskite, nitre and nitratine. The origin of the salts have been discussed and the differences in their type have been associated with composition of the materials and their physicochemical properties.

This work has been financially supported by the AGH University of Science and Technology, statutory grant no. 16.16.140.315.