

Test certificate no. 21000262-06-01-07e

**Customer**

Pagel-Spezialbeton  
GmbH & Co. KG  
Wolfsbankring 9  
  
45359 Essen

**Date of commission** 20.06.2006

**Date samples received** 20.06.2006

**Commission**

Test of the freeze-thaw resistance (CDF test method)

**Sample type**  
„V1/50 PAGEL – VERGUSS“

**No. of samples**  
25 drums x 25 kg

**Description of the tests or the provisions on which they were based**

Test of the freeze-thaw resistance in accordance with CDF test method under **DIN CEN 12390-9**, Testing hardened concrete, Part 9: Freeze-thaw resistance, scaling, published May 2002.

The results of the test refer exclusively to the sample(s)/the test object described above.  
Test certificates may not be published or copied with changes to the form or contents without the approval of the MPA NRW.  
Publication of extracts from a test report is only permissible with the approval of the MPA NRW.

This test certificate has 4 pages.

## 1 Sampling

On 20.06.2006 a representative of the test body took the sample in the Essen production plant arbitrarily from a larger stock and marked it; on 20.06.2006 a representative of the customer delivered it to the MPA NRW in Dortmund for testing.  
A record was made of the sampling.

## 2 Customer's data

Product designation: „**V1/50 PAGEL – VERGUSS**“  
Added water = 3.00 l / 25 kg

## 3 Test results

### 3.1 Determining the mixing ratio, fresh mortar characteristics and consistency

The sample was made from the dry factory-mixed grouting material in the climatic chamber at normal climate 20/65 in accordance with DIN 50 014.  
EN 196 Part 1 - Methods of testing cement Part 1: Determination of strength (May 1995) was used to make the mixture. First of all the required amount of water was filled and the dry grouting material was added with the agitator set to a low speed. After all starting materials were added there was an additional mixing time of 3 minutes - total mixing time: 5 minutes.

### 3.2 Fresh mortar characteristics

#### Mixing ratio

Water : „ <b>V1/50 PAGEL – VERGUSS</b> “	: 1 : 8.33 in weight parts
Water solid matter ratio	: 0.12
Assessment of consistency	: K <sub>M</sub> 3 soft flowing
Fresh mortar bulk density	: 2.29 kg/dm <sup>3</sup>

The following tests were all carried out using the mixing ratio shown in No. 3.2.

### 3.3 Freeze-thaw resistance in accordance with the CDF test method

The test was carried out using the CDF test method in accordance with draft E DIN EN 12390-9, May 2002 edition.

Cubes with an edge length of 150 mm were made for this purpose. The test specimens required for the test were acquired by sawing to size: the saw cut was vertical to the upper side as produced. The surface concreted against the steel mould served as the test surface.

The sides of the samples were sealed with an aluminium adhesive tape with butyl rubber. The test liquid absorption (3 mass % NaCl solution) was calculated both during the capillary suction and during the 28 freeze-thaw changes from the mass of the samples measured on the respective test date and taking account of scaling. The value related to the mass of the samples directly before the capillary suction (without sealing of the sides) was given to 0.1 mass %. The measuring results for the scaling and the water absorption were calculated as mean values from each of the five individual measurements.

#### Results

Neither German nor European standards contain a limit value for the CDF test for the maximum permissible scaling of concrete after 28 freeze-thaw changes. A maximum permissible value of 1.5 kg/m<sup>2</sup> is given in the literature (Setzer, M.J., *Prüfung des Frost-Tausalz-Widerstandes von Betonwaren, Forschungsberichte aus dem Fachbereich Bauwesen Heft 49*, published by the Dean of Technical Department 10 of the Universität – Gesamthochschule – Essen, Vol. 49, Essen, 1990). Table 5 contains the individual values for the scaling on the four test dates after 4, 14, 18 and 28 freeze-thaw changes.

An average 0.217 kg/m<sup>2</sup> scaling was measured for the three test specimens after 28 changes. The individual values lay in the range between 0.165 kg/m<sup>2</sup> and 0.296 kg/m<sup>2</sup>.

Table 6 contains the individual values for test liquid absorption during capillary suction and the following 28 freeze-thaw changes. During capillary suction the average liquid absorption of the test specimens was 0.22 mass %. Following this, the test specimens again absorbed on average 0.26 mass % during the 28 freeze-thaw changes.

Table 7 shows the evaluation of the relative dynamic e-modulus; a significant reduction of the e-modulus was **not** observed.

**Table 5: Individual values for scaling, „V1/50 PAGEL – VERGUSS“**

Number of FTCs	Scaling in kg/m <sup>2</sup>				Standard deviation
	1	2	3	Mean value	
4	0.017	0.026	0.029	0.024	0.01
14	0.081	0.087	0.135	0.101	0.06
18	0.114	0.114	0.182	0.136	0.08
28	0.191	0.165	0.296	<b>0.217</b>	0.13

**Table 6: Individual values for water absorption (capillary suction), „V1/50 PAGEL – VERGUSS“**

After days	Absorption of the test liquid in mass %				Standard-deviation
	1	2	3	Mean value	
	Capillary suction				
0	0.00	0.00	0.00	0.00	0.00
1	0.16	0.14	0.15	0.15	0.01
3	0.19	0.15	0.16	0.17	0.02
7	0.26	0.20	0.21	0.22	0.03
	Freeze-thaw changes				
After FTCs					
0	0.00	0.00	0.00	0.00	0.00
4	0.09	0.12	0.10	0.10	0.02
14	0.22	0.21	0.17	0.20	0.02
18	0.24	0.24	0.20	0.23	0.02
28	0.28	0.27	0.23	0.26	0.03

**Table 7: Individual values for the evaluation of the relative dynamic e-modulus of the test specimens „V1/50 PAGEL – VERGUSS“**

Number of FTCs	Rel. dyn. e-modulus of the test specimens in %				Standard deviation
	1	2	3	Mean value	
0	100.0	100.0	100.0	100.0	0.00
4	99.7	99.3	98.9	99.3	0.40
14	99.0	98.3	97.7	98.3	0.69
18	98.8	97.9	97.4	98.0	0.70
28	98.4	97.1	96.3	97.3	1.03

Dortmund, 26.03.2007

p.p.




Dipl.-Ing. Christoph Kühn  
 Inspector