Analysis of the In-depth Effects of Xypex Concentrate Crystalline Coating

Research report

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1. Objective of the Experiment

The objective of the experiment was to prove the in-depth effect of an application of Xypex Concentrate to a concrete structure and its ability to create a waterproof crystalline structure deep into the concrete substrate thus preventing the penetration of water.

The parameters of the test were adapted to a specific building (Raichlova 2644 apartment house in Prague 13) with the objective to simulate conditions in the building as accurately as possible (the subject structure was the basement wall). All measurements and production of the test specimens were performed in the laboratories of the Czech Technical University in Prague, Faculty of Civil Engineering Experimental Centre.

2. Production of the Test Specimens

For the experiment, 3 sets of test specimens were produced with each set having 3 sample pieces (for a total of 9 separate pieces). All specimens were formed in the shape of a rectangle having dimensions of 220 x 300 x 300 mm. The 220 mm dimension was chosen for evaluation as it represented the actual thickness of the rehabilitated building's basement wall. Each test specimen thus represented a reference element of this specific wall.

All specimens were produced with C 20/25 concrete (minimum cylinder strength 20 MPa or 3000 psi, minimum cube strength 25 MPa or 3,500 psi) using a standard methodology according to CSN EN 12390-2 with the exception of the rectangular cube dimensions.

Twenty-eight days after the concrete specimens were made, a Xypex Concentrate coating was applied to one set of the test samples (3 individual specimens). Application of the crystalline coating, including the surface preparation, the application itself and subsequent curing of the surface was performed precisely as described in the manufacturer's technical data sheet. The

other two sets of specimens (6 individual specimens) were not treated with the Xypex coating material.

Fig. 1 – Test specimen of C 25/30 concrete with Xypex Concentrate crystallisation coat applied

3. Test Procedure Set-Up

One set of samples with the applied crystalline waterproofing coating (3 pieces) and one set of the untreated test samples (3 pieces) were provided with additional test equipment that simulated the loading of moisture into the concrete as found at Raichlova 2644 apartment house in Prague 13.
This equipment consisted of an open faced plastic container which was affixed to the vertical surface of each of the 6 samples with a special adhesive. The test apparatus was adhered on the side opposite the crystalline waterproofing coating so that the cross sectional thickness of the concrete substrate between the coated surface and the applied test equipment was 220 mm. The untreated test samples were set up in exactly the same manner.

On the top surface of each plastic container there was an opening (see Fig. 2) so that it could be filled with water thus holding the liquid in the inner space created between the concrete surface of the test specimen and the outer wall of the plastic container. Both the treated samples and the untreated samples were treated in exactly the same fashion.

The containers fixed to the 6 specimens were then filled with water and during the entire course of the test the water level in each individual sample was monitored in the event that it needed to be replenished. All specimens were kept at exactly the same volume and water level for the duration of the test.

The test specimens (3 pieces) from the third set of samples were untreated and were left without the supplementary test equipment. These samples were allowed to air dry in ambient laboratory conditions.

Fig. 2 – Test set - specimen with fixed container for simulation of loading by moisture

Holes with a 6 mm diameter and 90 mm apart were drilled into each test specimen. The holes were drilled to a depth of 180 to 190 mm so that they were approximately 30 to 40 mm away from the face of the concrete test sample where the water holding, plastic containers were adhered.

During the course of the test, these holes served as the locations for the brush probes of the electric resistance moisture meter which monitored and measured the moisture level of the concrete substrate at a distance of 30 to 40 mm from the surface that was exposed to the water held in the plastic containers.

The measuring device used was a Greisinger GMH 3810 resistance moisture meter. Measuring of moisture content by this instrument is based on the principle of electric current conduction through a porous substance (concrete) via measurement of the resistance of the concrete, which changes very markedly depending on the humidity/moisture content. Arrangement of the test is shown in Figure 3 and measurement setup is shown in Figure 4.

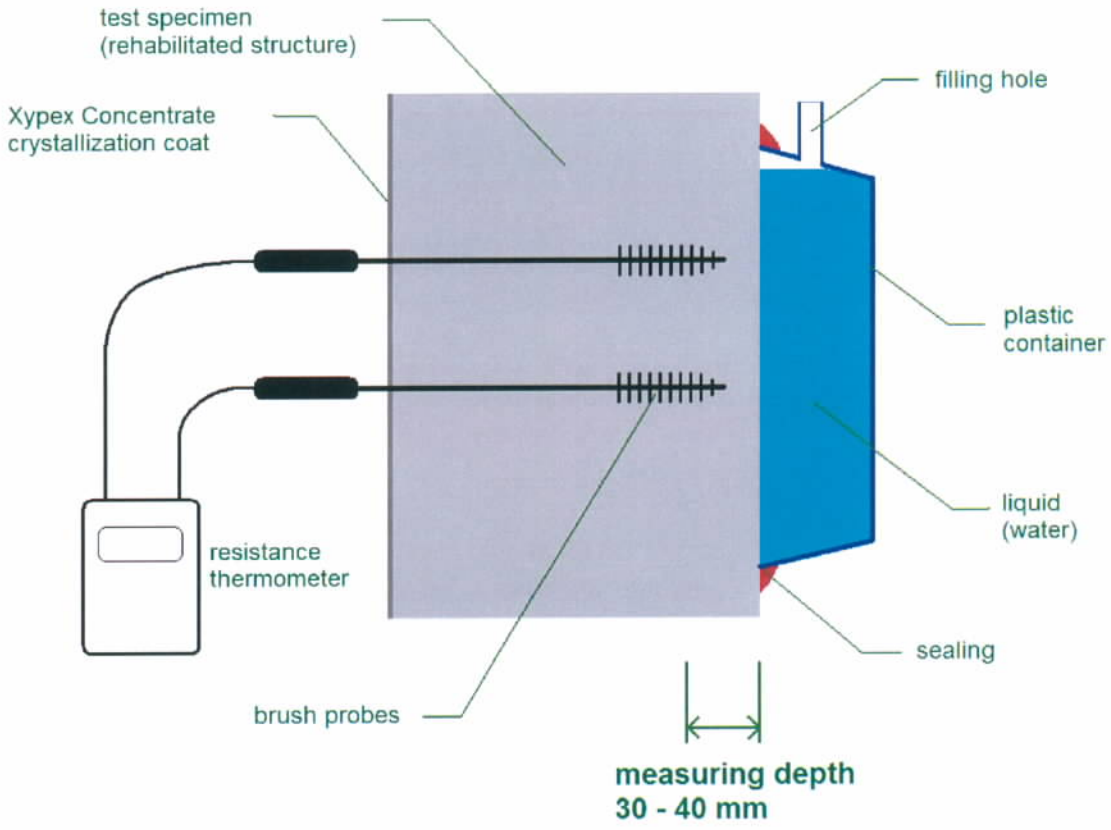

Fig. 3 – Schematic arrangement of the test

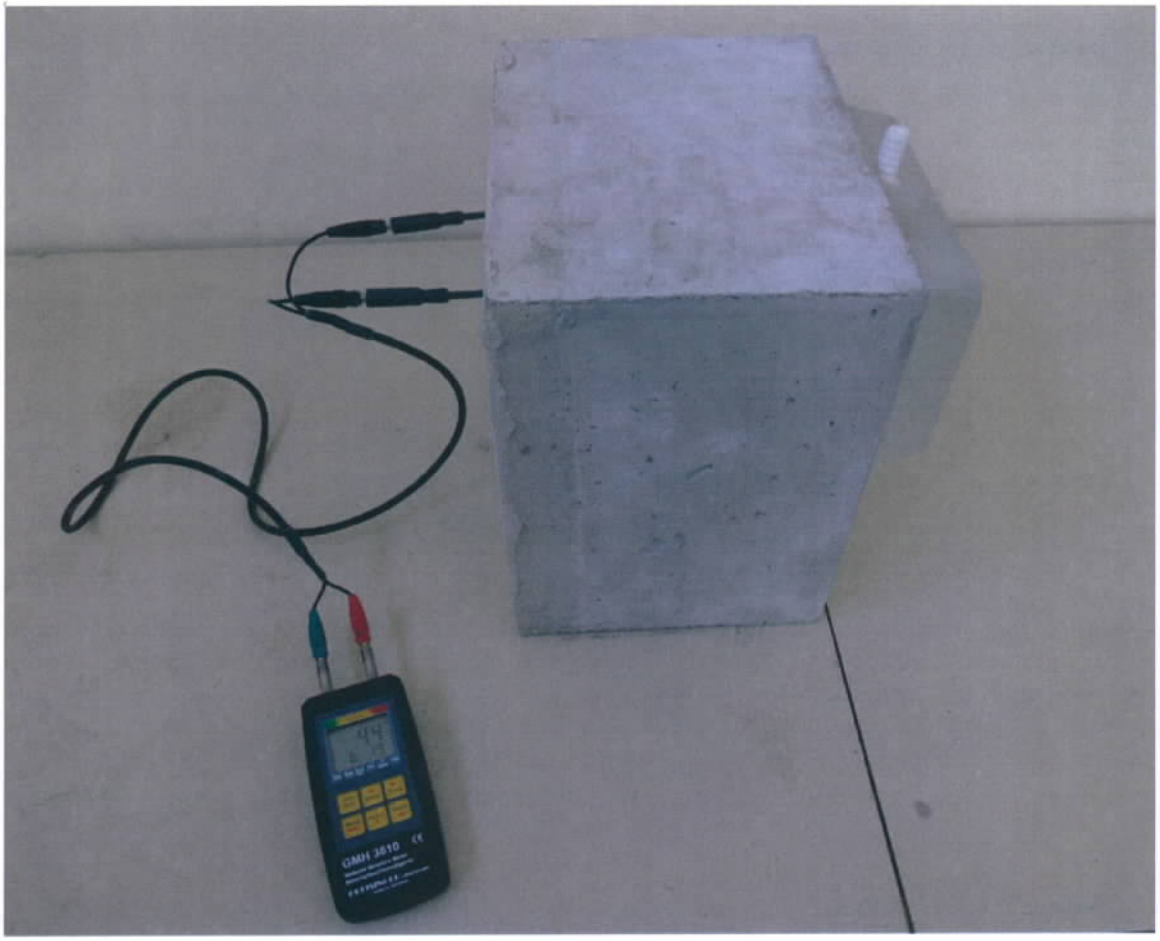

Fig. 4 – Measuring of humidity on the test set with the specimen with crystallisation coat applied

Measurement of the moisture content by the resistance moisture meter was performed on all test sets within several time intervals from the date that the specimens were cast. Measurements were taken at 28, 45, 125 and 132 days.

At the end of the test period (132 days after specimens were cast) all test samples were broken in a hydraulic press perpendicular to the moisture loading direction and subsequent to this, concrete samples were taken from the location where the brush probes were located. See Figure 5.

These samples were subjected to gravimetric measurement of moisture content for the purpose of calibrating the values measured by the instrument. Immediately after sampling, the pieces of concrete were weighed on a Kern Ew602m digital scale which had a tolerance of 0.01g and they were then dried at 105^{o}C in the Salvislab laboratory oven until mass measurement was

stabilized which took 7 days. This check of the measurement has proven that the deviation between the two methods of the moisture measurement was up to 5%.

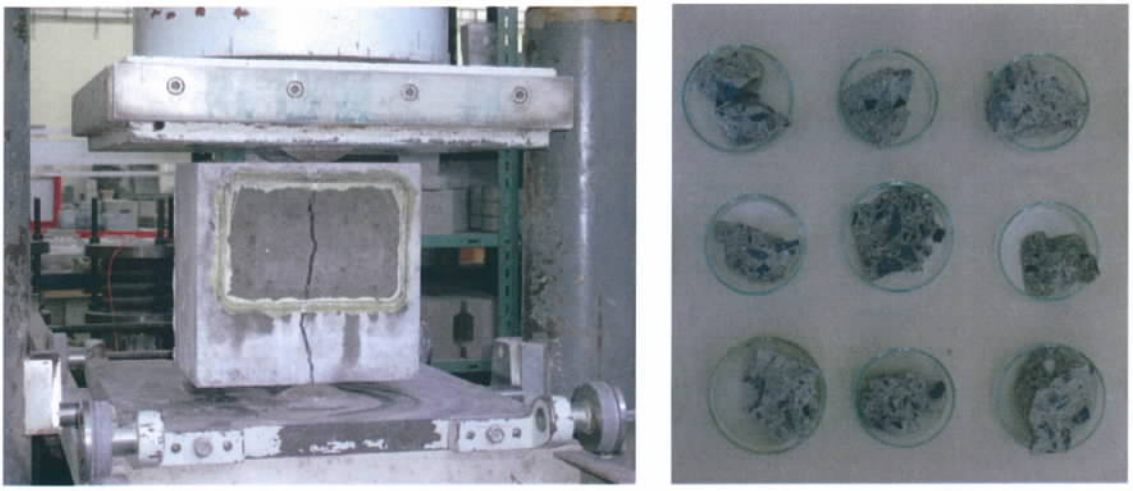

Fig. 5 – Breaking of the test specimen and samples taken for the gravimetric method

4. Results

The results of the concrete moisture measurement at the 30 to 40 mm depth under the "wet" surface of the specimen (i.e. at the distance of 180 to 190 mm from the coated surface are provided in Table 1.

Sample type	Exposure	Sample No.	Sample Moisture Content (%)									
			28 days		45 days		90 days		125 days		132 days	
C25/30 without treatment	Wet	1	8.9	8.9	7.8	8.4	9.1	8.8	7.5	7.8	7.8	7.9
		2	8.9		8.7		8.5		7.7		8.3	
		3	9.0		8.8		8.9		8.1		7.5	
C25/30 with coat	Wet	1	8.8	8.5	8.0	7.8	6.6	6.1	4.1	4.7	4.3	4.6
		2	8.7		7.8		5.9		4.1		4.5	
		3	8.1		7.7		5.8		5.9		5.1	
C25/30 without treatment	Dry	1	5.1	5.7	4.8	5.3	4.7	4.9	3.8	4.6	3.6	4.4
		2	6.1		5.9		5.1		5.2		5.2	
		3	5.9		5.1		4.8		4.8		4.4	

Tab. 1 – Moisture content of the test specimens concrete measured at 30 – 40 mm depth under surface exposed to moisture

From the results it is obvious that the test specimens with the applied crystalline coating had a significant drop in the humidity of the concrete over the course of the measured time. At 125 days from the beginning of the test, the moisture content of the coated samples is almost equal to that of the reference samples which had not been exposed to moisture and had been kept in a dry condition for the duration of the test. The gradual decrease in the moisture content of the concrete with the applied crystalline coating is also obvious in Figure 1 which illustrates the results from Table 1 in the form of a graph showing moisture content as a percentage measured against time from the start of the test.

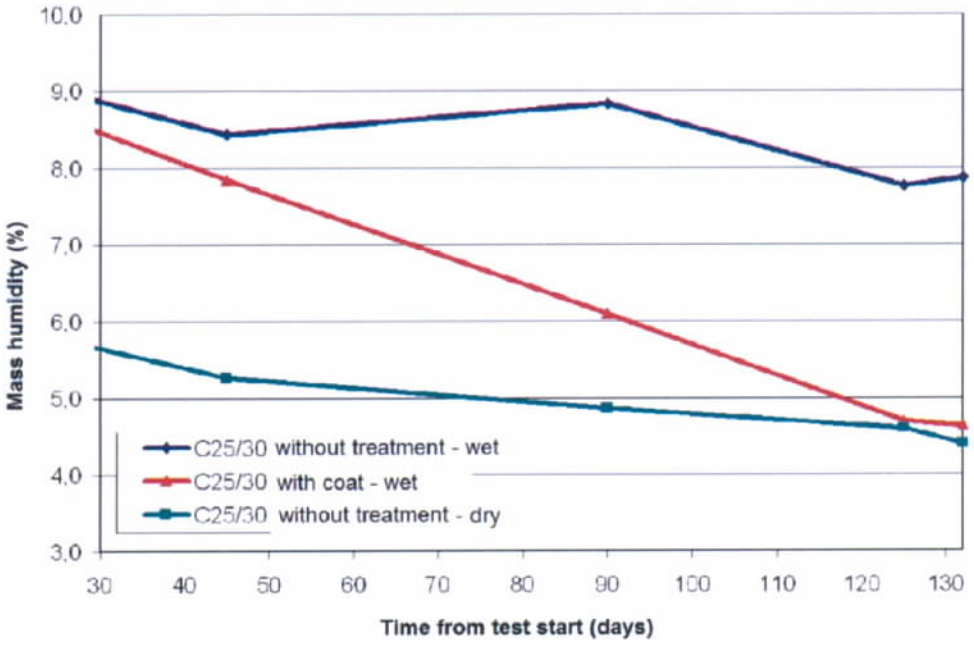

Figure 1 – Change in moisture content of the test specimens concrete (measured at 30 – 40 mm depth under the surface exposed to moisture, i.e. at the distance of 180-190 mm from the coated surface).

5. Conclusion

The results of the experimental measurements show that, under the given test conditions, the Xypex Concentrate crystalline coating has significantly influenced the waterproofing property of the concrete substrate at a depth of 180 to 190 mm from the point of application.

The ability of the crystalline chemicals to penetrate into the concrete to the 180 to 190 mm level (7.2"to 7.6") is first evident 90 days after application and the measurement of the moisture content in the concrete continued to decline until the test was terminated at 132 days.

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