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Institut für Baustoffe, Massivbau und Brandschutz | Materialprüfanstalt für das Bauwesen

Test Report

- Translation -

Document No.:	(5046/783/14a) – Pan of 20/10/2014
Client:	Bekina Compounds NV Berchemstraat 124 B 9690 KLUISBERGEN
Order date:	03/01/2014
Subject:	Verification of fitness for use of a "BeSealed Polybar Quellband" swelling tape for sealing construction joints in structural elements made from concrete with a high water penetration resistance - Tests for obtaining certification with a General Type Examination Certificate (abP) -
Test basis:	Test principles for joint sealing solutions prepared by the working committee of Deutsches Institut für Bautechnik (DIBt), Berlin, for General Building Code Test Certificates issued in compliance with Bauregelliste A Part 2 No. 1.4 ("Erteilung allgemeiner bauaufsichtlicher Prüfzeugnisse für Produkte nach Bauregelliste A Teil 2, No. 2.53"), revision status: October 2012
Test material received:	30/01/2013
Sampling:	Made by the client
Test period:	February until October 2014

This Test Report consists of 6 pages, including the cover sheet, and 6 annexes.

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Notified body (0761-CPD)
MPA Braunschweig has been approved and notified as a civil engineering supervisory, inspection and certification body. MPA Braunschweig has been ISO/IEC17025 accredited as a testing and calibration laboratory and ISO/IEC17020 accredited as an inspection body.

1 Commission

Bekina Compounds NV commissioned the Braunschweig Civil Engineering Materials Testing Institute (MPA) to carry out tests with the "BeSealed Polybar Quellband" swelling tape in connection with the "BeSealed Kontaktklebstoff" contact adhesive for certification with a General Type Examination Certificate (abP) in compliance with Bauregelliste A, Part 2, No. 2.53 (joint sealing solutions for structural elements made from concrete with a high water penetration resistance against pressing and non-pressing water and against ground moisture).

The "BeSealed Polybar" swelling tape is produced on the basis of synthetic rubber with components that swell in the presence of water; it comes as a rectangular element with the dimensions 20 mm x 5 mm (width x height).

The "BeSealed Kontaktklebstoff" contact adhesive is a single-component adhesive that is based on an MS polymer.

To demonstrate the fitness for use, the sealing behaviour of the swelling tape was tested with changing water pressures in a structural element test.

The following tests were made in addition for determination of the material characteristics and properties:

Swelling tape:
- dimensions/density
- Shore-A hardness
- Thermogravimetric analysis
- Swelling behaviour when store in distilled water, alkaline liquid and concrete attacking liquid (pH 4.5)
- Swelling pressure
- Reaction to fire (class B 2)

Adhesive:
- Density
- Infrared spectrum

This Test Report has been drawn up to present the test results.

2 Testing and test results

2.1 Leak test

The test installation is shown in Figs. A1 to A3. The swelling tape (cross section: 20 mm x 5 mm) was placed into the middle of the 30-centimetre wide construction joint between the concrete members (watertight concrete, grade C 30/37) as described in the instructions for installation (annex 6). The swelling tape was fixed with the adhesive. Once the top concrete had fully hardened, the construction joint was widened to 0.25 mm and fixed, and then the water pressure was applied.

The water pressure was raised in 0.25-bar steps with retention times of 24 hours to 1 bar, and then in 1-bar steps with retention times of 24 hours to 5 bar, and maintained at a constant level for 2

weeks. After that, the water was removed, and the joint was dried for 6 weeks. This test cycle with application of the water pressure and drying was repeated three times. Test parameters and test results are listed in table 1 below.

Table 1: Test results for the leak test

Water pressure (bar)	Exposure time (hrs)	Test results
0.25	24	No leaks
0.5	24	No leaks
0.75	24	No leaks
1	24	No leaks
2	24	No leaks
3	24	No leaks
4	24	No leaks
5	3 test cycles [1)]	No leaks

[1)] 1 test cycle = 2 weeks with 5 bar water pressure; 6 weeks drying

2.2 Material characteristics and properties of the swelling tape

2.2.1 Geometry and weight

The dimensions were determined with a slide gauge (accuracy 0.01 mm). For determining its weight, the tape was weighed (accuracy 0.01 g). The table below lists the values averaged for 10 samples.

Table 2: Geometry and weight

Cross section (width/height) in mm	20.0/5.1
Weight (g/m)	131

2.2.2 Density

The density of the swelling tape was determined on the basis of DIN EN ISO 1183-1 (immersion test). Table 3 shows the mean value of three samples.

Table 3: Density

Density (g/cm³)	1.26

2.2.3 Shore-A hardness

The Shore-A hardness was determined at a temperature of 21 °C after 15 s in accordance with DIN EN ISO 868. Table 4 shows the median for 5 samples.

Table 4: Shore-A hardness

Shore-A hardness	36

2.2.4 Thermogravimetric analysis

The thermogravimetric analysis for the swelling tape was made in accordance with the specifications in DIN EN ISO 11358. Measurements were made at temperatures between 25 °C and 1000 °C in a nitrogen atmosphere at a heating rate of 10 K/min. The material samples were measured in their as-supplied state.

TG/DTG graphs are shown in annex 3.

Table 5: Weight losses of the swelling tape at temperatures between 25 °C and 1000 °C

Weight loss (%)	78.6

2.2.5 Behaviour of the swelling tape when stored in distilled water, alkaline liquid and concrete attacking liquid (pH 4.5)

Three samples each of the swelling tape (approx. 150 mm long) were stored for 48 hours in distilled water, alkaline liquid (liquid according to ETAG 004: 1 l of water; 1 g of NaOH; 4 g of KOH; 0.5 g of $Ca(OH)_2$), and in a pH 4.5 liquid (SO_4^{2-} - > 4000 mg/l; sulphate content adjusted with Na_2SO_4) until a change in weight of $\Delta m_{48} \leq 2$ % was observed. After that, the samples were dried for 48 hours in a standard 23/50-2 climate, until again a change in weight of $\Delta m_{48} \leq 2$ % was observed. This cycle was repeated three times.

Table 6 below shows the mean values of the test results. The changes in weight are shown as a function of time in the graph in annex 4.

Table 6: Swelling behaviour of swelling tape stored in water, alkaline and acid liquid

Test liquid	Change in weight in % after					
	1st storage in liquid	1st drying phase	2nd storage in liquid	2nd drying phase	3rd storage in liquid	3rd drying phase
Dist. water	518	0	465	1	468	5
Alkaline	333	4	364	5	380	8
pH 4.5	243	0	225	1	213	1

2.2.6 Swelling pressure

To verify the swelling pressure in the installed state, three strength class C 30/37 concrete elements were produced, in which one 20 x 5 mm (length = 100 mm) swelling tape each was set in the concrete without joint (Fig. A7). After the first half of the specimen had been concreted, the swelling tape was applied with the adhesive to the untreated hardened concrete. Before concreting the second half of the specimen, a PE film was placed on the surfaces not covered by the swelling tape, so as to provide for a defined expansion process and unhindered access of the water to the swelling tape while determining the swelling pressure.

After the concrete had hardened, the specimens were widened by 0.25 mm and then placed into a water bath, so the water could get to the swelling tape from all sides. The water bath with the specimen was mounted in a test frame with an incorporated load cell to be able to determine the swelling pressure. The preload was 0.05 N/mm². Fig. A7 shows the test installation and the specimen.

After 45 days, a maximum swelling pressure of 1.30 N/mm² (mean value) was reached. Constituent parts of the material were not found to emigrate into the joint. The increase in stress as a function of time is shown in the graph in Fig. A8.

2.2.7 Reaction to fire

The test was made for the swelling tape in a joint (fibre cement boards) in accordance with DIN 4102. The mean values of the test results are shown in table 7 below.

Table 7: Reaction to fire

Exposure conditions	Ignition (s)	Max. height of flame (cm)	Flames extinguished themselves (s)	Burning droplets (s)	Smoke production
Flames applied to edge	1	6 to 7	30[1)]	-	2
Flames applied to surface	5 to 6	4	15	-	1

[1)] Flames extinguished

On the basis of the results that were produced in the test, the product can be classified as a building material class B2 material in accordance with DIN 4102-1.

2.3 Material characteristics of the adhesive

2.3.1 Density

The density of the hardened adhesive was determined on the basis of DIN EN ISO 1183-1 (immersion test). Table 8 shows the mean value of three samples.

Table 8: Density

	BeSealed contact adhesive (7-day hardening)
Density (g/cm³)	1.49

2.3.2 Infrared spectrum

The infrared spectrum of the contact adhesive was determined with the Golden Gate Single reflection ATR unit without having been subjected to any further preconditioning.

The amount of material was selected, so the requirements specified in DIN 51451 for the extinction ratio are complied with.

The IR spectrum was recorded with a Perkin-Elmer FTIR unit of the type Frontier within a range of 4000 cm^{-1} to 600 cm^{-1} reciprocal centimetres.

The infrared spectrum is shown in annex 3.

This document is the translated version of Test Report 5046/783/14a – Pan dated 20/10/2014. The legally binding text is the aforementioned German Test Report.

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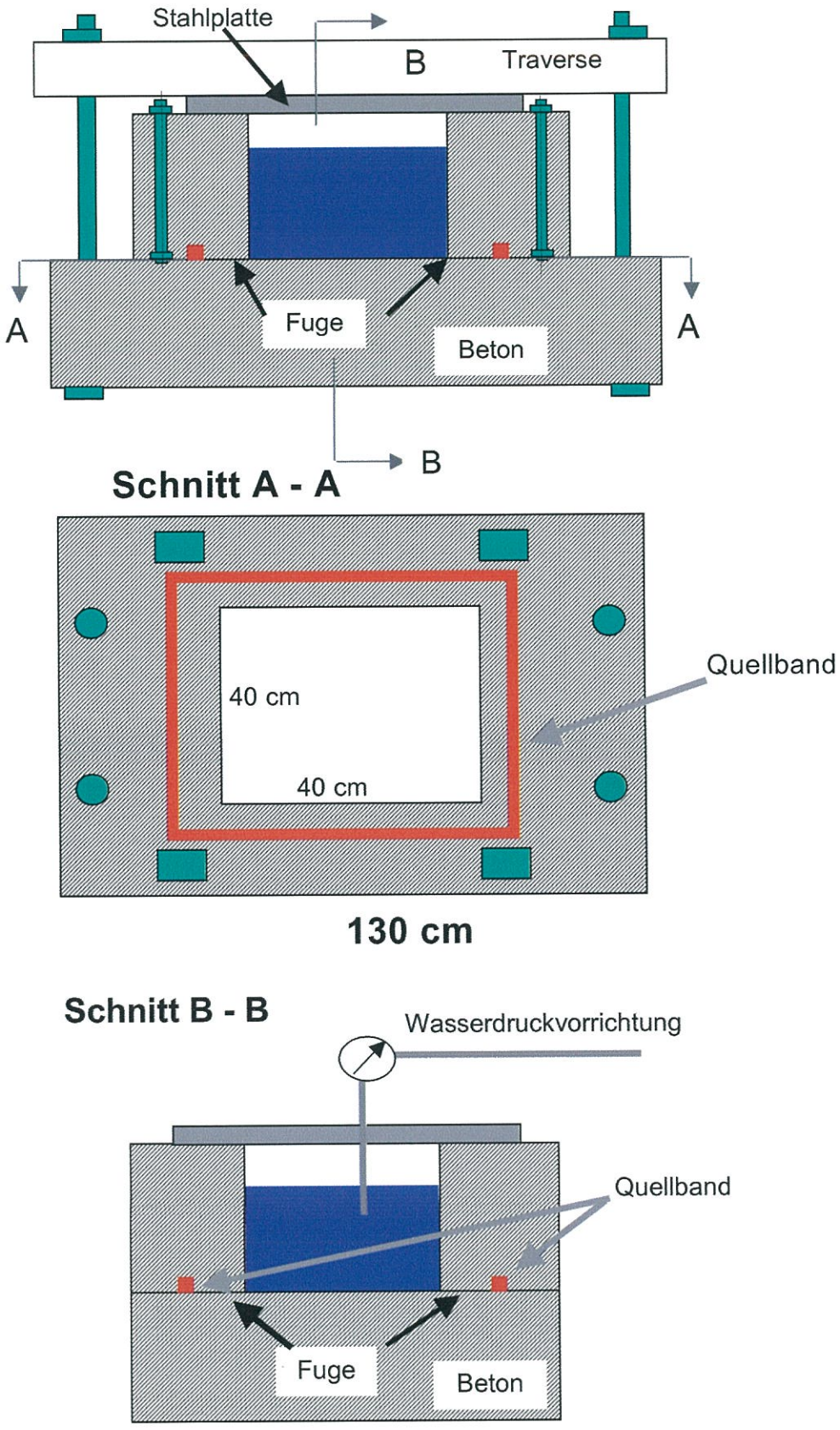

Fig. A1: Test installation, leak test (construction joint sealing with a swelling tape); sketch

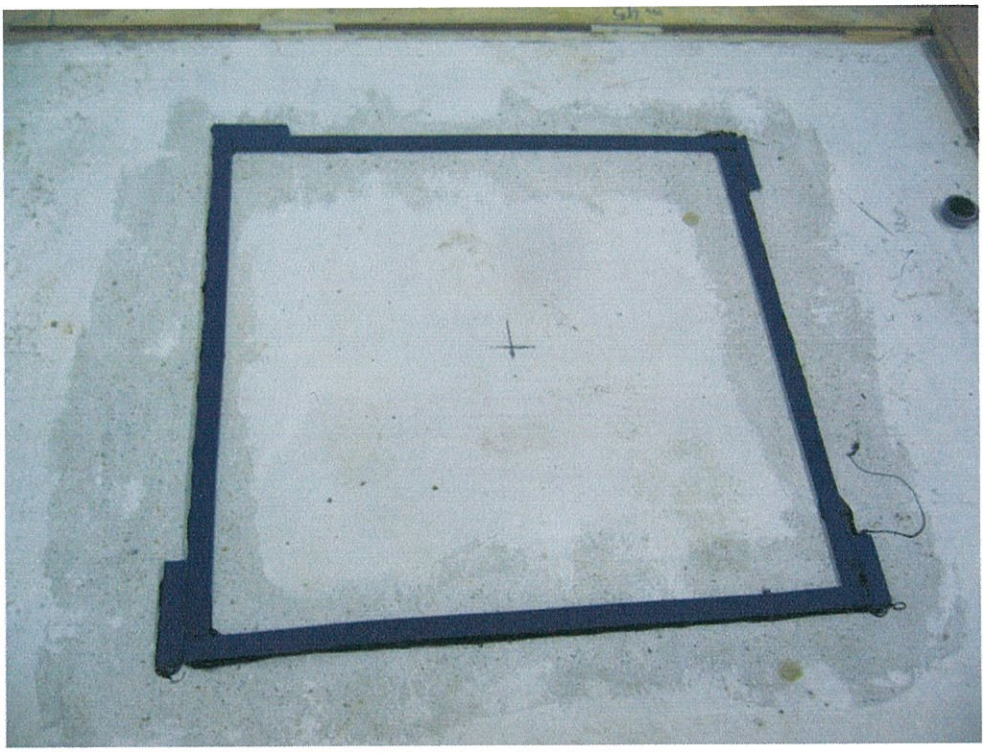

Fig.A2: Specimen with fitted swelling tape

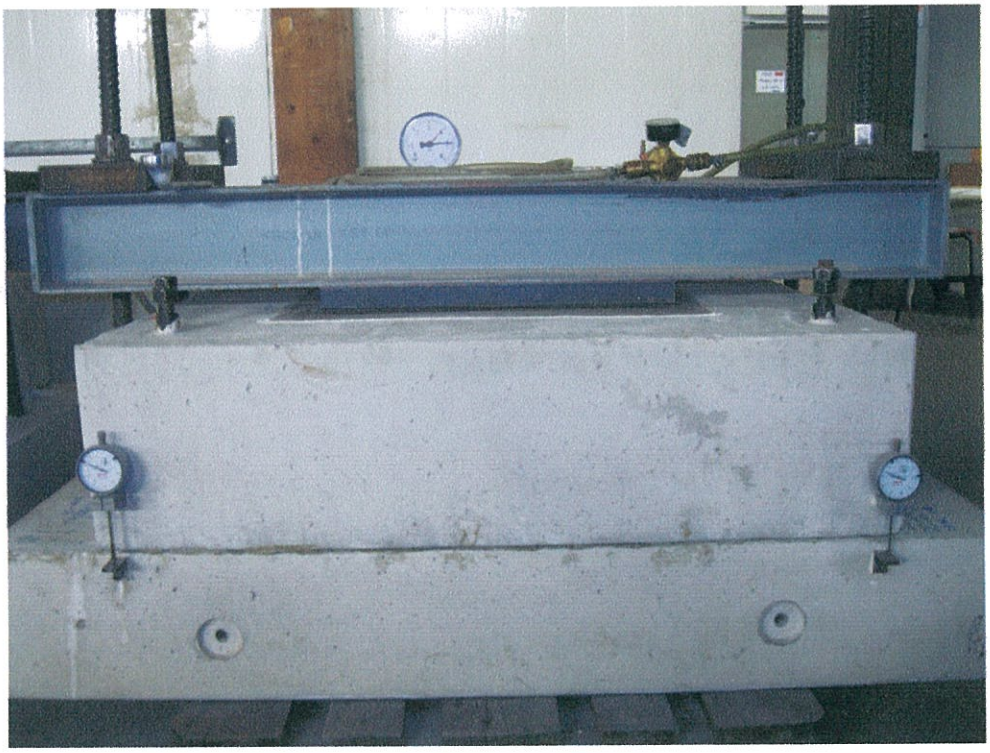

Fig. A3: Test installation and leak test

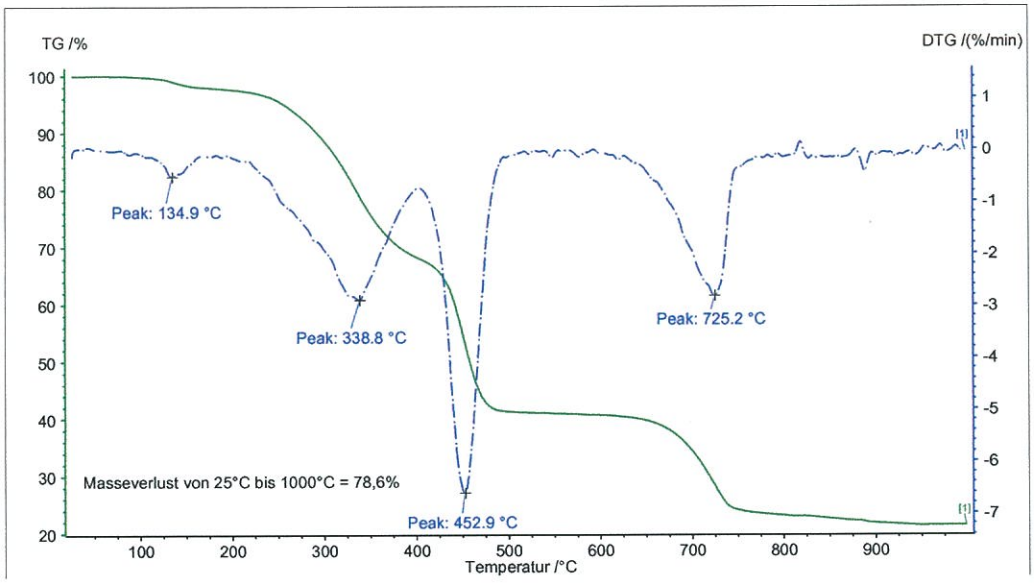

Fig. A4: TG and DTG graphs for "BeSealed Polybar" swelling tape

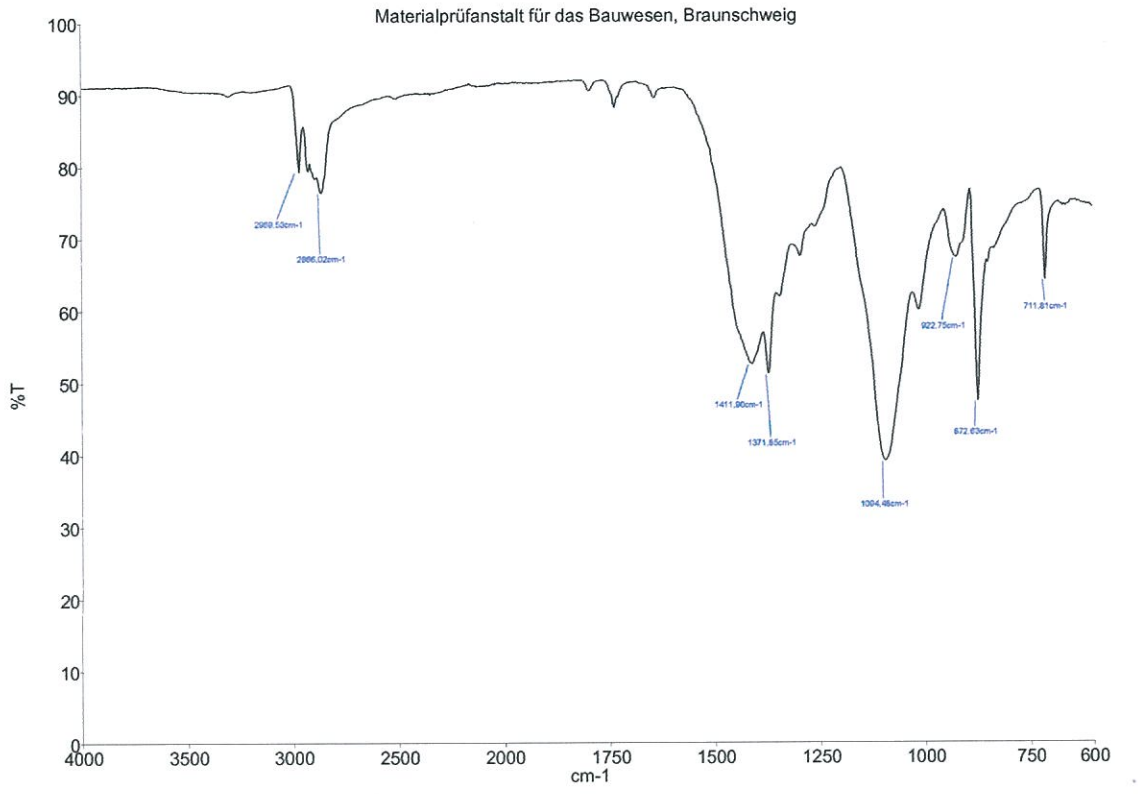

Fig. A5: Infrared spectrum of "BeSealed Kontaktklebstoff" contact adhesive

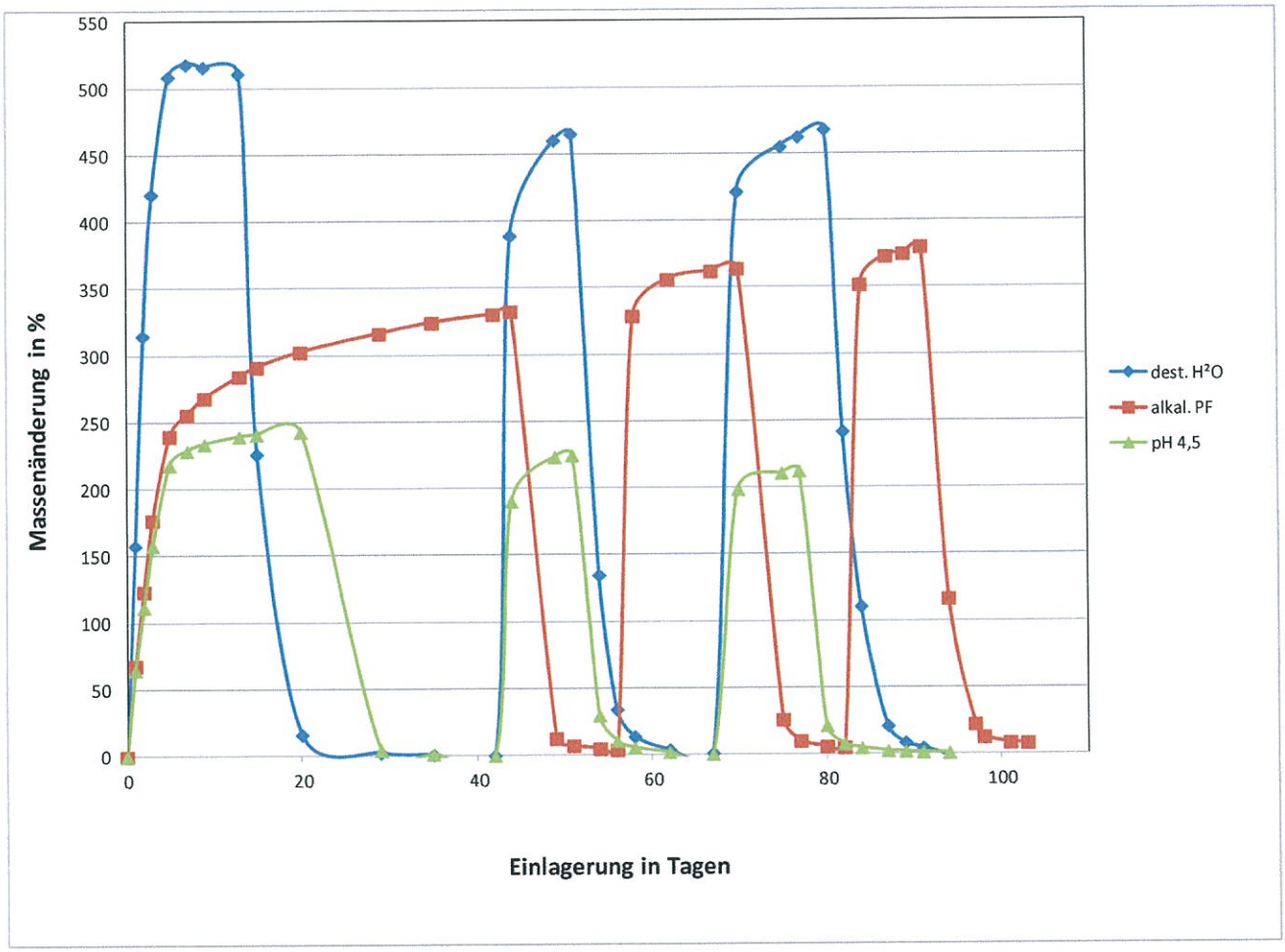

Fig. A6: Change in weight of the swelling tape when stored in distilled water, alkaline liquid and concrete attacking liquid (pH 4.5)

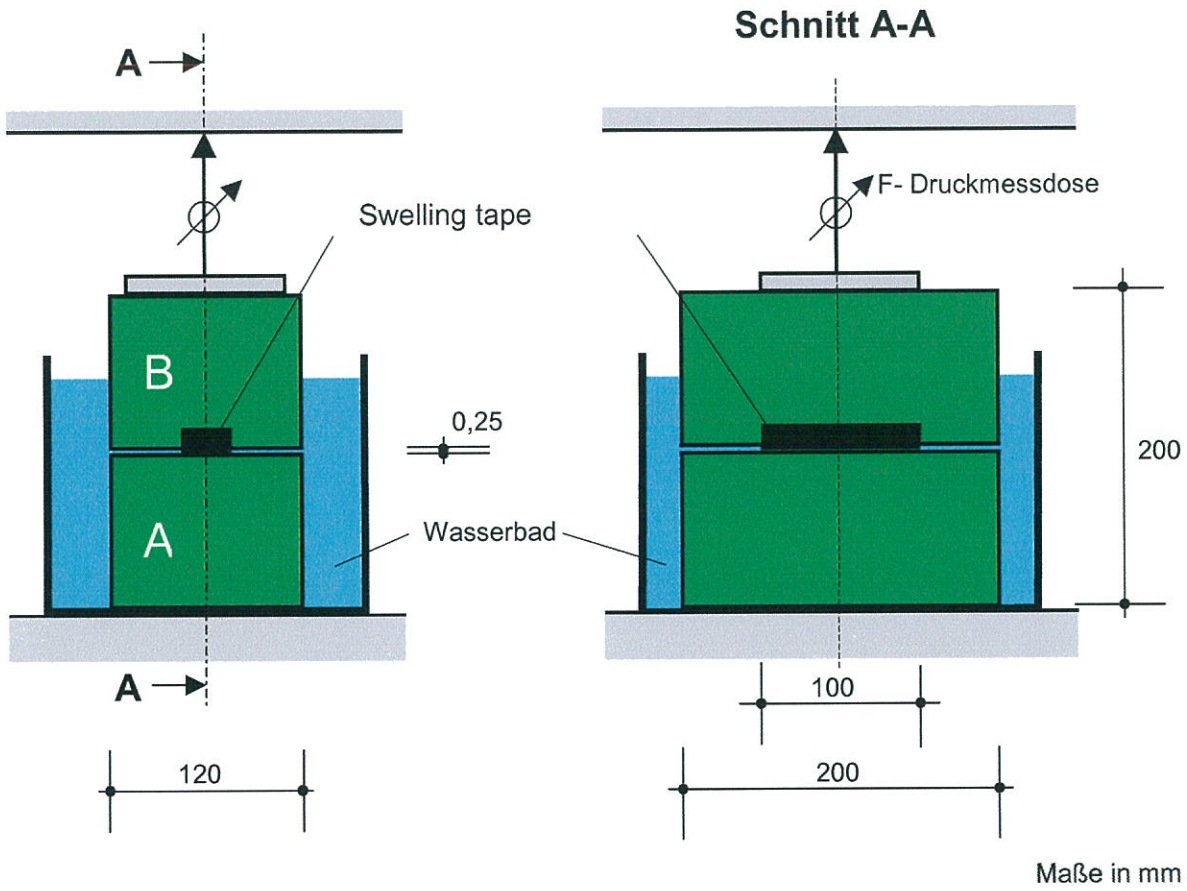

Fig. **A7:** Specimen and test installation for determination of the swelling pressure

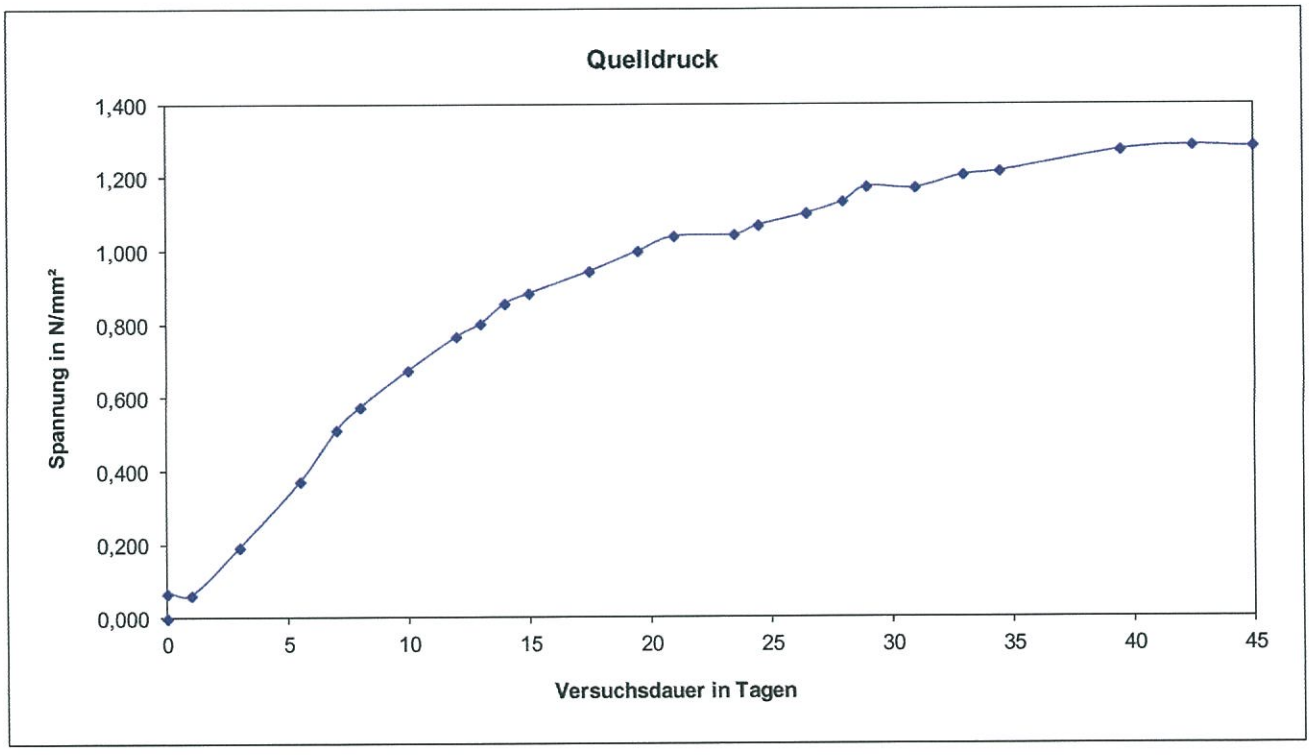

Fig. A8: Development of the swelling pressure plotted against time

Instructions for installation

- The "BeSealed Polybar" swelling tape has to be stored in a dry place and left in its original packaging until it is used.
- The base material must be dry, plane and it must have been freed from loose material, cement slurry and release agents.
- To prevent underflow, the swelling tape has to be glued to the base material with the "BeSealed" contact adhesive applied to its full face.
- The swelling tape is glued in place in the middle of the joint, leaving a space of about 8 cm both at the inner and the outer reinforcement. In members of a relatively large thickness, the swelling tape can be installed within 1/3 d to 1/2 d of the member thickness d (with respect to the exposed side).
- Joint areas are abutted, and fixed with an additional piece of swelling tape immediately next to the joint (overlap ≥ 20 mm each).
- The swelling tape has to be checked for perfect fit and premature swelling before placing the concrete.

Due regard must be given to the regulations in DIN 1045, Part 1 - 4, the regulations for watertight structures (WU-Richtlinie), and DBV codes of practice (DBV-Merkblätter) in designing and providing joints.