Deutsches Institut für Bautechnik

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European Technical Assessment

ETA-12/0390 of 27 March 2020

English translation prepared by DIBt - Original version in German language

General Part

Technical Assessment Body issuing the European Technical Assessment:	Deutsches Institut für Bautechnik
Trade name of the construction product	Blast furnace cement CEM III/A 42,5 N-LH/SR/LA "Deuna" CEM III/A 52,5 L-LH/SR/LA "Deuna" CEM III/A 52,5 N-LH/SR/LA "Deuna" CEM III/A 52,5 L-SR/LA "Deuna" CEM III/A 52,5 N-SR/LA "Deuna"
Product family to which the construction product belongs	Blast furnace cement CEM III/A with assessment of sulfate resistance and optional with low effective alkali content (LA) and/or low heat of hydratation (LH)
Manufacturer	Dyckerhoff GmbH Werk Deuna Industriestraße 7 37355 Niederorschel DEUTSCHLAND
Manufacturing plant	Dyckerhoff GmbH Werk Deuna Industriestraße 7 37355 Niederorschel DEUTSCHLAND
This European Technical Assessment contains	14 pages including 1 annex which forms an integral part of this assessment
This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of	EAD 150009-00-0301

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Specific Part

1 Technical description of the product

The blast furnace cement

- CEM III/A 42,5 N-LH/SR/LA "Deuna" respectively
- CEM III/A 52,5 L-LH/SR/LA "Deuna" respectively
- CEM III/A 52,5 N-LH/SR/LA "Deuna" respectively
- CEM III/A 52,5 L-SR/LA "Deuna" respectively
- CEM III/A 52,5 N-SR/LA "Deuna"

is a cement which fulfils all requirements given in EN 197-1[1] for a common cement of strength class 42,5 N or 52,5 L or 52,5 N and, if applicable, with low heat of hydration (LH).

Furthermore the blast furnace cement CEM III/A has a high resistance against sulfate attack on concrete (SR) and a low effective alkali content (LA).

The assessment for the verification of the essential characteristics "sulfate resistance" (SR), "low heat of hydration" (LH) and "low effective alkali content" (LA) were done on a blast furnace cement[2] CEM III/A 42,5 N-LH/SR/LA with a blast furnace slag content of 48,0 % by mass and a specific surface of 385 m²/kg (C1) respectively 382 m²/kg (C2).

The low effective alkali content (LA) can be verified by the Na_2O-equivalent (Na_2Oeq) and the blast furnace slag content of the blast furnace cement CEM III/A:

- Blast furnace slag content between 45 to 49 % by mass and $Na_2Oeq \leq 0,95$ % by mass or
- Blast furnace slag content of ≥ 50 % by mass and $Na_2Oeq \leq 1,10$ % by mass

The blast furnace cement CEM III/A can be manufactured by combined grinding of the main constituents (Portland cement clinker, granulated blast furnace slag) and defined minor additional constituents with the addition of gypsum or anhydrite or any mixture of them to control setting or by separately grinding and subsequent mixing of the raw material. The specific surface (Blaine) of the blast furnace cement CEM III/A shall be at least 385 m²/kg with following cement composition:

Portland cement clinker[3]:	35 to 52 % by mass
Blast furnace slag:	48 to 65 % by mass

2 Specification of the intended use in accordance with the applicable European Assessment Document

The blast furnace cement CEM III/A is intended to be used for preparation of concrete, mortar, grouts and other mixes for construction and for the manufacturing of construction products.

The blast furnace cement CEM III/A with "LH"-labelling shows a low heat of hydration.

Especially the blast furnace cement CEM III/A is characterized by an evidently high resistance against sulfate attack on concrete.

The blast furnace cement CEM III/A with "LA"-labelling can be used to avoid a damaging alkali-silica reaction in concrete.

1 EN 197-1 Cement - Part 1: Composition, specification and conformity criteria for common cement

2 The assessment testing was done on two blast furnace cements CEM III/A 42,5 N-LH/SR/LA (C1 and C2). The blast furnace cement C1 was manufactured with blast furnace slag 1 (S1) and blast furnace cement C2 with blast furnace slag 2 (S2). The assessment testing of the two test cements were positive. In this case it is possible to manufacture the blast furnace cement CEM III/A with a blast furnace slag composition of blast furnace slags S1 and S2.

3 The Portland cement clinker contains minor additional constituents (max. 4,5 % by mass).

The verification and assessment methods on which the European Technical Assessment is based lead to the assumption of a working life of concrete incorporating the blast furnace cement CEM III/A of at least 50 years. The indications given on the working life cannot be interpreted as a guarantee given by the producer, but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

3 Performance of the product and references to the methods used for its assessment

3.1 Mechanical resistance and stability (BWR 1)

Essential characteristic	Performance
(CaO + MgO)/SiO_2-ratio of the blast furnace slag	B_{S1} = 1,3 B_{S2} = 1,4
Glass content of the blast furnace slag	GC_{S1} = 96 % GC_{S2} = 98 %
Specific surface of the cement (Blaine)	ρ_{C1} = 385 m²/kg ρ_{C2} = 382 m²/kg
Sulfate resistance	see Annex A (A1 to A4)
Characteristics for a common cement (CEM III/A)	
Early strength (2 days)	Class N (≥ 10,0 N/mm²)
Standard strength (28 days)	Class 42,5 (≥ 42,5 N/mm²)
Initial setting time	C1: Passed (275 min) C2: Passed (265 min)
Soundness	C1: Passed (1 mm) C2: Passed (1 mm)
Loss on ignition	C1: Passed (2,65 % by mass) C2: Passed (2,35 % by mass)
Insoluble residue	C1: Passed (0,36 % by mass) C2: Passed (0,37 % by mass)
Sulfate content (as SO_3)	C1: Passed (2,1 % by mass) C2: Passed (2,8 % by mass)
Chloride content	C1: Passed (0,03 % by mass) C2: Passed (0,07 % by mass)
<u>Composition of the cement (C1):</u> Clinker (K): Blast furnace slag (S1): <u>Composition of the cement (C2):</u> Clinker (K): Blast furnace slag (S2):	<u>CEM III/A (C1):</u> K = 52 % by mass (35 – 52 % by mass) S1 = 48 % by mass (48 – 65 % by mass) <u>CEM III/A (C2):</u> K = 52 % by mass (35 – 52 % by mass) S2 = 48 % by mass (48 – 65 % by mass)
Alkali-Content of the cement (LA) Na_2O-equivalent	CEM III/A (C1): 0,93 % by mass CEM III/A (C2): 0,85 % by mass
Low heat of hydration (LH)	CEM III/A (C1): Passed (246 J/g) CEM III/A (C2): Passed (215 J/g)
S1: Blast furnace slag 1 S2: Blast furnace slag 2	C1: Blast furnace cement with blast furnace slag 1 C2: Blast furnace cement with blast furnace slag 2

4 Assessment and verification of constancy of performance (AVCP) system applied, with reference to its legal base

In accordance with EAD No. 150009-00-0301, the applicable European legal act is: 97/555/EC[4] of the European Commission amended by the Commission Decision 2010/683/EU[5].

The system(s) to be applied is: 1+

5 Technical details necessary for the implementation of the AVCP system, as provided for in the applicable EAD

Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited with Deutsches Institut für Bautechnik.

Issued in Berlin on 27 March 2020 by Deutsches Institut für Bautechnik

BD Dipl.-Ing. Andreas Kummerow
Head of Department

beglaubigt:
Schröder

[4] Official Journal of the European Communities L 229 of 20 August 1997
[5] Official Journal of the European Communities L 293 of 11 November 2010

Deutsches Institut für Bautechnik DIBt

ANNEX A: Assessment

Sulfate resistance – Flat prism method

The testing procedure was done according to EAD 150009-00-0301, Annex B.

Table A1: Expansion of length of mortar flat prisms – Blast furnace cement 1 (C1) with blast furnace slag 1 (S1)

	Expansion of length [mm/m] after				
	14 days	28 days	56 days	90 days	180 days
CEM III/A 42,5 N-LH/SR/LA "Deuna" (C1 with blast furnace slag 1 (S1)) – storage at 20 °C					
$Ca(OH)_2$-solution	0,01	0,04	0,08	0,09	0,06
Na_2SO_4-solution	0,04	0,11	0,19	0,28	0,38
ΔL	0,03	0,07	0,11	0,19	0,32
CEM III/A 42,5 N-LH/SR/LA "Deuna" (C1 with blast furnace slag 1 (S1)) – storage at 5 °C					
$Ca(OH)_2$-solution	-0,18	-0,20	-0,16	-0,21	-
Na_2SO_4-solution	-0,18	-0,16	-0,02	0,06	-
ΔL	0,00	0,04	0,14	0,27	-
CEM III/B 42,5 N-LH/SR – storage at 20 °C					
$Ca(OH)_2$-solution	0,02	0,04	0,09	0,07	0,07
Na_2SO_4-solution	0,04	0,06	0,12	0,12	0,19
ΔL	0,02	0,02	0,03	0,05	0,12
CEM III/B 42,5 N-LH/SR – storage at 5 °C					
$Ca(OH)_2$-solution	-0,20	-0,21	-0,15	-0,18	-
Na_2SO_4-solution	-0,20	-0,16	-0,10	-0,06	-
ΔL	0,00	0,05	0,05	0,12	-
CEM I 42,5 N-SR0 – storage at 20 °C					
$Ca(OH)_2$-solution	-0,01	0,03	0,05	0,03	0,03
Na_2SO_4-solution	0,09	0,13	0,28	0,49	1,27
ΔL	0,10	0,10	0,23	0,46	1,24
CEM I 42,5 N-SR0 – storage at 5 °C					
$Ca(OH)_2$-solution	-0,16	-0,20	-0,16	-0,21	-
Na_2SO_4-solution	-0,14	-0,12	0,09	0,38	-
ΔL	0,02	0,08	0,25	0,59	-

Table A2: Expansion of length of mortar flat prisms – Blast furnace cement 2 (C2) with blast furnace slag 2 (S2)

	Expansion of length [mm/m] after				
	14 days	28 days	56 days	90 days	180 days
CEM III/A 42,5 N-LH/SR/LA "Deuna" (C2 with blast furnace slag 2 (S2)) – storage at 20 °C					
$Ca(OH)_2$-solution	0,08	0,30	0,46	0,56	0,80
Na_2SO_4-solution	0,04	0,05	0,09	0,11	0,10
ΔL	0,04	0,25	0,37	0,45	0,70
CEM III/A 42,5 N-LH/SR/LA "Deuna" (C2 with blast furnace slag 2 (S2)) – storage at 5 °C					
$Ca(OH)_2$-solution	-0,12	-0,07	0,00	0,08	-
Na_2SO_4-solution	-0,15	-0,15	-0,16	-0,20	-
ΔL	0,03	0,08	0,16	0,28	-
CEM III/B 42,5 N-LH/SR – storage at 20 °C					
$Ca(OH)_2$-solution	0,08	0,13	0,18	0,21	0,29
Na_2SO_4-solution	0,04	0,05	0,09	0,12	0,13
ΔL	0,04	0,08	0,09	0,09	0,16
CEM III/B 42,5 N-LH/SR – storage at 5 °C					
$Ca(OH)_2$-solution	-0,13	-0,10	-0,08	-0,02	-
Na_2SO_4-solution	-0,15	-0,13	-0,16	-0,16	-
ΔL	0,02	0,03	0,08	0,14	-
CEM I 42,5 N-SR0 – storage at 20 °C					
$Ca(OH)_2$-solution	0,08	0,19	0,32	0,44	0,80
Na_2SO_4-solution	0,02	0,02	0,05	0,03	0,07
ΔL	0,06	0,17	0,27	0,41	0,73
CEM I 42,5 N-SR0 – storage at 5 °C					
$Ca(OH)_2$-solution	-0,11	-0,07	-0,06	0,05	-
Na_2SO_4-solution	-0,15	-0,10	-0,12	-0,16	-
ΔL	0,04	0,03	0,06	0,21	-

Table A3: Dynamic modulus of elasticity of mortar flat prisms - Blast furnace cement 1 (C1) with blast furnace slag 1 (S1)

	Dynamic modulus of elasticity in kN/mm² after					
	0 days	14 days	28 days	56 days	90 days	180 days
CEM III/A 42,5 N-LH/SR/LA "Deuna" (C1 with blast furnace slag 1 (S1)) – storage at 20 °C						
$Ca(OH)_2$-solution	34,8	37,8	38,6	39,7	40,8	40,1
Na_2SO_4-solution	34,7	38,6	39,4	40,0	39,6	37,8
CEM III/A 42,5 N-LH/SR/LA "Deuna" (C1 with blast furnace slag 1 (S1)) – storage at 5 °C						
$Ca(OH)_2$-solution	35,4	36,1	36,2	37,5	38,5	-
Na_2SO_4-solution	36,1	37,9	38,8	39,0	39,4	-
CEM III/B 42,5 N-LH/SR – storage at 20 °C						
$Ca(OH)_2$-solution	32,3	35,5	36,9	37,9	38,5	39,0
Na_2SO_4-solution	32,2	36,6	37,8	39,1	37,5	31,4
CEM III/B 42,5 N-LH/SR – storage at 5 °C						
$Ca(OH)_2$-solution	31,8	33,0	33,1	33,8	34,5	-
Na_2SO_4-solution	31,8	34,0	34,5	34,9	34,9	-
CEM I 42,5 N-SR0 – storage at 20 °C						
$Ca(OH)_2$-solution	35,0	36,2	36,7	36,9	37,2	37,3
Na_2SO_4-solution	35,3	37,1	37,3	38,6	38,5	37,2
CEM I 42,5 N-SR0 – storage at 5 °C						
$Ca(OH)_2$-solution	34,8	35,5	35,9	36,3	36,9	-
Na_2SO_4-solution	34,7	36,1	36,5	37,5	37,8	-

Table A4: Dynamic modulus of elasticity of mortar flat prisms - Blast furnace cement 2 (C2) with blast furnace slag 2 (S2)

	Dynamic modulus of elasticity in kN/mm² after					
	0 days	14 days	28 days	56 days	90 days	180 days
CEM III/A 42,5 N-LH/SR/LA "Deuna" (C2 with blast furnace slag 2 (S2)) – storage at 20 °C						
$Ca(OH)_2$-solution	34,7	37,4	38,9	40,1	40,7	41,7
Na_2SO_4-solution	33,5	37,8	39,0	38,7	39,0	39,8
CEM III/A 42,5 N-LH/SR/LA "Deuna" (C2 with blast furnace slag 2 (S2)) – storage at 5 °C						
$Ca(OH)_2$-solution	33,8	35,1	36,1	36,7	37,9	-
Na_2SO_4-solution	35,4	37,9	37,8	38,7	38,4	-
CEM III/B 42,5 N-LH/SR – storage at 20 °C						
$Ca(OH)_2$-solution	29,6	32,5	34,3	35,9	37,0	38,3
Na_2SO_4-solution	29,6	34,5	35,7	35,0	34,8	35,4
CEM III/B 42,5 N-LH/SR – storage at 5 °C						
$Ca(OH)_2$-solution	30,2	31,1	31,0	31,6	32,7	-
Na_2SO_4-solution	30,1	32,5	33,0	33,3	33,0	-
CEM I 42,5 R-SR0 – storage at 20 °C						
$Ca(OH)_2$-solution	36,3	37,0	37,9	38,4	38,1	37,8
Na_2SO_4-solution	37,3	39,0	39,5	40,4	40,9	41,3
CEM I 42,5 R-SR0 – storage at 5 °C						
$Ca(OH)_2$-solution	36,3	37,1	37,2	37,1	37,9	-
Na_2SO_4-solution	36,3	37,4	37,6	37,5	38,0	-

Table A5: Mass of mortar flat prisms - Blast furnace cement 1 (C1) with blast furnace slag 1 (S1)

	Mass in g after					
	0 days	14 days	28 days	56 days	90 days	180 days
CEM III/A 42,5 N-LH/SR/LA "Deuna" (C1 with blast furnace slag 1 (S1)) – storage at 20 °C						
$Ca(OH)_2$-solution	147,58	147,66	147,84	148,02	148,22	148,50
Na_2SO_4-solution	147,95	148,23	148,34	148,69	149,07	149,80
CEM III/A 42,5 N-LH/SR/LA "Deuna" (C1 with blast furnace slag 1 (S1)) – storage at 5 °C						
$Ca(OH)_2$-solution	148,33	148,64	148,81	148,99	149,14	-
Na_2SO_4-solution	148,06	148,44	148,60	148,98	149,53	-
CEM III/B 42,5 N-LH/SR – storage at 20 °C						
$Ca(OH)_2$-solution	146,95	146,,87	147,08	147,24	147,51	147,73
Na_2SO_4-solution	147,49	147,54	147,67	147,80	147,90	148,97
CEM III/B 42,5 N-LH/SR – storage at 5 °C						
$Ca(OH)_2$-solution	146,64	147,05	147,31	147,34	147,48	-
Na_2SO_4-solution	146,24	146,34	146,43	146,73	147,03	-
CEM I 42,5 N-SR0 – storage at 20 °C						
$Ca(OH)_2$-solution	148,14	148,16	148,16	148,10	148,21	148,46
Na_2SO_4-solution	148,16	148,65	148,80	149,21	149,61	150,54
CEM I 42,5 N-SR0 – storage at 5 °C						
$Ca(OH)_2$-solution	147,62	147,94	148,15	148,21	148,25	-
Na_2SO_4-solution	147,67	148,14	148,41	148,74	149,13	-

Table A6: Mass of mortar flat prisms - Blast furnace cement 2 (C2) with blast furnace slag 2 (S2)

	Mass in g after					
	0 days	14 days	28 days	56 days	90 days	180 days
CEM III/A 42,5 N-LH/SR/LA "Deuna" (C2 with blast furnace slag 2 (S2)) – storage at 20 °C						
$Ca(OH)_2$-solution	147,7	148,2	148,4	148,3	148,7	148,9
Na_2SO_4-solution	147,0	147,1	147,6	148,3	148,8	149,2
CEM III/A 42,5-LH/SR/LA "Deuna" (C2 with blast furnace slag 2 (S2)) – storage at 5 °C						
$Ca(OH)_2$-solution	146,3	146,7	146,8	146,8	147,3	-
Na_2SO_4-solution	147,6	147,9	148,3	148,9	149,3	-
CEM III/B 42,5 N-LH/SR – storage at 20 °C						
$Ca(OH)_2$-solution	146,0	146,4	146,5	147,0	146,7	147,0
Na_2SO_4-solution	145,92	146,5	146,5	146,4	147,5	148,1
CEM III/B 42,5 N-LH/SR – storage at 5 °C						
$Ca(OH)_2$-solution	145,7	146,1	146,0	146,1	146,4	-
Na_2SO_4-solution	145,3	145,5	145,5	145,9	146,2	-
CEM I 42,5 R-SR0 – storage at 20 °C						
$Ca(OH)_2$-solution	146,5	146,6	146,6	146,5	146,6	147,3
Na_2SO_4-solution	148,9	149,1	149,4	149,8	150,2	150,7
CEM I 42,5 R-SR0 – storage at 5 °C						
$Ca(OH)_2$-solution	146,9	147,3	147,3	147,4	147,5	-
Na_2SO_4-solution	147,8	148,2	148,4	148,8	149,4	-

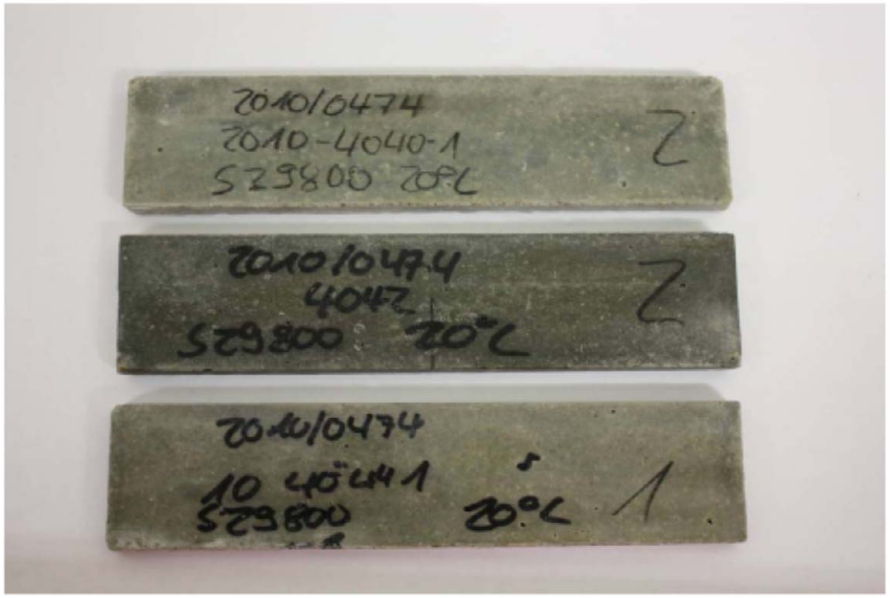

Figure A1: Flat prism after 180 days storage in Na_2SO_4-solution at 20 °C
(top: prism from CEM III/A 42,5 N-LH/SR/LA "Deuna" (C1) with blast furnace slag 1 (S1);
mid: CEM I 42,5 N-SR0; bottom: CEM III/B 42,5 N-LH/SR)

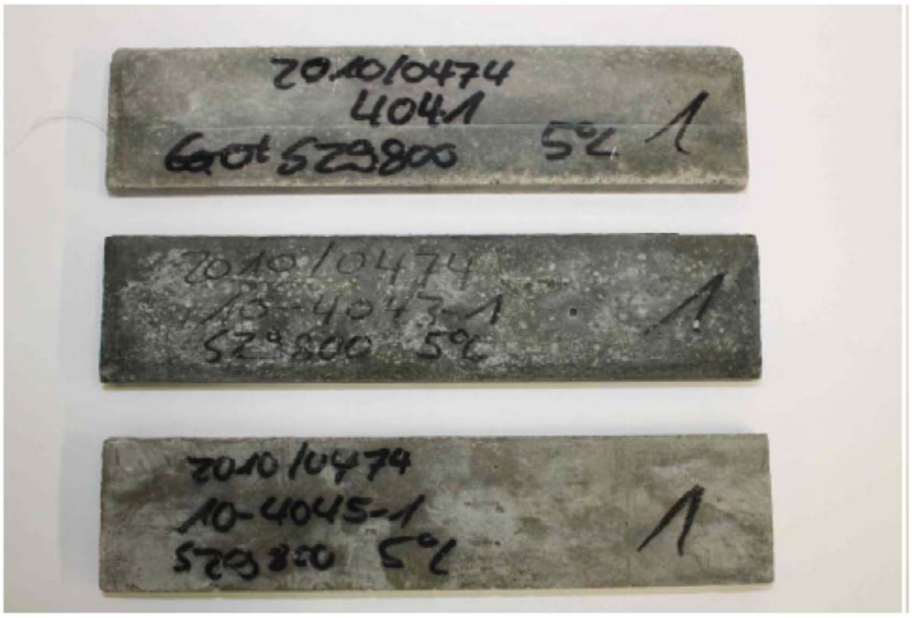

Figure A2: Flat prism after 180 days storage in Na_2SO_4-solution at 5 °C
(top: prism from CEM III/A 42,5 N-LH/SR/LA "Deuna" (C1) with blast furnace slag 1 (S1);
mid: CEM I 42,5 N-SR0; bottom: CEM III/B 42,5 N-LH/SR)

Figure A3: Flat prism from blast furnace cement CEM III/A 42,5 N-LH/SR/LA "Deuna" (C2) with blast furnace 2 (S2) after 180 days storage in Na_2SO_4-solutions at 20 °C (on the left) and 5 °C (on the right)

Figures A4: Flat prism from blast furnace cement CEM III/B 42,5 N-LH/SR after 180 days storage in Na_2SO_4-solutions at 20 °C (on the left) and 5 °C (on the right)

Figures A5: Flat prism from Portland cement CEM I 42,5 R-SR0 after 180 days storage in Na_2SO_4-solutions at 20 °C (on the left) and 5 °C (on the right)