

Test certificate no.

21000262-06-02-05e

Monitoring contract no. 217099

Customer

Pagel-Spezialbeton
GmbH & Co. KG
Wolfsbankring 9

45359 Essen

Monitoring contract dated 15.10.1998

Date of commission 05.12.2006

Date samples received 06.12.2006

Commission

Initial test in accordance with the **DafStb Code of Practice**
Manufacture and Application of Cement-Bound Grouting Concrete and Grouting Mortar

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

Initial test in accordance with the **DafStb Code of Practice**
Manufacture and Application of Cement-Bound Grouting Concrete and Grouting Mortar,
June 2006.

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Test certificates may not be published or copied with changes to the form or contents without the approval of the MPA NRW.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 7 pages.

1 Sampling

On 05.12.2006 a representative of the test body took the sample in the Essen production plant arbitrarily from a larger stock and marked it; on 06.12.2006 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 : „ V1/50 PAGEL – VERGUSS “	: 1 : 8.33 in weight parts
Water solid matter ratio	: 0.12
Assessment of consistency	: F ₆ very much flowing
Fresh mortar bulk density	: 2.31 kg/dm ³

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

3.3 Working properties

The working properties of the grouting mortar were specified by determining the extent of the slump. After all starting materials were added and the mixing process was completed the extent of the slump was measured corresponding to the prescribed periods in accordance with section 3.3.2.1 of the DafStb Code of Practice.

**Table 1: Slump, „V1/50 PAGEL – VERGUSS“
 Amount of water 3.00l / 25 kg**

Period after completion of mixing process	Slump in mm
5 minutes	770
30 minutes	790
60 minutes	765
90 minutes	750
Processing time: slump may be reduced by max. 80 mm after 30 minutes	
Requirements fulfilled:	+

+ = Requirements fulfilled
 – = Requirements not fulfilled

3.4 Swelling

The change in volume of the grouting mortar was determined on the basis of DIN EN 445, grout for prestressing tendons, July 1996.

The results can be seen in the following table.

**Table 2: Swelling behaviour, „V1/50 PAGEL – VERGUSS“
 Date made: 08.01.2007**

Sample no.	Age of sample on test day	(Volume change in vol.-%)
1	24 hours	+ 0.6
2		+ 0.6
3		+ 0.8
Mean value:		+ 0.7
Setpoint:		≥ + 0.1

*) - sign = Reduction in volume (shrinkage)
 + sign = Increase in volume (swelling)

3.5 Segregation and sedimentation stability

Segregation and foam formation on the surface of the fresh concrete were not visible. Sedimentation was not visible at the hardened grouting concrete samples.

3.6 Shrinkage

The test was carried using cylinders with a diameter of 150 mm and a height of 300 mm in conformity with DafStb Heft 422, Testing Concrete, Recommendations and Commentary as a Supplement to DIN 1048, Section 2.6.

The specimens were made in accordance with section 3.2. After 24 hours the samples were released from the formwork and the reference measuring was carried out. After this the specimens were stored at 20°C and 65 % rel. humidity. Shrinkage was measured after 7, 28, 56 and 91 days.

The results can be seen in the following table.

**Table 3: Shrinkage at the cylinder diameter 150 mm, height 300 mm, „V1/50 PAGEL – VERGUSS“
 Date made: 08.01.2007**

Serial no. of sample	Age of samples on day of test	After-shrinkage Storage 20°C and 65 % rel. humidity	
		At the prism in mm	Converted to mm/m
1	7 days	0.148	0.493
2		0.138	0.460
3		0.126	0.420
Mean value		0.137	0.458
1	28 days	0.223	0.743
2		0.208	0.693
3		0.192	0.640
Mean value		0.208	0.692
1	56 days	0.258	0.860
2		0.251	0.837
3		0.234	0.780
Mean value		0.248	0.826
1	91 days	0.301	1.003
2		0.281	0.937
3		0.266	0.887
Mean value		0.283	0.942

Requirements: Shrinkage class SKVB I: $\epsilon_{s,m91} \leq 0.8 \text{ mm/m}$
 $\epsilon_{s,i91} \leq 1.0 \text{ mm/m}$
 Shrinkage class SKVB II: $\epsilon_{s,m91} \leq 1.5 \text{ mm/m}$
 $\epsilon_{s,i91} \leq 2.0 \text{ mm/m}$

3.7 Compressive strength

Preparation of the specimens and the test took place in conformity with DIN EN 12390-3, Testing hardened concrete, Part 3: Compressive strength of test specimens.

Cubes with an edge length of 150 mm were made as the test specimens. The grouting concrete was poured into the moulds without compression (lightly rodded) and covered with oiled glass plates.

For the determination of the strength at 24 hours the specimens were stored in their steel moulds and were removed shortly before the start of the time for the test.

After 24 hours the other samples (test age 7, 28, 56 and 91 days) were removed from the moulds and stored under water up to the test.

The results are contained in the following table.

Table 4: Compressive strength, „V1/50 PAGEL – VERGUSS“
 Date made: 08.01.2007

Serial no. of sample	Age of samples on day of test	Bulk density	Compressive strength $f_{c,cube}$
		kg/dm ³	N/mm ²
1	24 hours	2.26	49
2		2.26	49
3		2.26	49
Mean value		2.26	49
4	7 days	2.27	72
5		2.27	72
6		2.26	72
Mean value		2.27	72
7	28 days	2.27	89
8		2.26	88
9		2.29	89
Mean value		2.27	89
10	56 days	2.27	97
11		2.29	99
12		2.28	97
Mean value		2.28	98
13	91 days	2.30	106
14		2.28	105
15		2.28	108
Mean value		2.29	106

Requirements: after 24 hours $f_{c,cube} \geq 40$ N/mm² (Class A),
 $f_{c,cube} \geq 25$ N/mm² (Class B),
 $f_{c,cube} \geq 10$ N/mm² (Class C),
 after 28 days $f_{c,cube} \geq 55$ N/mm², strength class \geq C 50/60
 after 56 and 91 days no loss of strength

4 Summary

The above tests were carried out in accordance with the **DafStb Code of Practice, Manufacture and Application of Cement-Bound Grouting Concrete and Grouting Mortar**, June 2006.

The „**V1/50 PAGEL – VERGUSS**“ conforms to the quality requirement of the above provision with regard to the tested fresh and hardened concrete properties.

All examinations were carried out with a mixing ratio of 3.00 l water to 25 kg „**V1/50 PAGEL – VERGUSS**“.

The „**V1/50 PAGEL – VERGUSS**“ can be classified as follows under the DafStb Code of Practice, Manufacture and Application of Cement-Bound Grouting Concrete and Grouting Mortar, June 2006:

	Test value	Classification
Slump class:	770 mm	a₃ (≥ 700 mm)
Shrinkage class:	$\epsilon_{s,m91} = 0.9 \text{ mm/m}$ $\epsilon_{s,i91} = 1.0 \text{ mm/m}$	SKVB II $\epsilon_{s,m91} \leq 1.5 \text{ mm/m}$ $\epsilon_{s,i91} \leq 2.0 \text{ mm/m}$
Early strength class	$f_{c,cube, 24h, min} = 49 \text{ N/mm}^2$	Early strength class A (≥ 40 N/mm ²)
Compressive strength class	$f_{c,i,cube, 28d} = 88 \text{ N/mm}^2$ $f_{c,m,cube, 28d} = 89 \text{ N/mm}^2$	C 60/75 , $f_{ci} \geq f_{ck} - 5$ $f_{cm} \geq f_{ck} + 5$

Dortmund, 20.06.2007

p.p.



Dipl.-Ing. Christoph Kühr
Inspector

