Consolidation of Sandstone

(A case study from Petra)

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Abstract

The decay and disintegration of Jordanian Monuments has in recent years assumed frightening proportions. Stone Monuments which represent an important part of our cultural heritage suffer from constant decay and damage. This state of instability, indeed, makes these monuments in pressing need for an immediate action and accurate intervention. Taking the necessary measures both preventive and interventive to protect and conserve these monuments is the only guarantee that these monuments will survive. It is obvious that the deep understanding of the nature and causes of damage and weathering of the monuments is the first step needed for an effective preservation and conservation treatment of the monuments.

The main aim of this research was to study and examine different types of stone consolidants and their reactions with sand stone. So drill cores of sand stone samples have been taken from a quarry near Um-sayhun to examine the efficacy of the different consolidants in preserving sandstone. The methodology of the present research is based on laboratory tests for assessing the extent to which various preservatives meet predetermined requirements.

Four types of materials were selected for this study. These are variations of silicic acid esters and silicate based materials. The consolidant have the following commercial names: Wacker OII, Wacker II, Fundsoil OII, And Befix.

These materials were applied to the stone samples and were tested according, either to German standards (DIN) or American standards (ASTM). Laboratory tests which have been carried out were as the following:

- Consolidant uptake value.
- Capillary water uptake value.
- Water absorption by total immersion.
- Water vapor permeability.
- Salt encapsulation test.
- Salt crystallisation test.
Freeze-Thaw damage

The main results obtained from these tests can be summarised as follows:

- In consolidant uptake test, the best penetration was achieved by Wacker H followed by Wacker OH. This is mainly due to their low viscosity and their low molecular weights.

- In water uptake test for treated and untreated samples, calculation of water absorption coefficients indicate that the order of reduction of water absorption was: Wacker H = Befix 1:1 > Befix concentrated > Wacker OH > Funcosil OH > Befix 1:3 > Befix 1:6 > Untreated.

- Result of the water absorption by total immersion for treated and untreated samples indicate that Befix 1:4 and Wacker H offered the best performance, this due to their water repellency.

- In the water vapour permeability test, the largest decrease in water vapour permeability was caused by Wacker H, while the lowest decrease was caused by Funcosil OH.

- In the compressive strength test, Befix caused the largest increase in compressive strength, while Wacker OH caused the smallest.

- In the salt encapsulation test, sample treated with Befix seems to inhibit to some extent the removal of salts. This might be due to the trapping of some of the salts in pores or that some salt held in pocket by the consolidant. The other consolidants seem not to have any effect on the immobilisation of salts.

- Results of salt crystallisation test indicate that sample treated with Funcosil OH showed the most resistance toward salt crystallisation. Other treated samples showed variable resistance to damage caused by the crystallisation of salts.