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Hidravlično vezane zmesi – Specifikacije – 2. del: Žlindraste vezane zmesi

Hydraulically bound mixtures - Specifications - Part 2: Slag bound mixtures

Hydraulisch gebundene Gemische - Anforderungen - Teil 2: Schlackengebundene Gemische

Mélanges traités aux liants hydrauliques - Specifications - Partie 2 : Mélanges traités au laitier

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Hydraulically bound mixtures - Specifications - Part 2: Slag bound mixtures

Mélanges traités aux liants hydrauliques - Spécifications -
Partie 2 : Mélanges traités au laitier

Hydraulisch gebundene Gemische - Anforderungen - Teil 2:
Schlackengebundene Gemische

This European Standard was approved by CEN on 16 April 2004.

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EN 14227-2:2004 (E)**Foreword**

This document (EN 14227-2:2004) has been prepared by Technical Committee CEN/TC 227 "Road materials", the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by January 2005, and conflicting national standards shall be withdrawn at the latest by January 2005.

This standard is one of a series of standards for hydraulically bound mixtures:

EN 14227-1, *Hydraulically bound mixtures — Specifications — Part 1: Cement bound granular mixtures.*

EN 14227-2, *Hydraulically bound mixtures — Specifications — Part 2: Slag bound mixtures.*

EN 14227-3, *Hydraulically bound mixtures — Specifications — Part 3: Fly ash bound mixtures n, classification.*

EN 14227-4, *Hydraulically bound mixtures — Specifications — Part 4: Fly ash for hydraulically bound mixtures.*

EN 14227-5, *Hydraulically bound mixtures — Specifications — Part 5: Hydraulic road binder bound mixtures.*

prEN 14227-10, *Hydraulically bound mixtures — Specifications — Part 10: Soil treated by cement.*

prEN 14227-11, *Unbound and hydraulically bound mixtures — Specifications — Part 11: Soil treated by lime.*

prEN 14227-12, *Unbound and hydraulically bound mixtures — Specifications — Part 12: Soil treated by slag.*

prEN 14227-13, *Unbound and hydraulically bound mixtures — Specifications — Part 13: Soil treated by hydraulic road binder.*

prEN 14227-14, *Unbound and hydraulically bound mixtures — Specifications — Part 14: Soil treated by fly ash.*

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

1 Scope

This document specifies “slag bound mixtures” for roads, airfields and other trafficked areas and specifies the requirements for their constituents, composition and laboratory performance classification. In this document slag refers to slag from the iron and steel industry.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 196-6, *Methods of testing cement — Part 6: Determination of fineness.*

EN 933-1, *Tests for geometrical properties of aggregates — Part 1: Determination of particle size distribution — Sieving method.*

EN 1097-6, *Tests for mechanical and physical properties of aggregates — Part 6: Determination of particle density and water absorption.*

EN 1097-7, *Tests for mechanical and physical properties of aggregates — Part 7: Determination of particle density of filler — Pyknometer method.*

EN 13242, *Aggregates for unbound and hydraulically bound materials for use in civil engineering work and road construction.*

EN 13286-1, *Unbound and hydraulically bound mixtures — Part 1: Test methods for laboratory reference density and water content — Introduction, general requirements and sampling.*

prEN 13286-2, *Unbound and hydraulically bound mixtures — Part 2: Test methods for the determination of the laboratory reference density and water content — Proctor compaction.*

EN 13286-3, *Unbound and hydraulically bound mixtures — Part 3: Test methods for laboratory reference density and water content — Vibrocompression with controlled parameters.*

EN 13286-4, *Unbound and hydraulically bound mixtures — Part 4: Test methods for laboratory reference density and water content — Vibrating hammer.*

EN 13286-5, *Unbound and hydraulically bound mixtures — Part 5: Test methods for laboratory reference density and water content — Vibrating table.*

EN 13286-40, *Unbound and hydraulically bound mixtures — Part 40: Test method for the determination of the direct tensile strength of hydraulically bound mixtures.*

EN 13286-41, *Unbound and hydraulically bound mixtures — Part 41: Test method for the determination of the compressive strength of hydraulically bound mixtures.*

EN 13286-42, *Unbound and hydraulically bound mixtures — Part 42: Test method for the determination of the indirect tensile strength of hydraulically bound mixtures.*

EN 13286-43, *Unbound and hydraulically bound mixtures — Part 43: Test method for the determination of the modulus of elasticity of hydraulically bound mixtures.*

EN 13286-44, *Unbound and hydraulically bound mixtures — Part 44: Test method for the determination of the alpha coefficient of vitrified blast furnace slag.*

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EN 13286-47, *Unbound and hydraulically bound mixtures — Part 47: Test method for the determination of the California bearing ratio, immediate bearing index and linear swelling.*

prEN 13286-50, *Unbound and hydraulically bound mixtures — Part 50: Method for the manufacture of test specimens of hydraulically bound mixtures using Proctor equipment or vibrating table compaction.*

prEN 13286-51, *Unbound and hydraulically bound mixtures — Part 51: Method for the manufacture of test specimens of hydraulically bound mixtures by vibrating hammer compaction.*

prEN 13286-52, *Unbound and hydraulically bound mixtures — Part 52: Method for the manufacture of test specimens of hydraulically bound mixtures by vibrocompression.*

prEN 13286-53, *Unbound and hydraulically bound mixtures — Part 53: Method for the manufacture of test specimens of hydraulically bound mixtures by axial compression.*

prEN 14227-11, *Unbound and hydraulically bound mixtures — Specifications — Part 11: Soil treated by lime.*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

- 3.1 hydraulically bound mixture**
mixture which sets and hardens by hydraulic reaction
- 3.2 slag bound mixture**
mixture containing one or more of the following slags and water, which hardens by hydraulic reaction and/or carbonation

NOTE Hardening may be accelerated by the addition of an activator defined in 5.5.

- 3.3 air-cooled blast furnace slag**
aggregate made mainly of crystalline silicates and aluminosilicates of calcium and magnesium, obtained by slow air cooling of molten blastfurnace slag

NOTE Air-cooled blastfurnace slag is obtained by slow air cooling of molten blastfurnace slag. The cooling process may be assisted by the controlled application of water. Air-cooled blastfurnace slag hardens by hydraulic reaction and carbonation.

- 3.4 air-cooled steel slag**
aggregate made mainly of crystalline calcium silicates and calcium ferrites comprising CaO, SiO₂, MgO and iron oxides, obtained by slow air cooling of molten steel slag

NOTE The cooling process may be assisted by the controlled application of water. Air-cooled steel slag hardens mainly by carbonatic reactions.

- 3.5 granulated blast furnace slag**
glassy, sandy material made up mainly of CaO, SiO₂, Al₂O₃ and MgO, produced generally by rapid water quenching of molten blast furnace slag

NOTE 1 Granulated blast furnace slag hardens by hydraulic reaction.

NOTE 2 Pelletized and dry granulated blastfurnace slag may have similar hydraulic properties.

3.6**partially ground granulated blast furnace slag**

granulated blast furnace slag partially ground in order to increase the proportion of material finer than 0,063 mm. This increases the rate of hardening and the strength of the mixture

3.7**ground granulated blast furnace slag**

granulated blast furnace slag more fully ground in order to further increase the proportion of material finer than 0,063 mm

3.8**slenderness ratio**

height to diameter ratio of the specimen

3.9**compacity**

ratio of the absolute volume of the solid to the apparent volume of the mixture (see annex C)

4 Symbols and abbreviations

For the purpose of this document, the following symbols and abbreviations apply.

C is the CaO content of granulated blast furnace slag, expressed in percentage by mass (%);

A is the Al₂O₃ content of granulated blast furnace slag, expressed in percentage by mass (%);

C.A is the product of C and A;

CBR is the California bearing ratio, expressed in percent (%);

R_c is the compressive strength, expressed in megapascals (MPa);

R_t is the direct tensile strength, expressed in megapascals (MPa);

R_{it} is the indirect tensile strength, expressed in megapascals (MPa);

E is the modulus of elasticity, expressed in megapascals (MPa);

E_C is the E determined by compressive strength, expressed in megapascals (MPa);

E_t is the E determined in direct tension, expressed in megapascals (MPa);

E_{it} is the E determined in indirect tension, expressed in megapascals (MPa).

5 Constituents**5.1 Granulated blast furnace slag**

Granulated blast furnace slag shall have the following composition by mass expressed as a percentage of the total dry material:

— SiO₂: 27 % to 41 %;

— Al₂O₃: 7 % to 20 %;

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— CaO: 30 % to 50 %;

— MgO: <20 %

In accordance with annex A, the C.A product category from Table A.1 and the alpha coefficient category from Table A.2 shall be declared.

5.2 Partially ground granulated blast furnace slag

The composition of partially ground granulated blast furnace slag shall conform to 5.1. In accordance with annex A, the C.A product category from Table A.1 and the “fines content” category from Table A.3 shall be declared. Also in accordance with annex A the alpha coefficient category from Table A.2 of the parent granulated blast furnace slag shall be declared.

5.3 Ground granulated blast furnace slag

The composition of ground granulated blast furnace slag shall conform to 5.1. In accordance with annex A, the C.A product category from Table A.1 and the Blaine fineness category from Table A.4 shall be declared.

5.4 Aggregates

Aggregates shall be selected from EN 13242.

The properties and the appropriate categories of the aggregates shall be specified depending on the position of the slag bound mixture in the pavement structure and the traffic to be carried.

Aggregates shall be volumetrically stable. When this is not the case, the use of the mixture shall be permitted provided there is a satisfactory performance record or a thorough laboratory evaluation of the mixture has been carried out in accordance with provisions valid at the place of use.

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5.5 Activators

Activators shall include lime in accordance with prEN 14227-11, gypsum, steel slags and other similar products containing lime and or sulphate.

5.6 Water

Water shall not contain components that adversely affect the hardening and performance of the slag bound mixture.

6 Slag bound mixtures**6.1 General****6.1.1 Types**

Slag bound mixture shall be made from the constituents specified in clause 5.

The mixture shall be selected from the types and sub-types described below and shall conform to the specified requirements for the selected mixture.

6.1.2 Water content

The water content shall be selected to permit compaction on site by rolling and to optimize the mechanical performance of the mixture. The water content shall be determined by the Proctor test or other method in accordance with EN 13286-1 to -5 and limits set to give a workable range of water content on site compatible with the compaction and the desired mechanical performance of the mixture.

6.1.3 Proportioning of the constituents, grading and dry density

The proportioning of the constituents, expressed as a percentage by dry mass of the total dry mass of the mixture, the grading and the dry density of the mixture, shall be declared. The declared proportions shall be based on the laboratory mixture design and/or practical experiences with mixtures produced with the same constituents and under the same conditions in a way that the mixture complies with the requirements of this document.

6.2 Slag bound mixture A

6.2.1 Description

Slag bound mixture A shall be a granular mixture in which the setting and hardening may be protracted. There are 5 sub-types depending on the aggregate size and the use of granulated blast furnace slag. Slag bound mixture A4 shall contain granulated blast furnace slag but the proportion shall not exceed 70 %. For this sub-type and any other sub-type containing granulated blast-furnace slag including ground and partially ground material, the requirements of 5.1 shall not apply.

NOTE Slag bound mixtures A are used when significant stiffness is not required.

6.2.2 Grading of the mixture

The grading of the selected sub-type, determined in accordance with EN 933-1, shall comply with Table 1.

Table 1 — Grading of slag bound mixture A

Column	1	2	3
Line	Slag bound mixture	Grading mm	Grading envelopes
1	A1	0/22,4	Figure 1
2	A2	0/31,5	Figure 2
3	A3	0/45	Figure 3
4	A4	0/31,5	Figure 4
5	A5	Declared grading	

6.2.3 Laboratory mechanical performance

The laboratory mechanical performance of slag bound mixture A shall normally be characterized by the California bearing ratio test and the category shall be selected from 7.2.

EN 14227-2:2004 (E)**6.3 Slag bound mixture B****6.3.1 General****6.3.1.1 Description**

Slag bound mixture B shall be a mixture of aggregate, granulated blast furnace slag, activator and water specified in clause 5.

NOTE Slag bound mixtures B obtain significant stiffness in the medium to long term.

The mixture shall be selected from the 4 sub-types described below and shall conform to the specified requirements for the selected mixture.

6.3.1.2 Granulated blast furnace slag

Granulated blast furnace slag shall be either granulated blast furnace slag conforming to 5.1, partially ground granulated blast furnace slag conforming to 5.2 or ground granulated blast furnace slag conforming to 5.3.

6.3.1.3 Laboratory mechanical performance

The laboratory mechanical performance characterization and class of slag bound mixture shall be selected from 7.3 or 7.4.

6.3.2 Slag bound mixture B 1**6.3.2.1 Description**

Slag bound mixture B 1 shall comply with the grading requirements of slag bound mixture A but shall contain granulated, or partially ground granulated or ground granulated blast furnace slag in accordance with 5.1, 5.2 and 5.3 respectively.

6.3.2.2 Grading of the mixture

The grading of the selected sub-type, determined in accordance with EN 933-1, shall comply with Table 2.

Table 2 — Grading of slag bound mixture B 1

Column	1	2	3
Line	Slag bound mixture	Grading mm	Grading envelopes
1	B1-1	0/22,4	Figure 1
2	B1-2	0/31,5	Figure 2
3	B1-3	0/45	Figure 3
4	B1-4	0/31,5	Figure 4

6.3.3 Slag bound mixture B 2**6.3.3.1 Description**

Slag bound mixture B 2 shall be a granular mixture with compacity requirement.