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Tensile strength of polyester geogrids embedded in concrete

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ABSTRACT: The maximum tensile strength and maximum tensile strain of a typical polymer coated polyester geogrid embedded in concrete was examined to find out the effects of external hydrolysis. Embedding in concrete was done in concrete cubes with a length of edges of 100 mm. Test and control series were realised under different controlled storage and test conditions during a period of 2 years. No significant long-term losses of strength can be registered (Damisch 1996).

1 SAMPLES

The geogrid samples were embedded and tested in the machine (longitudinal) direction.

The geogrid data are (according to the producers information):

- trade name: Fortrac® 80/30-20
- description: high-tenacity polyester, woven, polymer-coated, mesh-size 20 x 20 mm
- short-time properties (machine direction):
  tensile strength ≥ 80 kN/m
  strain at break ≤ 14 %

The samples were taken from the roll under statistical aspects. Each sample has the dimensions B ≈ 40 mm (including two longitudinal elements) and L = 1,000 mm. The in-concrete-embedment-length is 100 mm.

A concrete class B 35 (35 N/mm² compressive strength after 28 days) was used for the concrete cubes. A pH values of about 12.5 was registered both in fresh and later in saturated long-term state.

2 STORAGE OF SAMPLES

Test series A: The samples were stored in water filled container in a dark cellar. Temperature and humidity were permanent registered during the whole test period of 2 years. In this period of time the values varied between 60 to 90% humidity and 17 to 24°C temperature.

Test series B: The samples were stored on a wooden board laid outdoors free on the ground. To guarantee an all-round influence of the weather the cubes were set up at larger distance. Like in test series A the temperature and humidity, and additional, the precipitation and periods of sunshine were permanent registered during the whole test period, see Fig. 1.

Parallel to the geogrid samples, embedded in concrete, geogrid samples, not embedded in concrete, (control samples) for both test series A and B were stored under the same conditions next to the samples embedded in concrete.

3 TESTS

Maximum tensile strength and maximum tensile strain were determined according to DIN 53957 using a test machine (UPM 1484). The free ends of the geogrid strips were clamped in a roller clamp to exclude clamp cracks. The strain was measured with a contact-free optical precision measuring device.

The tensile strength and strain were tested at the days 0 (only control samples), 6, 14, 61, 120, 365 and 730. Per test session 5 samples of test series A (+ control samples) and of test series B (+ control samples) were tested. Altogether: 1 x 5 + 6 * [(5 + 5) + (5 + 5)] = 125 samples were tested.

4 RESULTS AND EVALUATION

The test results are presented in Fig. 2 to 5.

The values of the maximum tensile strength and maximum tensile strain of the control samples (geogrids of the same charge under same storage conditions) stay as expected approximately constant during the whole test period.

The average value of maximum tensile strength after 2 years of the test series A (storage in cellar) is about 21% and of the test series B (storage in the open air) about 20% below the average value of the zero-samples (day 0). These losses of tensile strength are already registered right in the first test session after 6 days. The further changes of the tensile strengths are comparable with the respective scatters

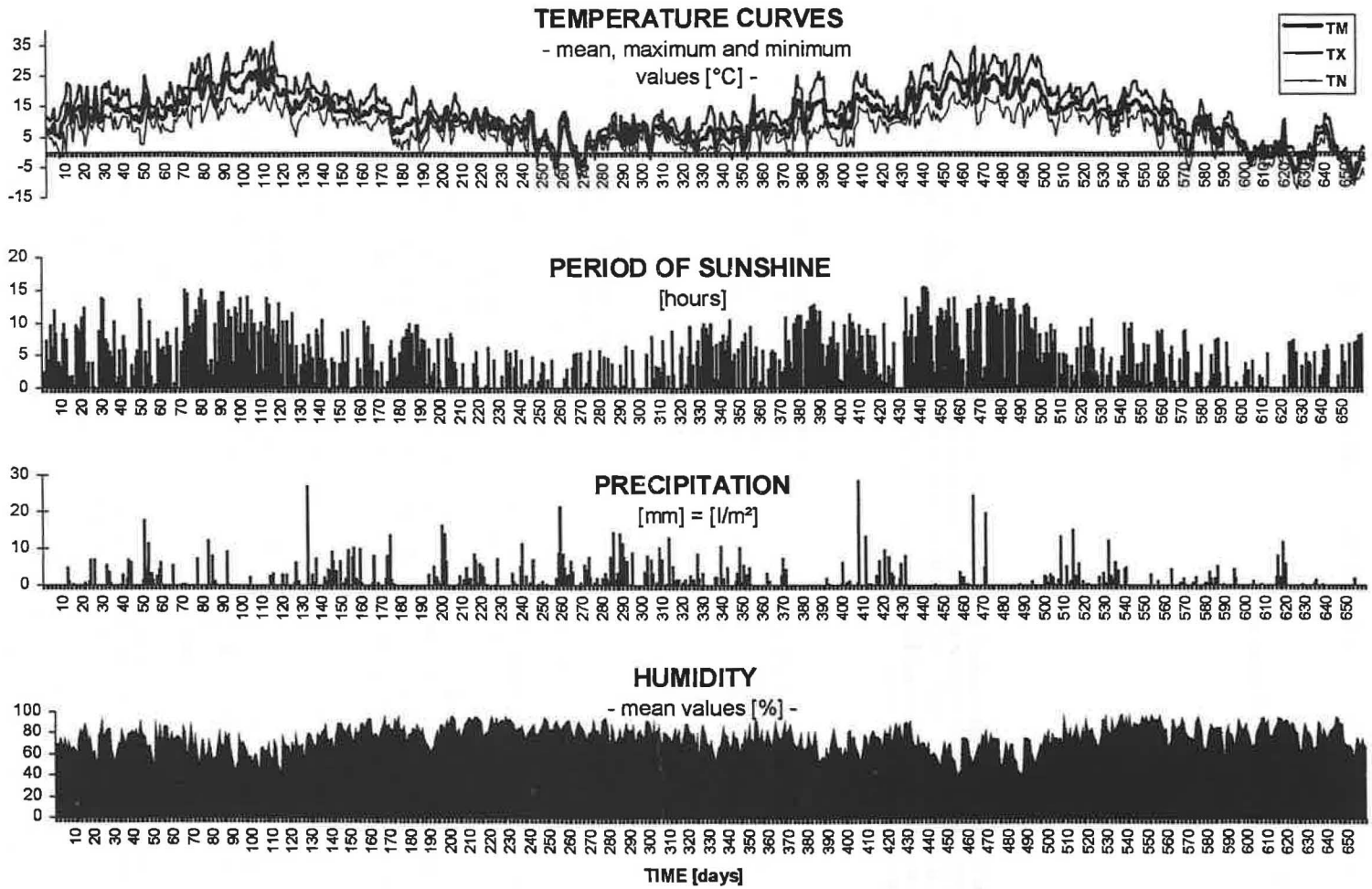

Fig. 1 Weather conditions of test series B (in the open air)

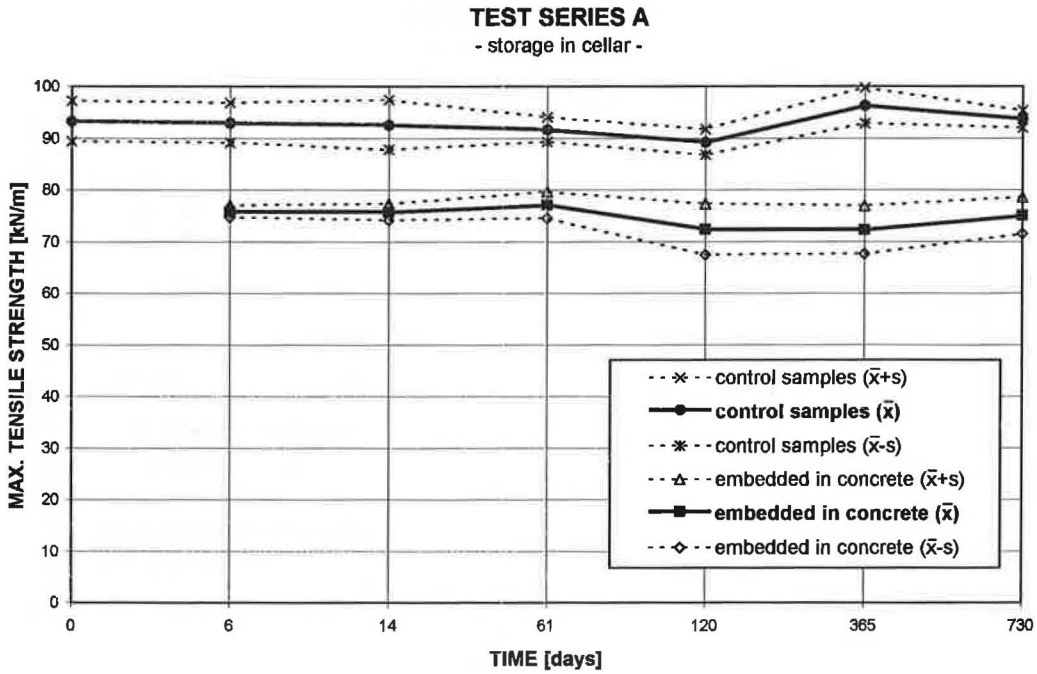

Fig. 2 Max. tensile strength of geogrids embedded in concrete and control samples - test series A

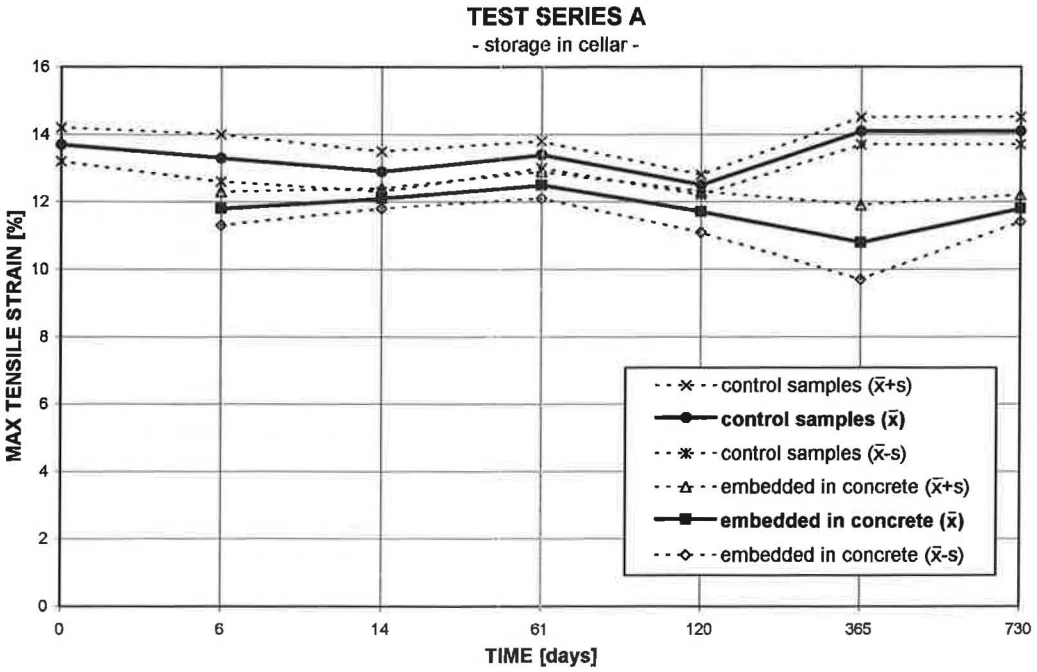

Fig. 3 Max. tensile strain of geogrids embedded in concrete and control samples - test series A

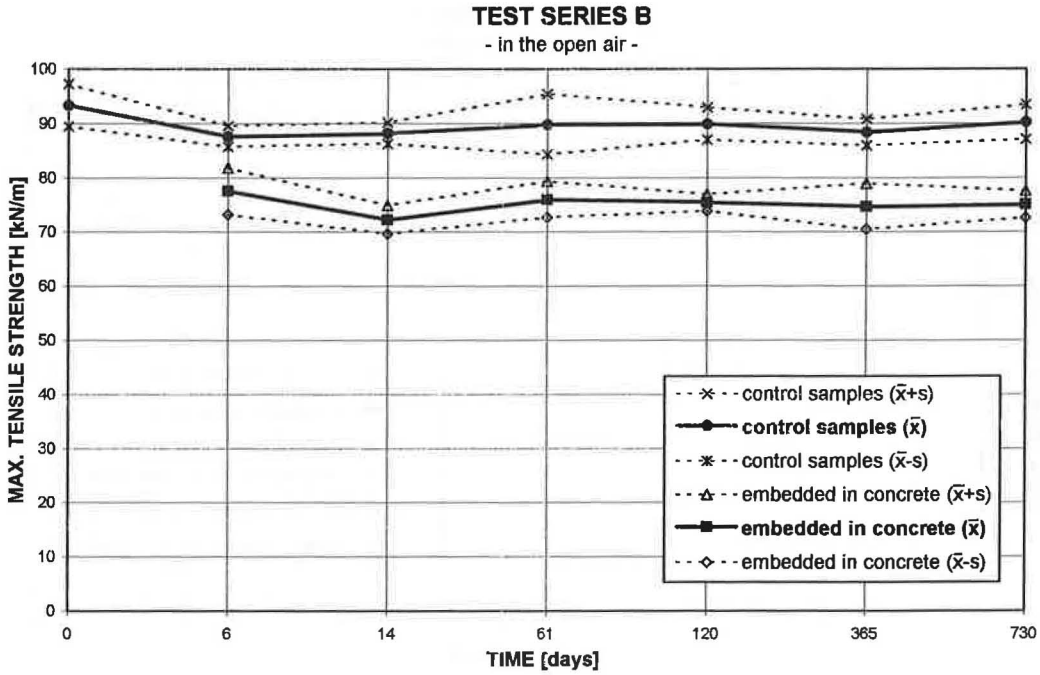

Fig. 4 Max. tensile strength of geogrids embedded in concrete and control samples - test series B

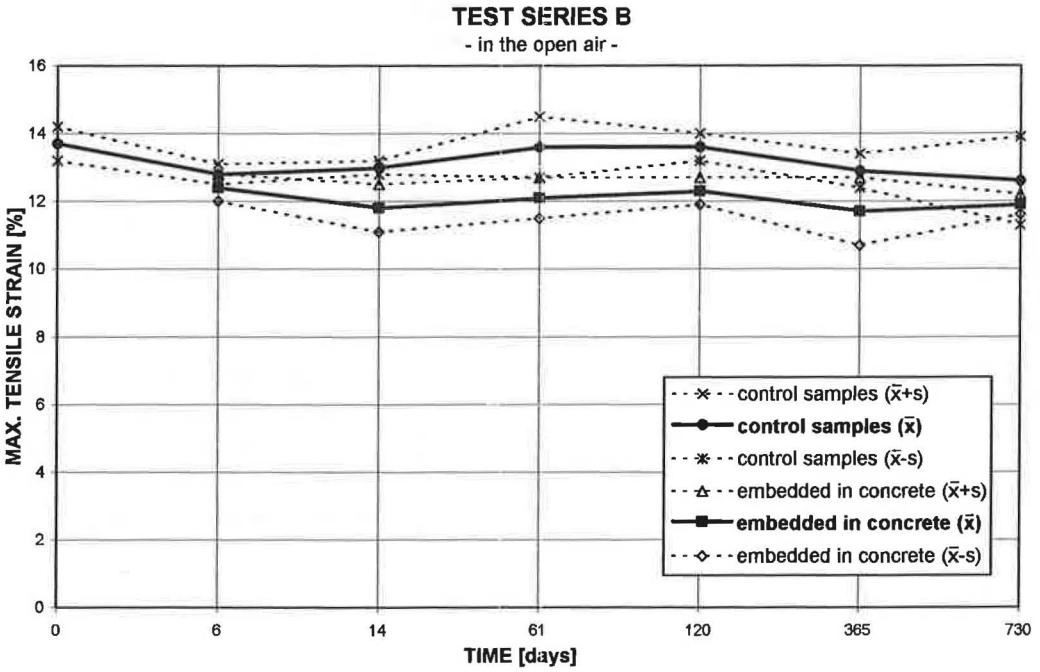

Fig. 5 Max. tensile strain of geogrids embedded in concrete and control samples - test series B

of the tensile test results.

During all tensile tests on samples embedded in concrete, the break of the geogrid appeared directly on the surface of concrete. This fact, together with the leap of 20 to 21% mentioned above (see Fig. 2 and 4), already after 6 days without significant changes later, let assume, that this reduction of tensile strength is probably a result of local tension concentration, tension leaps and an eccentric loading during testing.

The comparison between the reduction of the strength at the beginning (6 days) and the end (2 years) for the geogrids embedded in concrete of the test series A and B shows a reduction of tensile strength of 1 to 3%. This fact is not relevant from the point of view of this evaluation because the results of both test series show an increase of strength after the first year (see Fig. 2 and 4).

5 SUMMARY

To determine any losses of tensile strength of concrete-embedded coated polyester geogrids by external hydrolysis test series for storage in water and in the open air (weathering) were carried out. No statistical significant losses of strength coused by external hydrolysis can be found out within a test period of the past 2 years. A trend towards a reduction of strength is also not noticeable.

Additional tests on still existing samples will be carried out after further 2 years.

REFERENCES

Damisch, A. 1996. Zugversuche an einbetonierten Polyestergeogittern. unpublished test report, IBD Stendal, Germany