

Test report no. 232382
English Version

1st copy of 30 August 2023

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

Date of commission: 12.05.2023 / Mr Beyer

Subject of commission: Tests regarding the efficiency of water resisting admixture
for concrete

Product: BETOCRETE CP350-CI

The test report contains 8 pages.

The testing material is used up.



Remark: This test report is the English version of original German version of 30 August 2023.

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 07.06.23 were delivered by an employee of the ordering party:

- 40 kg Cement CEM I 42.5 N, Wittekind
- 1 l REMICRETE SP10 (SP), in a bottle produced by Schomburg
- 2 kg BETOCRETE CP 350-CI, in a canister, produced by Schomburg

The aggregate for manufacture the concrete was provided from the stock of MPA HANNOVER:

- Weser sand 0/2
- Weser gravel 2/8
- Weser gravel 8/16

3. Scope

The scope of performed tests listed in Table 1. The tests were performed each at the Reference concrete (Reference) and at the concrete produced with the water resisting admixture BETOCRETE CP 350-CI (CP 350-CI).

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 | 1 |
| 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 | Freeze-thaw-salt resistance DIN CEN/TS 12390-9:2017-05 | 28 d | 5 |

4. Results

4.1 Manufacture of samples

The samples were produced according to DIN EN 12390-2:2019-08 in the laboratory of MPA HANNOVER. A forced mixer UEZ JetMix ZM 80 was used for the mixing. The mixing time was 2 min after water addition. The water resisting admixture and the superplasticizer were added separately. The compositions of mixtures are listed in Table 2. All test specimens as well as the fresh grout tests were prepared from three mixtures each.

Table 2: Composition of mixtures

| Raw material | | Reference | | CP 350-CI | |
|--------------------------|----------------------|-----------|---------------------------|-----------|---------------------------|
| | | 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 | 30 | 542 | 30 | 542 |
| Gravel 2-8 mm | | 30 | 537 | 30 | 537 |
| Gravel 8-16 mm | | 40 | 719 | 40 | 719 |
| BETOCRETE CP 350-CI (DM) | M.-% of cement | - | - | 0.80 | 2.80 |
| REMICRETE SP10 (FM) | | 0.30 | 1.05 | 0.30 | 1.05 |

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

| | | | |
|---|--------------------|------------|-----------|
| Date of testing: | | 12.06.2023 | |
| Series | | Reference | CP 350-CI |
| Air temperature | °C | 23 | 23 |
| Flow table test A after water addition | mm | 500 | 440 |
| Fresh concrete temperature | °C | 24.6 | 24.3 |
| Bulk density of fresh concrete | kg/dm ³ | 2.38 | 2.32 |
| Air content | Vol.- % | 0.9 | 3.3 |

4.3 Freeze-thaw-salt resistance

4.3.1 Preparation for testing

The test of the freeze-thaw resistance was carried out according to DIN CEN/TS 12390-9. The samples were sawn, measured and prepared for testing, approximately 7 days before the start of the test. The lateral faces were glued with an aluminium foil with butyl bonding. The specimens were stored in a climate chamber at a temperature of 20 °C and a relative humidity of 65 % until testing. The weights of the specimens were determined before and after sealing of the lateral faces.

4.3.2 Capillary suction

After preparing of the specimens and the pre-storage described above, the specimens were placed into the test containers on spacers with a height of 10 mm with the test surface facing the bottom. Then a test solution consisting of 3-percent sodium chloride solution was filled into the containers up to a height of 15 mm so that the specimens were immersed 5 mm depth into the test solution. The increase in weight of the test specimens was measured after two, five and seven days of storage in the test solution.

4.3.3 Freeze-thaw testing

The test specimens together with the test containers and the present test liquid were placed into a temperature-controlled chest with liquid cooling bath and subjected to freeze-thaw testing according to the test specification mentioned in section 1. One freeze-thaw cycle lasts 12 hours. Beginning at + 20 °C, the temperature was lowered in 4 hours with a constant cooling rate to –20 °C. Then it was left to cool for 3 hours at this temperature and within 4 hours increased to +20 °C again and subsequently held for one hour. The specimens were taken from the chest in specific intervals and the water uptake, the surface scaling and the dynamic E-modulus were determined according to test specification. The results of the freeze-thaw test are compiled in Table 4 as mean values. Details of the tests are listed in Appendix A1.

Table 4: Results of the test of Freeze-thaw-salt resistance, mean values

| | | Surface scaling in g/m ² | | rel. dyn. E-modulus in % | |
|---------------------|----|--|-----------|-----------------------------|-----------|
| | | Reference | CP 350-CI | Reference | CP 350-CI |
| Frost-thaw cycle | 0 | 0 | 0 | 100 | 100 |
| | 4 | 74 | 48 | 99 | 96 |
| | 10 | 246 | 141 | 97 | 97 |
| | 14 | 854 | 430 | 93 | 96 |
| | 18 | 1777 | 667 | 86 | 100 |
| | 24 | 2878 | 914 | 75 | 96 |
| | 28 | 4781 | 1266 | 68 | 95 |

Hanover, 30 August 2023
Head of Testing Institute
By proxy

(ORR Dr.-Ing. H. Höveling)



Contact

(Dipl.-Ing. A. Giese)

APPENDIX

Appendix A1: Freeze-thaw-salt testing

Appendix A1-1: Dimensions and mass for specimen preparation. Reference

| Specimen | | | 1 | 2 | 3 | 4 | 5 |
|------------------------|--------------|----|------|------|------|------|------|
| Weight | without belt | g | 2638 | 2773 | 2789 | 2831 | 2823 |
| | with belt | | 2699 | 2838 | 2854 | 2896 | 2887 |
| Dimensions w/o sealing | Length | mm | 150 | 150 | 151 | 152 | 151 |
| | Width | | 111 | 110 | 111 | 110 | 111 |
| | Height | | 68 | 72 | 72 | 73 | 73 |

Appendix A1-2: Water uptake. Reference

| Begin of test: | | | | | | | | | 10.07.2023 |
|------------------------|---------|-------|-------|-------|-------|-------|-------------|--------------|--------------------|
| Probe | after d | | 1 | 2 | 3 | 4 | 5 | Mean | Standard deviation |
| Capillary suction in d | -7 | M.- % | -0.63 | -0.65 | -0.67 | -0.83 | -0.81 | -0.72 | 0.10 |
| | -5 | | -0.17 | -0.17 | -0.19 | -0.25 | -0.21 | -0.20 | 0.03 |
| | -3 | | -0.10 | -0.09 | -0.09 | -0.11 | -0.09 | -0.10 | 0.01 |
| | 0 | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Frost-thaw cycle | 4 | | 0.23 | 0.29 | 0.29 | 0.32 | 0.30 | 0.29 | 0.04 |
| | 8 | | 0.49 | 0.57 | 0.48 | 0.56 | 0.56 | 0.53 | 0.04 |
| | 14 | | 0.76 | 0.87 | 0.70 | 0.86 | 0.82 | 0.80 | 0.07 |
| | 18 | 0.90 | 1.07 | 0.85 | 0.95 | 0.99 | 0.95 | 0.08 | |
| | 22 | 1.06 | 1.26 | 0.94 | 1.06 | 1.08 | 1.08 | 0.12 | |
| | 28 | 1.18 | 1.28 | 1.04 | 1.12 | 1.18 | 1.16 | 0.09 | |

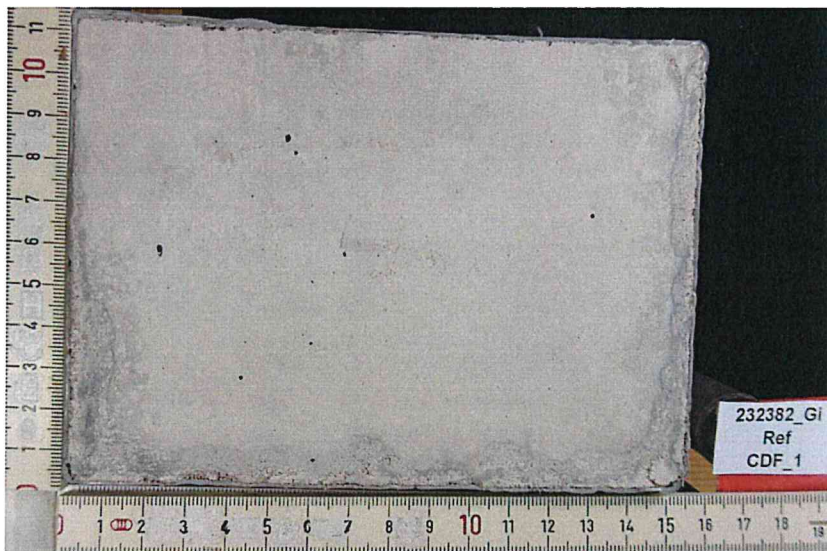
Appendix A1-3: Relative dynamic E-modulus of the specimens, Reference

| Frost-thaw cycle | Relative dynamic E-modulus in % | | | | | | |
|------------------|---------------------------------|-----|-----|-----|-----|------------|--------------------|
| | 1 | 2 | 3 | 4 | 5 | Mean | Standard deviation |
| 0 | 100 | 100 | 100 | 100 | 100 | 100 | 0.0 |
| 4 | 100 | 99 | 100 | 97 | 98 | 99 | 1.0 |
| 8 | 100 | 95 | 98 | 96 | 98 | 97 | 1.6 |
| 14 | 97 | 89 | 97 | 90 | 91 | 93 | 3.3 |
| 18 | 98 | 87 | 87 | 86 | 70 | 86 | 8.8 |
| 22 | 90 | 82 | 81 | 85 | 36 | 75 | 19.6 |
| 28 | 83 | 77 | 77 | 68 | 34 | 68 | 17.7 |

Appendix A1-4: Surface scaling of the specimens by weathering, Reference

| Frost-thaw cycle | Surface scaling in g/m ² | | | | | | |
|------------------|-------------------------------------|------|------|------|------|-------------|--------------------|
| | 1 | 2 | 3 | 4 | 5 | Mean | Standard deviation |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 | 74 | 80 | 71 | 78 | 65 | 74 | 6 |
| 8 | 252 | 190 | 250 | 279 | 258 | 246 | 33 |
| 14 | 732 | 498 | 771 | 1295 | 976 | 854 | 299 |
| 18 | 1569 | 1147 | 1521 | 2601 | 2046 | 1777 | 561 |
| 22 | 2556 | 2114 | 2477 | 3996 | 3248 | 2878 | 747 |
| 28 | 4075 | 4032 | 4137 | 6157 | 5506 | 4781 | 987 |

Appendix A1-5: Sample before testing, Reference



Appendix A1-6: Sample after testing, Reference



Appendix A1-7: Dimensions and mass for specimen preparation, CP 350-CI

| Specimen | | | 1 | 2 | 3 | 4 | 5 |
|------------------------|--------------|----|------|------|------|------|------|
| Weight | without belt | g | 2761 | 2531 | 2807 | 2841 | 2739 |
| | with belt | | 2826 | 2591 | 2873 | 2908 | 2804 |
| Dimensions w/o sealing | Length | mm | 149 | 150 | 145 | 150 | 150 |
| | Width | | 111 | 110 | 110 | 110 | 111 |
| | Height | | 72 | 66 | 77 | 75 | 72 |

Appendix A1-8: Water uptake, CP 350-CI

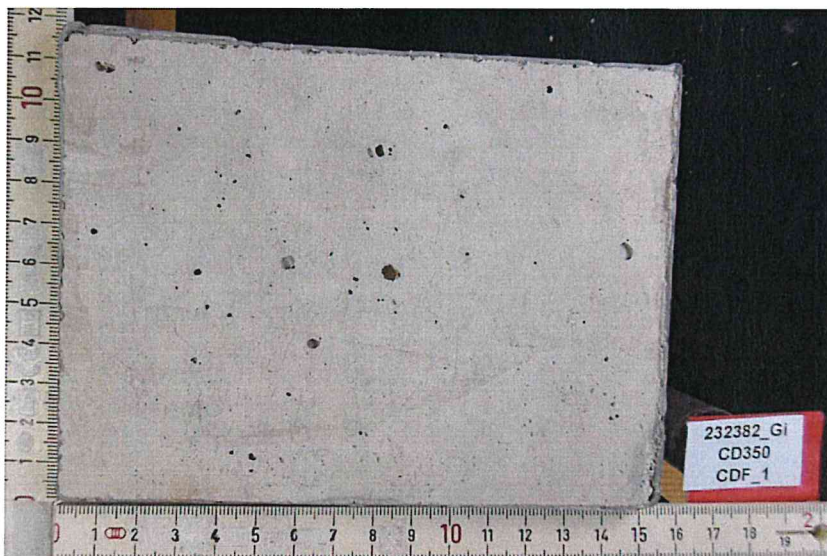
| Begin of test: | | | | | | | | | 10.07.2023 |
|------------------------|---------|-------|-------|-------|-------|-------|-------|--------------|--------------------|
| Probe | after d | | 1 | 2 | 3 | 4 | 5 | Mean | Standard deviation |
| Capillary suction in d | -7 | M.- % | -0.75 | -0.47 | -0.53 | -0.51 | -0.73 | -0.60 | 0.13 |
| | -5 | | -0.21 | -0.14 | -0.12 | -0.15 | -0.20 | -0.17 | 0.04 |
| | -2 | | -0.09 | -0.07 | -0.06 | -0.07 | -0.11 | -0.08 | 0.02 |
| | 0 | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Frost-thaw cycle | 4 | | 0.26 | 0.21 | 0.23 | 0.22 | 0.26 | 0.23 | 0.02 |
| | 8 | | 0.45 | 0.37 | 0.40 | 0.36 | 0.45 | 0.41 | 0.04 |
| | 14 | | 0.64 | 0.52 | 0.56 | 0.48 | 0.63 | 0.57 | 0.07 |
| | 18 | | 0.70 | 0.58 | 0.62 | 0.53 | 0.70 | 0.63 | 0.07 |
| | 22 | | 0.74 | 0.64 | 0.68 | 0.58 | 0.76 | 0.68 | 0.08 |
| | 28 | | 0.79 | 0.66 | 0.75 | 0.62 | 0.82 | 0.73 | 0.09 |

Appendix A1-9: Relative dynamic E-modulus of the specimens, CP 350-CI

| Frost-thaw cycle | Relative dynamic E-modulus in % | | | | | | |
|------------------|---------------------------------|-----|-----|-----|-----|------------|--------------------|
| | 1 | 2 | 3 | 4 | 5 | Mean | Standard deviation |
| 0 | 100 | 100 | 100 | 100 | 100 | 100 | 0.0 |
| 4 | 98 | 96 | 95 | 96 | 96 | 96 | 1.1 |
| 8 | 99 | 96 | 95 | 96 | 96 | 97 | 1.2 |
| 14 | 97 | 95 | 95 | 96 | 97 | 96 | 1.0 |
| 18 | 101 | 99 | 99 | 99 | 100 | 100 | 0.9 |
| 22 | 97 | 95 | 95 | 95 | 97 | 96 | 0.9 |
| 28 | 96 | 95 | 95 | 95 | 95 | 95 | 0.4 |

Appendix A1-10: Surface scaling of the specimens by weathering, CP 350-CI

| Frost-thaw cycle | Surface scaling in g/m ² | | | | | | |
|------------------|-------------------------------------|------|-----|------|-----|-------------|--------------------|
| | 1 | 2 | 3 | 4 | 5 | Mean | Standard deviation |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 | 38 | 36 | 60 | 46 | 59 | 48 | 11 |
| 8 | 75 | 179 | 137 | 186 | 129 | 141 | 45 |
| 14 | 213 | 734 | 266 | 657 | 279 | 430 | 245 |
| 18 | 331 | 1210 | 360 | 1015 | 421 | 667 | 414 |
| 22 | 449 | 1687 | 474 | 1364 | 594 | 914 | 573 |
| 28 | 651 | 2264 | 631 | 1890 | 894 | 1266 | 759 |

Appendix A1-11: Sample before testing, CP 350-CI**Appendix A1-12: Sample after testing, CP 350-CI**