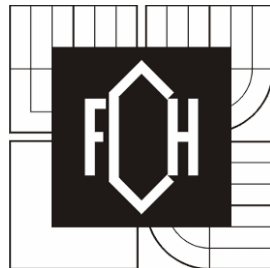


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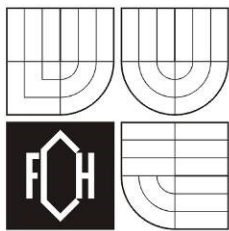
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Research Report

Title:	The study of durability of Tytan Professional Thin Bed Mortar in autoclaved aerated concrete	
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1 Introduction

The samples of polyurethane mortar Tytan Professional Thin Bed Mortar (Fig. 1) were supplied by the submitter (Selena FM S.A.). The task was to evaluate the gripping (adhesiveness) and the durability of Tytan Professional Thin Bed Mortar applied to cellular concrete walling masonry. The autoclaved aerated concrete with density 500 kg/m³ class TLMB" were used for the experiment.



Fig. 1
The supply of Tytan Professional Thin Bed Mortar

2 Experimental

The size of cellular concrete elements was adjusted, so that the strength and adhesiveness measurements of Tytan Professional Thin Bed Mortar could be performed. The Tytan Professional Thin Bed Mortars were applied onto the cellular concrete elements in accordance with the instructions given on Tytan Professional Thin Bed Mortar label. After one hour from application the samples were stored in several environments, i.e. standard laboratory conditions, external dry-storage (under the roof) and in salt (NaCl) spray chamber. The samples were subjected to the measurements of strength of Tytan Professional Thin Bed Mortar after 1, 7, 28, 60 and 90 days and simultaneously the degradation of hardened PUR mortars was observed using the FT-IR-ATR method. The sample preparation is shown in Figs 2 and 3.



Fig. 2
The preparation of samples for experiments.



Fig. 3
Prepared sample.

3 FT-IR-ATR method

The samples of Tytan Professional Thin Bed Mortar were analysed by means of Infrared Spectroscopy. Infrared Spectroscopy is a technique used for the structural analysis and for the identification of organic and inorganic substances. The sample subjected to the measurement is neither deteriorated, nor changed; it is non-destructive analytical optical method which provides qualitative as well as quantitative analysis.

The measurements were performed using NICOLET iS50 spectrometer. The device is shown in Fig. 5. The example of measurement record is given in the attachment.



Fig. 4
Nicolet iS 50 spectrometer.

4 Mechanical tests of bond strength

The tests of bond strengths were performed using Instron 5900 tension testing machine (up to 10 kN and up to 250 kN). The measurement arrangement and the device are shown in Fig. 5. The experiment was set in such way, that two horizontal planes pressed the sample with the rate of 1mm per minute and the force required for the sample destruction was determined.



Fig. 5
Instron 5900 tension testing machine, experiment arrangement.

5 Corrosion chamber with NaCl

For the storage in salt spray environment, Liebisch SKB 400A-TR chamber was used. The samples were stored at the temperature of 25 °C and the humidity of 100 % in salt spray (NaCl) which was generated continuously by the chamber from 5% solution of NaCl.



Fig. 6
Liebisch SKB 400A-TR corrosion chamber.

6 Results and findings

6.1 Tests of mechanical properties

The tests were carried out for 90 days and the samples were stored in four environments, as already mentioned in Chapter 2. Achieved strength values are not given, because they can not be ascribed to Tytan Professional Thin Bed Mortar. In all experiments the destruction took place within the cellular concrete, the surface of adhesive was not detached from cellular concrete. The experiments are reflected in Figs. 7 and 8.

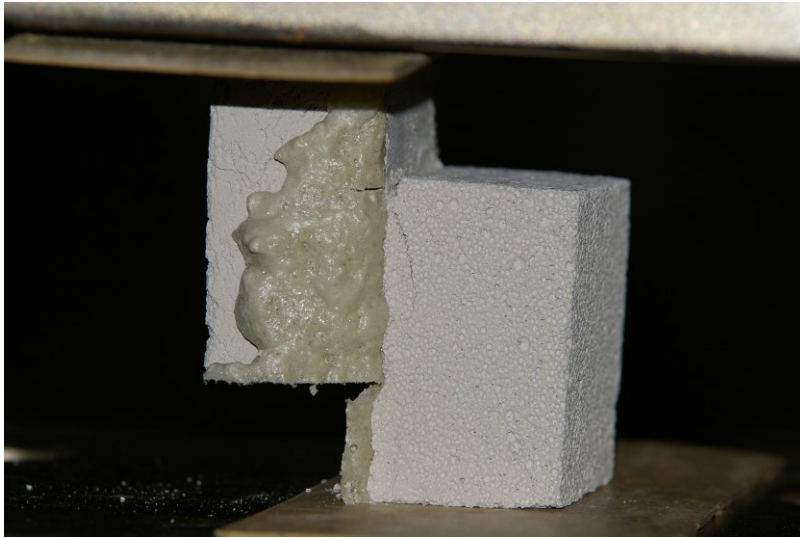


Fig. 7
The destruction of cellular concrete during the test.

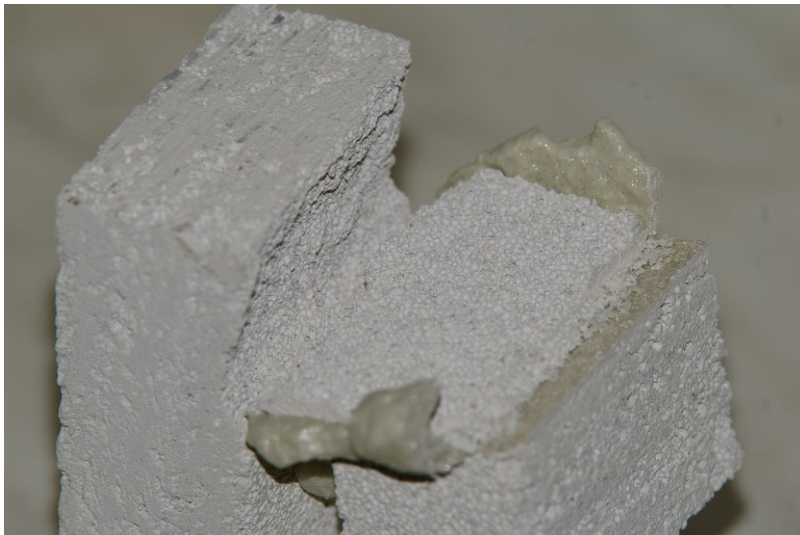


Fig. 8
The detachment of cellular concrete during the test.

6.2 Testing of Tytan Professional Thin Bed Mortars stability

The FT-IR-ATR technique was applied for the determination of stability. The spectra of Tytan Professional Thin Bed Mortars stored in particular conditions were measured. The rate of degradation of PUR thin-layered adhesive was evaluated. Prior to each measurement the samples were dried in forced convection drier for 24 hours at 30 °C. Received results are given in Figs. 9– 12, and are sorted according to the storage conditions.

Note

The straight section within the wavenumber interval of 1800 – 2300 cm^{-1} is modified. Very distinguished peak of diamond was removed purposely from this interval (ATR extension piece was made of diamond), as it distorted the results of analysis.

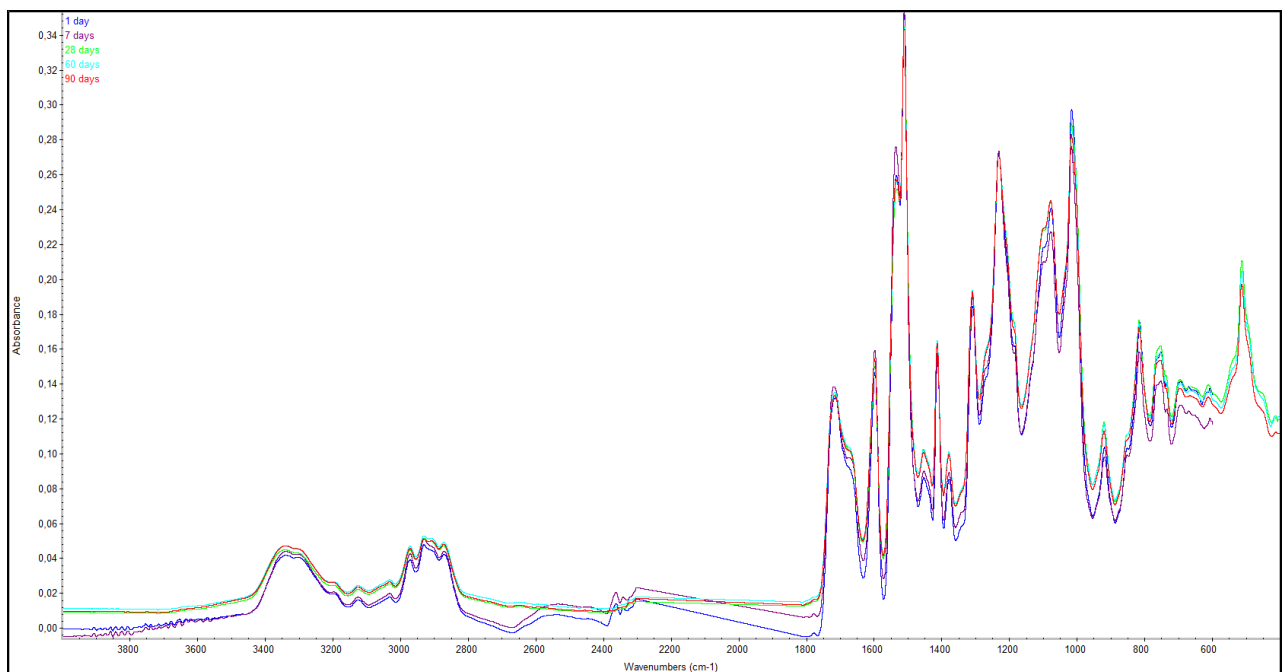


Fig. 9

FT-IR spectra of Tytan Professional Thin Bed Mortar stored in laboratory conditions.

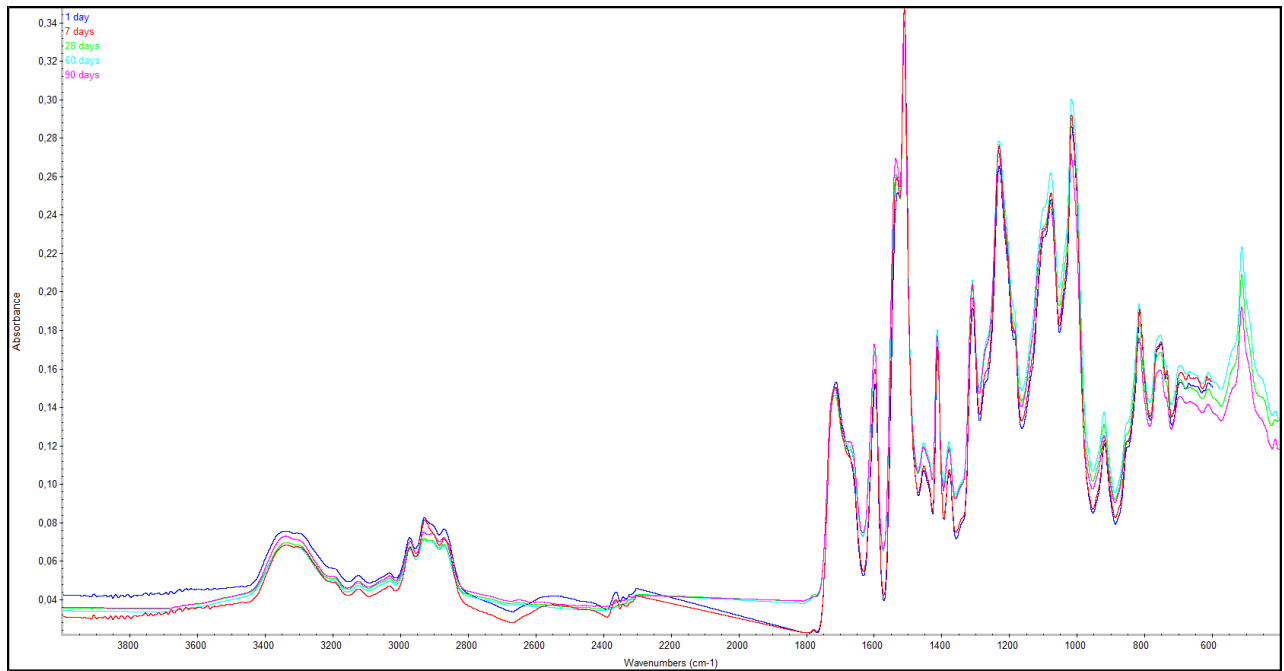


Fig. 10
FT-IR spectra of Tytan Professional Thin Bed Mortar stored in external dry storage.

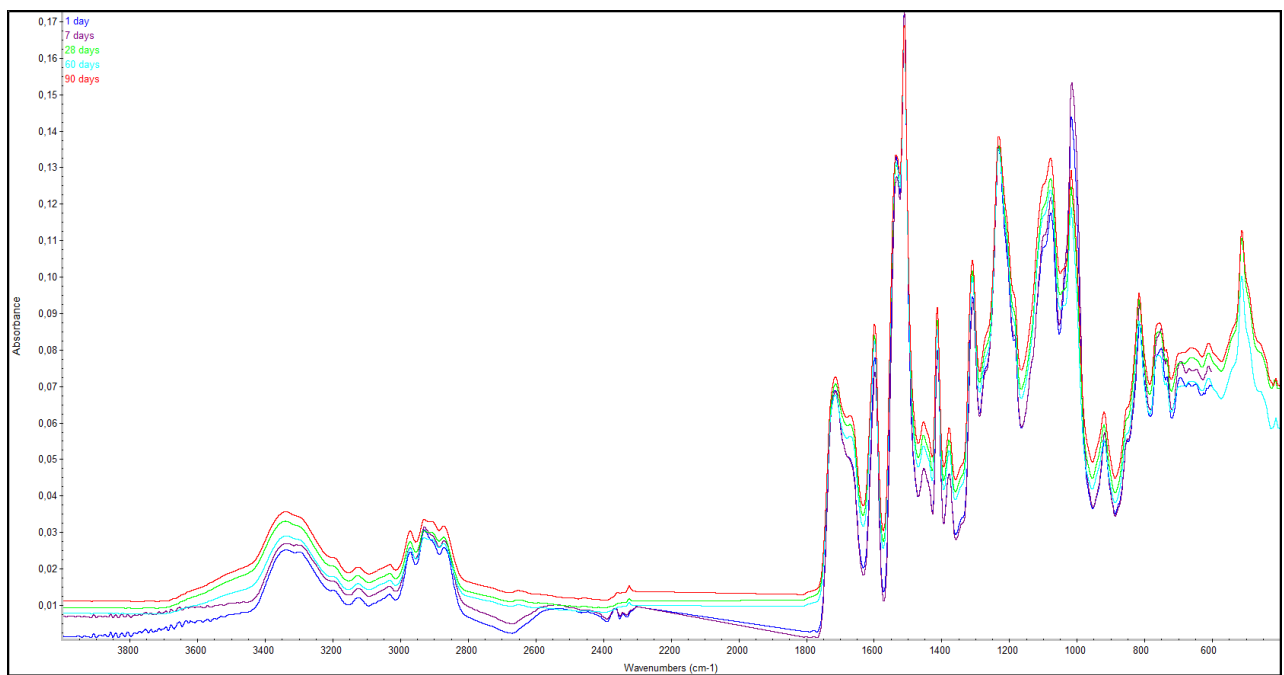


Fig. 11
FT-IR spectra of Tytan Professional Thin Bed Mortar stored in salt spray (NaCl).

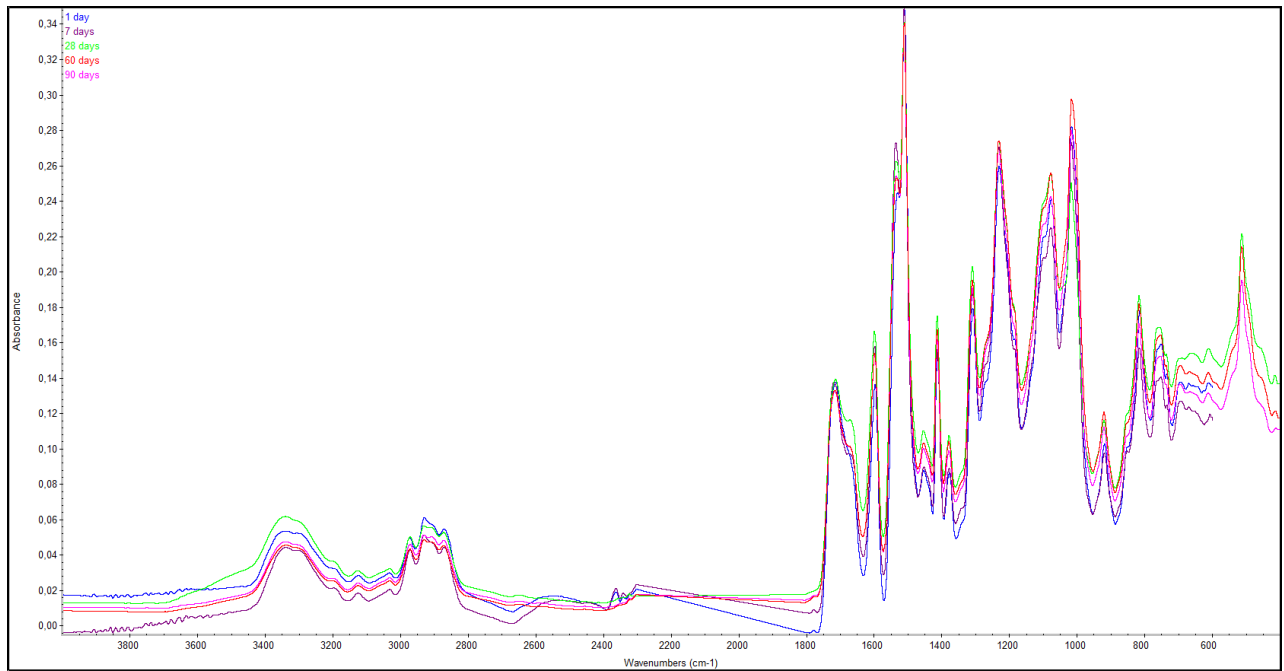


Fig. 12
FT-IR spectra of Tytan Professional Thin Bed Mortar stored in 100% humidity.

Discussion

The results given above reveal that after 7 days the samples stayed almost unchanged. The strength measurements confirmed that statement.



7 Conclusion

The results of durability and resistivity tests of Tytan Professional Thin Bed Mortar applied as the binder of aerated concrete walling masonry are given in this research report.

Generally it can be stated that tested Tytan Professional Thin Bed Mortar conforms to the requirements of being applied as a binder for aerated concrete walling blocks. It was proved, that the exposition to high humidity and to corrosive environment causes only negligible deterioration of strengths.

The service life of Tytan Professional Thin Bed Mortar can only be estimated from the tests of fired bricks applications, since the bond with aerated concrete was so strong, that the destruction proceeded within the aerated concrete. The mathematical model applied for fired bricks revealed, that after a certain period of time the strengths should never fall below the determined values. The same holds also for aerated concrete, where the minimum strengths of whole system is limited by the minimum strength of aerated concrete itself.

Tytan Professional Thin Bed Mortars applied as binders for aerated concrete walling masonry will exhibit stable strengths and will maintain their long-lasting binding ability for up to hundreds of years. However, these properties depend on the surrounding conditions in which the Tytan Professional Thin Bed Mortar will be applied (i.e. primary moisture of aerated bricks).

Polyurethanes form cross-linked molecules, however, there are also hydrogen bridges in their structure. Hence it can be supposed that the long-term influence of humidity (months, years) will cause the deterioration of adhesive and its quality will fall.