Deutsches Institut für Bautechnik

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Bautechnisches Prüfamt

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European Technical Assessment

ETA-12/0389 of 22 November 2017

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 52,5 N-SR "Ennigerloh"
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 hydration (LH)
Manufacturer	HeidelbergCement AG Berliner Straße 6 69120 Heidelberg DEUTSCHLAND
Manufacturing plant	HeidelbergCement AG Werksgruppe Ennigerloh Zur Anneliese 7 59320 Ennigerloh DEUTSCHLAND
This European Technical Assessment contains	10 pages including 4 annexes which form 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
This version replaces	ETA-12/0389 issued on 19 December 2012

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Specific Part

1 Technical description of the product

The blast furnace cement CEM III/A 52,5 N-SR "Ennigerloh" is a cement which fulfils all requirements given in EN 197-1[1] for a common cement of strength class 52,5 N.

Furthermore the blast furnace cement CEM III/A 52,5 N-SR "Ennigerloh" has a high resistance against sulfate attack on concrete.

The assessment for the verification of the essential characteristic "sulfate resistance" (SR) was done on a blast furnace cement CEM III/A with a blast furnace content of 51 % by mass. The blast furnace slag has a glass content of at least 90 % and a (CaO + MgO)/SiO_2-ratio of at least 1,2.

The blast furnace cement CEM III/A 52,5 N-SR "Ennigerloh" can be manufactured by combined grinding from a Portland cement clinker, a blast furnace slag and defined minor additional constituents with the addition of gypsum or anhydrite or any mixture of them to control setting. The specific surface (Blaine) of the cement shall be at least 585 m²/kg. The blast furnace cement CEM III/A 52,5 N-SR "Ennigerloh" can also be manufactured by separately grinding and subsequent mixing of the raw materials with a specific surface (Blaine) of at least 510 m²/kg. The cement composition shall be in the following range:

Portland Cement clinker[2]:	35 to 49 % by mass
Blast furnace slag:	51 bis 65 % by mass

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

The blast furnace cement CEM III/A 52,5 N-SR "Ennigerloh" is intended to be used for preparation of concrete, mortar, grouts and other mixes for construction and for the manufacturing of construction products.

Especially the blast furnace cement CEM III/A 52,5 N-SR "Ennigerloh" is characterized by an evidently high resistance against sulfate attack on concrete.

The verifications 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 52,5 N-SR "Ennigerloh" 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 = 1,4
Glass content of the blast furnace slag	GC = 98 %

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

[2] The Portland cement clinker contains minor additional constituents (maximum 3 % by mass).

Essential characteristic	**Performance**
Specific surface of the cement (Blaine)	ρ* = 585 m²/kg ρ** = 510 m²/kg
Sulfate resistance	see Annex A (A1 to A4)
Characteristics for a common cement (CEM III/A)	
Early strength (2 days)	Class N (≥ 20,0 N/mm²)
Standard strength (28 days)	Class 52,5 (≥ 52,5 N/mm²)
Initial setting time	Passed (185 min)
Soundness	Passed (0 mm)
Loss on ignition	Passed (1,68 % by mass)
Insoluble residue	Passed (0,98 % by mass)
Sulfate content (as SO_3)	Passed (1,87 % by mass)
Chloride content	Passed (0,05 % by mass)
Composition of the cement: Clinker (K): Blast furnace slag (S):	 K[2] = 49 % by mass (35 – 49 % by mass) S = 51 % by mass (51 – 65 % by mass)
* The manufacturing of the cement were done by combined grinding of the raw materials. ** The manufacturing of the cement was done by separate grinding of the raw materials and subsequent mixing of the finely ground raw materials	

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

According to Decision 97/555/EC[3] of the European Commission amended by the Commission Decision 2010/683/EU[4], the assessment and verification of constancy of performance system (AVCP system) (see Annex V to Regulation (EU) 305/2011 as amended by the Commission Delegated Regulation (EU) No 568/2014) given in table1 applies.

Table 1: AVCP system

Product	Intended use(s)	Level(s) or Classe(s) of performance	AVCP system
Blast furnace cement CEM III/A with assessment of sulfate resistance (SR) and optional with low effective alkali content (LA) and/or low heat of hydration (LH)	Preparation of concrete, mortar, grouts and other mixes for construction and for the manufacture of construction products	--------	1+

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

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 22 November 2017 by Deutsches Institut für Bautechnik

BD Dipl.-Ing. Andreas Kummerow
Head of Department

beglaubigt:
Schröder

Deutsches Institut für Bautechnik DIBt

Testing of sulfate resistance of blast furnace cement CEM III/A – Flat prism method S_{FPM}

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

Table 1: Expansion of length of mortar flat prisms

	Expansion of length [mm/m] after				
	14 days	28 days	56 days	90 days	180 days
CEM III/A 52,5 N-SR "Ennigerloh" – storage at 20 °C					
$Ca(OH)_2$-solution	0,04	0,04	0,06	0,07	0,14
Na_2SO_4-solution	0,08	0,15	0,15	0,18	0,30
ΔL	0,04	0,11	0,09	0,11	0,16
CEM III/A 52,5 N-SR "Ennigerloh" – storage at 5 °C					
$Ca(OH)_2$-solution	-0,15	-0,15	-0,14	-0,19	-
Na_2SO_4-solution	-0,13	-0,11	-0,05	-0,07	-
ΔL	0,02	0,04	0,09	0,12	-
CEM III/B 42,5 N-LH/SR – storage at 20 °C					
$Ca(OH)_2$-solution	0,04	0,07	0,06	0,05	0,16
Na_2SO_4-solution	0,09	0,13	0,16	0,15	0,28
ΔL	0,05	0,06	0,10	0,10	0,12
CEM III/B 42,5 N-LH/SR – storage at 5 °C					
$Ca(OH)_2$-solution	-0,14	0,00	-0,07	-0,04	-
Na_2SO_4-solution	-0,10	0,04	-0,01	0,01	-
ΔL	0,04	0,04	0,06	0,05	-
CEM I 42,5 R-SR0 – storage at 20 °C					
$Ca(OH)_2$-solution	0,04	0,07	0,06	0,02	0,10
Na_2SO_4-solution	0,10	0,16	0,20	0,62	2,46
ΔL	0,06	0,09	0,14	0,60	2,36
CEM I 42,5 R-SR0 – storage at 5 °C					
$Ca(OH)_2$-solution	-0,10	-0,03	-0,11	-0,11	-
Na_2SO_4-solution	-0,09	0,06	0,01	0,31	-
ΔL	0,01	0,09	0,12	0,42	-

Blast furnace cement CEM III/A 52,5 N-SR "Ennigerloh"	**Annex A1**
Results of the assessment "sulfate resistance (Flat prism method) – S_{FPM}" Expansion of length	

Testing of sulfate resistance of blast furnace cement CEM III/A – Flat prism method S_{FPM}

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

Table 2: Dynamic modulus of elasticity of mortar flat prisms

	Dynamic modulus of elasticity in kN/mm² after					
	0 days	14 days	28 days	56 days	90 days	180 days
CEM III/A 52,5 N-SR "Ennigerloh" – storage at 20 °C						
$Ca(OH)_2$-solution	30,69	33,62	34,87	36,88	37,86	39,41
Na_2SO_4-solution	31,33	35,91	37,73	38,99	38,26	34,28
CEM III/A 52,5 N-SR "Ennigerloh" – storage at 5 °C						
$Ca(OH)_2$-solution	31,19	31,80	32,80	34,01	34,59	-
Na_2SO_4-solution	30,94	33,11	34,92	36,20	35,02	-
CEM III/B 42,5 N-LH/SR – storage at 20 °C						
$Ca(OH)_2$-solution	31,06	33,38	34,22	36,31	37,16	38,73
Na_2SO_4-solution	30,91	35,07	36,05	37,17	36,51	35,48
CEM III/B 42,5 N-LH/SR – storage at 5 °C						
$Ca(OH)_2$-solution	30,24	31,25	31,70	32,63	32,96	-
Na_2SO_4-solution	30,77	33,25	34,29	35,52	35,44	-
CEM I 42,5 R-SR0 – storage at 20 °C						
$Ca(OH)_2$-solution	35,83	36,40	36,89	37,70	37,48	36,13
Na_2SO_4-solution	35,89	37,25	37,82	38,30	38,09	38,34
CEM I 42,5 R-SR0 – storage at 5 °C						
$Ca(OH)_2$-solution	36,14	37,17	37,02	38,08	38,10	-
Na_2SO_4-solution	35,92	37,03	37,95	38,89	37,28	-

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Testing of sulfate resistance of blast furnace cement CEM III/A – Flat prism method S_{FPM}

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

Table 3: Mass of mortar flat prisms

	Mass in g after					
	0 days	14 days	28 days	56 days	90 days	180 days
CEM III/A 52,5 N-SR "Ennigerloh" – storage at 20 °C						
$Ca(OH)_2$-solution	144,09	144,25	144,44	144,99	145,07	145,47
Na_2SO_4-solution	143,94	144,14	144,22	144,61	145,37	146,68
CEM III/A 52,5 N-SR "Ennigerloh" – storage at 5 °C						
$Ca(OH)_2$-solution	144,42	144,73	144,94	145,19	145,32	-
Na_2SO_4-solution	144,05	144,32	144,45	144,69	145,22	-
CEM III/B 42,5 N-LH/SR – storage at 20 °C						
$Ca(OH)_2$-solution	147,58	148,17	148,04	148,32	148,50	148,94
Na_2SO_4-solution	148,16	148,51	148,52	149,09	149,63	150,55
CEM III/B 42,5 N-LH/SR – storage at 5 °C						
$Ca(OH)_2$-solution	146,12	146,83	146,97	147,26	147,24	-
Na_2SO_4-solution	146,74	147,45	147,43	147,54	147,70	-
CEM I 42,5 R-SR0 – storage at 20 °C						
$Ca(OH)_2$-solution	149,06	149,34	149,35	149,37	149,37	149,24
Na_2SO_4-solution	148,48	148,92	149,11	149,43	150,03	150,94
CEM I 42,5 R-SR0 – storage at 5 °C						
$Ca(OH)_2$-solution	149,36	150,14	150,13	150,39	150,32	-
Na_2SO_4-solution	148,91	149,84	149,82	150,07	150,15	-

Blast furnace cement CEM III/A 52,5 N-SR "Ennigerloh"	**Annex A3**
Results of the assessment "sulfate resistance (Flat prism method) – S_{FPM}" Mass of the mortar flat prisms	

Testing of sulfate resistance of blast furnace cement CEM III/A – Flat prism method S_{FPM}

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

After a testing period of 180 days the specimens show no expansion damages, cracks or flaking based on formation of thaumasite, see figures A1 to A3.

Figure A1: Specimens with CEM III/A 52,5 N-SR "Ennigerloh" after 180 days;
Na_2O_4-Lösung Solution: 20 °C-storage (on the left) and 5 °C-storage (on the right)

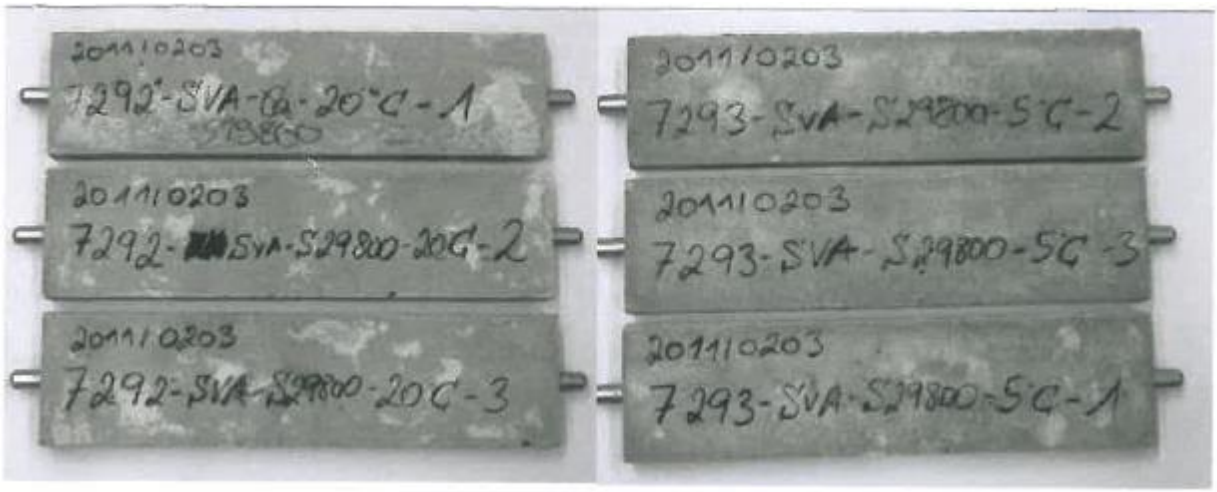

Figure A2: Specimens with CEM III/B 42,5 N-LH/SR after 180 days;
Na_2O_4-Lösung Solution: 20 °C-storage (on the left) and 5 °C-storage (on the right)

Blast furnace cement CEM III/A 52,5 N-SR "Ennigerloh"	**Annex A4** **Page 1 of 2**
Results of the assessment "sulfate resistance (flat prism method) – S_{FPM}" Visual examination of the flat prims with blast furnace cement CEM III/A 52,5 N SR "Ennigerloh" and CEM III/B 42,5 N-LH/SR	

Figure A3: Specimens with CEM I 42,5 R-SR0 after 180 days;
Na_2O_4-Lösung Solution: 20 °C-storage (on the left) and 5 °C-storage (on the right)

Blast furnace cement CEM III/A 52,5 N-SR "Ennigerloh"	**Annex A4** **Page 2 of 2**
Results of the assessment "sulfate resistance (flat prism method) – S_{FPM}" Visual examination of the flat prims with CEM I 42,5 R–SR0	