

Test report no. 220417

Revision 1 - English Version

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Ordering party: Schomburg GmbH & Co. KG
Entwicklungs- und Produktionsgesellschaft
Aquafinstraße 2-8
32760 Detmold

Date of commission: 27.08.2021 / Mr Eltzroth

Subject of commission: Tests regarding the efficiency of water resisting admixture
for concrete - Resistance to carbonation

Product: BETOCRETE CL210-WP (DM)

Cement: CEM II/B-S 52.5 N

The test report contains 6 pages.

The testing material is used up.



All previous versions have now been replaced by this revision.
This version may only be used.

The test report shall be published unabridged. Any partial publishing requires written allowance by the testing institute. The test results refer only to the tested material.

1. General

The ordering party has assigned MPA HANNOVER to perform tests regarding the efficiency of water resisting admixture for concrete in comparison to a reference concrete. The scope of the tests to be carried out has been determined by the ordering party and is set out in section 3. This test report states the results of the tests.

2. Delivery of samples

On 05.10.2021 were delivered by an employee of the MPA HANNOVER:

12 pcs. Concrete cubes, L x B x H = 150 x 150 x 150 mm³
 3 pcs. Concrete beams, L x B x H = 500 x 100 x 100 mm³
 with following information:
 Date of production 04.10.2021
 Mixture no. Reference

and:

12 pcs. Concrete cubes, L x B x H = 150 x 150 x 150 mm³
 3 pcs. Concrete beams, L x B x H = 500 x 100 x 100 mm³
 with following information:
 Date of production 04.10.2021
 Mixture no. CL210-WP

3. Scope

The scope of performed tests listed in Table 1. The tests were performed each at the Reference concrete and at the concrete produced with the water resisting admixture BETOCRETE CL210-WP (CL210-WP). A cement type CEM II/B-S 52.5 N (Wittekind) was used for all mixtures.

Table 1: Scope of testing

Test ID	Type of test	Age of sample	No. of samples
1	Flow table test DIN EN 12350-5:2019-09	5 min, 30 min	1 each
2	Bulk density DIN EN 12350-6:2019-09	20 min	1
3	Air content DIN EN 12350-7:2019-09	20 min	1
4	Compressive strength and bulk density DIN EN 12390-3:2019-10 Cube 150 mm	1, 7 and 28 d	3 each
5	Determination of resistance to carbonation BAW-Guideline MDCC, Annex A Beams 500 x 100 x 100 mm Start of testing: 7 d	90 d	3

4. Results

4.1 Manufacture of samples

The samples were produced according to DIN EN 12390-2:2019-08 in the laboratory of Ha-Be Betonchemie GmbH, Hameln with attendance of a representative of MPA HANNOVER. A forced mixer UEZ LZ 35 was used for the mixing. The mixing time was 2 min after water addition. The superplasticizer and the water resisting admixture was added separately. The compositions of mixtures are listed in Table 2. All test specimens as well as the fresh mortar tests were produced from three mixtures each.

Table 2: Composition of mixtures

Raw material		Reference		CL210-WP	
		Quantity	Mass kg/m ³	Quantity	Mass kg/m ³
Cement	-	-	350	-	350
Water	-	-	175	-	175
w/c-ratio	-	-	0,50	-	0,50
Sand 0-2 mm	M.-% of aggregate	35	640	35	640
Gravel 2-8 mm		30	548	30	548
Gravel 8-16 mm		35	640	35	640
BETOCRETE CL210-WP (DM)	M.-% of cement	-	-	1.80	6.30
BETOCRETE SP10 (FM)		0.37	1.30	0.37	1.30

4.2 Bulk density of fresh concrete, air content and flow table test

The properties of fresh concrete were determined according to DIN EN 12350-5 (flow table test), DIN EN 12350-6 (bulk density) and 12350-7 (air content). The results are listed in Table 3.

Table 3: Results of test on fresh concrete^{*)}

		Reference	CL210-WP
		Air temperature	°C
Flow table test A after water addition in mm	5 min	420	400
	30 min	370	-
Fresh concrete temperature	°C	24.2	24.8
Bulk density of fresh concrete	kg/dm ³	2.35	2.31
Air content	Vol.- %	2.2	2.8

4.3 Compressive strength and bulk density

The determination of compressive strength was carried out 1, 7 and 28 days after casting according to DIN EN 12390-3 at cubes with 150 mm edge length. The mean values of the results are shown in Table 4. The details of the tests are shown in Appendix A1.

Table 4: Results of test of compressive strength according to DIN EN 12390-3, mean values

Mean of samples no.	Age d	Reference		CL210-WP	
		Bulk density kg/m ³	Compressive strength $f_{c,cube}$ MPa	Bulk density kg/m ³	Compressive strength $f_{c,cube}$ MPa
1-3	1	2360	31.2	2350	27.5
4-6	7	2340	54.3	2330	50.1
7-9	28	2320	67.2	2300	62.6

4.4 Resistance to carbonation

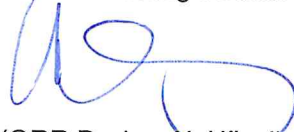
The carbonation resistance was tested on three concrete beams according to the BAW-Guideline "Durability design and assessment of reinforced concrete structures under carbonation and chloride action (MDCC)", Annex A following DIN EN 12390-10:2019-08. The sample age at the start of the test was 7 d. The mean values of the results are shown in table 5. The details of the tests are shown in Appendix A2.

Table 5: Resistance to carbonation

Probe	Carbonatisierungstiefe mm	
	Referenz	CL210-WP
after 90 d CO₂-storage		
1	1.0	0.5
2	1.0	0.5
3	1.0	0.5
Mean	1.0	0.5
Carbonatisierungsrate k_{NAC} (mm/a^{0.5})^{*)}	2.0	1.0

^{*)} based on BAW-Guideline „MDCC“ calculated after 90 d CO₂-storage


Hanover, 11 April 2022
Head of Testing Institute



(ORR Dr.-Ing. H. Höveling)



Contact



(Dipl.-Ing. A. Giese)

APPENDIX

Appendix A1: Test of compressive strength

Appendix A1-1: Test results of compressive strength according to DIN EN 12390-3, Reference

Date of casting:								04.10.2021	
Sample no.	Dimensions			Age d	Mass kg	Bulk density kg/m ³	max. load F kN	Compressive strength	
	Length mm	Width mm	Hight mm					f _{c,dry}	f _{c,cube}
1	150	150	150	1	7.98	2360	711	-	31.6
2	150	150	150		7.95	2360	688	-	30.6
3	150	150	150		7.94	2350	705	-	31.3
Mean:						2360	-	-	31.2
4	150	152	150	7	7.98	2340	1227	-	53.8
5	150	150	150		7.94	2350	1228	-	54.5
6	150	151	150		7.95	2330	1238	-	54.6
Mean:						2340	-	-	54.3
7	152	150	150	28	7.95	2320	1702	74.6	68.6
8	151	150	150		7.91	2320	1655	72.8	67.0
9	153	150	150		7.96	2310	1650	71.8	66.1
Mean:						2320	-	73.1	67.2

Appendix A1-2: Test results of compressive strength according to DIN EN 12390-3, CL210-WP

Date of casting:								04.10.2021	
Sample no.	Dimensions			Age d	Mass kg	Bulk density kg/m ³	max. load F kN	Compressive strength	
	Length mm	Width mm	Hight mm					f _{c,dry}	f _{c,cube}
1	150	150	150	1	7.92	2350	635	-	28.2
2	150	150	150		7.94	2350	628	-	27.9
3	150	150	150		7.93	2350	595	-	26.4
Mean:						2350	-	-	27.5
4	150	152	150	7	7.96	2330	1091	-	47.9
5	150	152	150		7.95	2330	1155	-	50.8
6	150	153	150		7.97	2320	1179	-	51.5
Mean:						2330	-	-	50.1
7	152	150	150	28	7.89	2310	1620	71.2	65.5
8	153	150	150		7.95	2300	1546	67.3	61.9
9	152	150	150		7.84	2300	1490	65.6	60.3
Mean:						2300	-	68.0	62.6

Appendix A2: Resistance to carbonation**Appendix A2-1: Test results of resistance to carbonation after 90 d, Reference**

Date of casting:		04.10.2021				
Date of testing:		09.01.2022				
Sample	Measuring point	Depth of carbonation (mm) after 90 d CO ₂ -storage				
		Side 1	Side 2	Side 3	Side 4	Mean
1	0.25	0.7	1.2	0.0	0.5	-
	0.50	1.0	0.1	0.0	0.8	-
	0.75	1.0	1.3	0.0	1.4	-
	d _k	1.0	1.0	0.0	1.0	1.0
2	0.25	0.7	1.6	0.0	1.1	-
	0.50	1.6	0.9	0.0	0.7	-
	0.75	1.1	0.1	0.0	1.3	-
	d _k	1.0	1.0	0.0	1.0	1.0
3	0.25	1.0	1.2	0.0	0.9	-
	0.50	1.6	2.0	0.0	1.4	-
	0.75	1.1	1.7	0.6	1.6	-
	d _k	1.5	1.5	0.0	1.5	1.0
Mean value after 90 d CO₂-storage:						1.0

Appendix A2-2: Test results of resistance to carbonation after 90 d. CL210-WP

Date of casting:		04.10.2021				
Date of testing:		09.01.2022				
Sample	Measuring point	Depth of carbonation (mm) after 90 d CO ₂ -storage				
		Side 1	Side 2	Side 3	Side 4	Mean
1	0.25	1.0	0.1	0.0	0.5	-
	0.50	1.5	0.6	0.0	0.8	-
	0.75	0.1	0.7	0.0	0.3	-
	d _k	1.0	0.5	0.0	0.5	0.5
2	0.25	0.8	0.0	0.6	0.0	-
	0.50	0.0	0.0	0.0	0.9	-
	0.75	0.0	0.0	0.5	1.2	-
	d _k	0.5	0.0	0.5	0.5	0.5
3	0.25	0.7	0.0	0.0	1.8	-
	0.50	0.7	0.0	0.0	0.8	-
	0.75	0.5	0.6	0.0	0.7	-
	d _k	0.5	0.0	0.0	1.0	0.5
Mean value after 90 d CO₂-storage:						0.5