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Building lime - Part 1: Definitions, specifications and conformity criteria

Baukalk - Teil 1: Begriffe, Anforderungen und Konformitätskriterien

Chaux de construction - Partie 1: Définitions, spécifications et critères de conformité

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EUROPEAN STANDARD

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English Version

Building lime - Part 1: Definitions, specifications and conformity criteria

Chaux de construction - Partie 1: Définitions, spécifications et critères de conformité

Baukalk - Teil 1: Begriffe, Anforderungen und Konformitätskriterien

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Foreword

This document (EN 459-1:2010) has been prepared by Technical Committee CEN/TC 51 “Cement and building limes”, the secretariat of which is held by NBN.

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of an identical text or by endorsement, at the latest by March 2011, and conflicting national standards shall be withdrawn at the latest by March 2011.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 459-1:2001.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this document.

EN 459, *Building lime*, consists of the following parts:

— *Part 1: Definitions, specifications and conformity criteria*

— *Part 2: Test methods*

— *Part 3: Conformity evaluation*

The requirements in EN 459-1 are based on the results of tests on building lime determined in accordance with EN 459-2. Annexes A and D are normative, Annexes B, C and ZA are informative.

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

Introduction

The revision of this European Standard for building lime was initiated by Resolution No 402 taken by CEN/TC 51 "Cement and building limes" in 2004.

Different sources of raw materials and different climatic conditions have led to different developments in building construction and civil engineering practices and materials and therefore to different kinds of building lime in different regions of Europe.

The inclusion of a wider range of building lime which exists in Europe has made it necessary to establish a number of classes.

The previous national standards for building lime generally also formed the basis for different areas of application (see Annex C (informative)). The classification chosen therefore also takes into consideration these circumstances as far as possible.

For a better understanding, the standard makes a clear distinction between air lime (Clause 4) and lime with hydraulic properties (Clause 5). Depending on the composition and characteristics of the products, each clause is then divided into sub-paragraphs (calcium lime and dolomitic lime for air lime; natural hydraulic lime, formulated lime and hydraulic lime for lime with hydraulic properties) containing the appropriate definitions, specifications and conformity criteria.

1 Scope

This European Standard applies to building lime used for:

— preparation of binder for mortar (for example for masonry, rendering and plastering);

— production of other construction products (for example calcium silicate bricks, autoclaved aerated concrete, concrete, etc.);

— civil engineering applications (for example soil treatment, asphalt mixtures, etc.).

It gives definitions for the different types of building lime and their classification. It also gives requirements for their chemical and physical properties which depend on the type of building lime and specifies the conformity criteria.

Terms of delivery or other contractual conditions, normally included in documents exchanged between the supplier and the purchaser of building lime, are outside the scope of this European Standard.

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 197-1, *Cement — Part 1: Composition, specifications and conformity criteria for common cements*

EN 459-2:2010, *Building lime — Part 2: Test methods*

EN 459-3:2001, *Building lime — Part 3: Conformity evaluation*

3 Terms and definitions

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

NOTE See also Annex C.

3.1
lime
calcium oxide and/or hydroxide, and calcium-magnesium oxide and/or hydroxide produced by the thermal decomposition (calcination) of naturally occurring calcium carbonate (for example limestone, chalk, shells) or naturally occurring calcium magnesium carbonate (for example dolomitic limestone, dolomite)

3.2
building lime
group of lime products, exclusively consisting of two families: air lime and lime with hydraulic properties, used in applications or materials for construction, building and civil engineering

3.3
air lime[1)]
lime (see 3.1) which combines and hardens with carbon dioxide present in air

1) Translation of a term used in most European countries.

NOTE Air lime has no hydraulic properties. Air lime is divided into two sub-families, calcium lime (CL) and dolomitic lime (DL).

3.4
lime with hydraulic properties
building lime (see 3.2) consisting mainly of calcium hydroxide, calcium silicates and calcium aluminates

NOTE It has the property of setting and hardening when mixed with water and/or under water. Reaction with atmospheric carbon dioxide is part of the hardening process. Lime with hydraulic properties is divided into three sub-families, natural hydraulic lime (NHL), formulated lime (FL) and hydraulic lime (HL).

3.5
allowable probability of acceptance
CR
for a given sampling plan, allowed probability of acceptance of building lime with a characteristic value outside the specified characteristic value

3.6
sampling plan
specific plan which states the (statistical) sample size(s) to be used, the percentile P_k and the allowable probability of acceptance CR

3.7
characteristic value
value of a required property outside which lies a specified percentage, the percentile P_k, of all the values of the population

3.8
specified characteristic value
characteristic value of a strength, physical or chemical property which in the case of an upper limit is not to be exceeded or in the case of a lower limit is, as a minimum, to be reached

3.9
single result limit value
value of a strength, physical or chemical property which − for any single test result − in the case of an upper limit is not be exceeded or in the case of a lower limit is, as a minimum, to be reached

3.10
spot sample
sample taken at the same time and from one and the same place, relating to the intended tests

NOTE It can be obtained by combining one or more immediately consecutive increments (see EN 459-2).

3.11
autocontrol testing
continual testing by the manufacturer of building lime spot samples taken at the point(s) of release from the factory/depot

3.12
control period
period of production and dispatch identified for the evaluation of the autocontrol test results

4 Air lime

4.1 General

Air lime is used for the preparation or the production of materials used in building construction as well as in civil engineering.

Air lime (see 3.3) when appropriately batched and mixed with water, forms a paste that improves the workability (values of flow and penetration) and water retention of mortars. The carbonation of hydrates in contact with atmospheric carbon dioxide forms calcium carbonate which develops strength and contributes to the durability of mortars containing building lime (hence the name of air lime).

Sub-families and forms of air lime are given in 4.2 and 4.3 respectively.

4.2 Sub-families of air lime

4.2.1 Calcium lime (CL)

Calcium lime is an air lime consisting mainly of calcium oxide and/or calcium hydroxide without any hydraulic or pozzolanic addition.

4.2.2 Dolomitic lime (DL)

Dolomitic lime is an air lime consisting mainly of calcium magnesium oxide and/or calcium magnesium hydroxide without any hydraulic or pozzolanic addition.

4.3 Forms of air lime

4.3.1 Quicklime (Q)

Quicklime is an air lime mainly in the oxide form which reacts exothermically on contact with water. Quicklime is available in a range of sizes from lump to powder.

4.3.2 Hydrated lime (S, S PL or S ML)

Hydrated lime is an air lime mainly in the hydroxide form produced by the controlled slaking of quicklime. Hydrated lime is available as:

— powder (S);

— putty (S PL); or

— slurry or milk of lime (S ML).

Dolomitic lime is also produced as semi-hydrated dolomitic lime (S1), mainly consisting of calcium hydroxide and magnesium oxide.

4.4 Calcium lime

4.4.1 Classification of calcium lime

Calcium lime shall be classified according to the notation given in Table 1 and its total (CaO + MgO) content in accordance with Table 2.

Table 1 — Types of calcium lime[a]

Designation	Notation
Calcium lime 90	CL 90
Calcium lime 80	CL 80
Calcium lime 70	CL 70

[a] In addition, calcium lime is classified according to the form of the product, quicklime (Q), hydrated lime (S), lime putty (S PL) or milk of lime (S ML).

Conformity with this classification is assessed by means of statistical quality control as described in Annex A of this European Standard.

4.4.2 Chemical requirements for calcium lime

The properties of the type of calcium lime shown in Table 2 determined in accordance with EN 459-2 shall conform to the requirements in that table. All types of calcium lime listed in Table 2 may contain additives in small quantities to improve the manufacture or properties of calcium lime. When the total content exceeds 0,1 %, the actual types and amounts shall be declared.

Table 2 — Chemical requirements of calcium lime given as characteristic values

Type of calcium lime	Values given as mass fraction in percent				
	CaO + MgO	MgO[a]	CO_2[b]	SO_3	Available lime[c]
CL 90	≥ 90	≤ 5	≤ 4	≤ 2	≥ 80
CL 80	≥ 80	≤ 5	≤ 7	≤ 2	≥ 65
CL 70	≥ 70	≤ 5	≤ 12	≤ 2	≥ 55

The values for CaO + MgO, MgO, CO_2 and SO_3 are applicable to all forms of calcium lime. For quicklime these values correspond to the finished product; for all other forms of lime (hydrated lime, lime putty and milk of lime) the values are based on the product after subtraction of its free water and bound water content.

The values for available lime (calcium oxide for quicklime, calcium hydroxide for hydrated lime) refer to the product when tested in accordance with EN 459-2.

[a] MgO content up to 7 % is permitted if the soundness test in accordance with EN 459-2 is passed.

[b] A higher content of CO_2 is permitted, if all other chemical requirements in Table 2 are satisfied and the test frequency satisfies the requirements in Table 7.

[c] Higher values of available lime may be requested.

4.4.3 Physical requirements and other physical properties for quicklime

The physical properties of the type of quicklime shown in Tables 3 to 4 determined in accordance with EN 459-2 shall conform to the requirements in those tables.

Table 3 — Physical requirements of quicklime

Type of quicklime	Soundness after slaking in accordance with 6.4.4 of EN 459-2:2010[a]
CL 90	Pass
CL 80	
CL 70	
[a] Slaking according to the instructions of the lime producer	

Table 4 — Reactivity (R) of quicklime given as characteristic values

Type of quicklime	Reactivity (time in min), in accordance with 6.6 of EN 459-2:2010				
	R5	R 4	R3	R2	R_{sv}
CL 90	$t_{60} < 10$	$t_{60} < 25$	—	—	other specified value or no requirement
CL 80	$t_{60} < 10$	$t_{60} < 25$	$t_{50} < 25$	—	
CL 70	—	—	—	$t_{40} < 25$	

The particle size distribution of all types of quicklime shown in Table 1 shall conform to the requirements in Table 5 and shall be determined in accordance with EN 459-2.

Table 5 — Particle size distribution (P) of quicklime given as characteristic values

Sieve size	Particle size distribution[a] (mass fraction passing the sieve in percent), in accordance with Clause 6 of EN 459-2:2010				
	P4	P3	P2	P1	P_{sv}
10 mm	100	—	—	—	other specified value or no requirement
5 mm	≥ 95	100	100	—	
2 mm	—	≥ 95	≥ 95	100	
0,2 mm	—	—	≥ 70	≥ 95	
0,09 mm	—	≥ 30	≥ 50	≥ 85	
[a] Particle size ≥ 2 mm shall be determined by dry sieving in accordance with EN 459-2:2010, 6.1 and particle size < 2 mm by air-jet sieving in accordance with EN 459-2:2010, 6.2.					

4.4.4 Physical requirements and other physical properties for hydrated lime and lime putty

The physical properties of hydrated lime and lime putty of the type shown in Table 6 determined in accordance with EN 459-2 shall conform to the requirements in that table.

Table 6 — Physical requirements of hydrated calcium lime and lime putty[a], given as characteristic values

Type of hydrated calcium lime	Particle size[b]		Free water content[c]	Soundness[d, e]			Mortar tests[b, f]	
	% residue by mass			For hydrated limes		Lime putty	Penetration	Air content
				Reference method	Alternative method			
	0,09 mm[g]	0,2 mm	%	mm	mm		mm	%
CL 90 CL 80 CL 70	≤ 7	≤ 2	≤ 2	≤ 2	≤ 20	Pass	> 10 and < 50	≤ 12

[a] Particle size and free water content apply to hydrated calcium lime for all applications. Soundness, penetration and air content apply only to hydrated calcium lime for masonry mortar, plastering and rendering.

[b] Not for lime putty.

[c] Not for lime putty. The free water content of lime putty is normally between 45 % and 70 %.

[d] Tested in accordance with 6.4 of EN 459-2:2010.

[e] Hydrated calcium lime which includes particles larger than 0,2 mm shall satisfy the requirements of the soundness test for hydrated calcium limes with grains larger than 0,2 mm in EN 459-2.

[f] Tested in accordance with the test on standard mortar in EN 459-2.

[g] A residue on 0,09 mm sieve up to 15 % is permitted as long as the soundness test given in 6.4.2 of EN 459-2:2010 is passed.

4.4.5 Additional properties

Other properties may be subject either to requirements in application standards dealing with the use of calcium lime or to requests from the user. These properties are given in informative Annex B.

4.4.6 Durability requirements

The choice of calcium lime, particularly as regards types for different applications and exposure conditions shall follow the appropriate European or national application standards and/or regulations valid in the place of use.

4.4.7 Conformity criteria of calcium lime

4.4.7.1 General requirements

Conformity of calcium lime to this European Standard shall be continuously evaluated on the basis of testing of spot samples. The properties to be tested for the autocontrol testing by the manufacturer, test methods and the minimum testing frequencies for each type of calcium lime detailed in Table 1 are specified in Table 7.

The declaration of conformity by the manufacturer, shall be based on the evaluation of conformity of building lime with this European Standard according to the scheme specified in EN 459-3.

NOTE Requirements for the declaration of conformity which the manufacturer should make available under the CE marking procedure are established in Annex ZA and should not be confused with other types of declaration of conformity.

4.4.7.2 Conformity requirements

Sampling shall take place at the point of release of the building lime.

Conformity of calcium lime with the requirements concerning chemical and physical properties in this European Standard is assumed if the requirements in Tables 2 to 6 inclusive are met. The requirements in these tables shall be taken as absolute values.

The evaluation procedure depends on the frequency of testing during the control period of twelve months. If the number of samples is at least one per week, the evaluation may be statistical (characteristic values) (see Annex A).

Statistical evaluation is normally carried out by attributes (see Table 7 and A.1.3). If the data are normally distributed, the evaluation may be made by variables (see Table 7 and A.1.2).

NOTE This standard does not deal with acceptance inspection at delivery.

Table 7 — Properties, test methods and minimum testing frequencies[a] for the autocontrol testing by the manufacturer

Property	Form of calcium lime[b]	Test method to be used[c]	Minimum frequency of testing by manufacturer			
			Autocontrol testing			
			Regular[d] (see 4.4.7.2)	Initial type testing[l]	Inspection by variables[h]	Inspection by attributes[j]
1	2	3	4	5	6	7
Particle size	Quicklime	EN 459-2	1/week	2/week	X	
	Hydrated lime[m]		1/day	2/day	X	
Soundness	Quicklime[e] Hydrated lime		1/day[g]	2/day		X
	Lime putty		1/week	2/week		X
Penetration/ Water demand	Hydrated lime		2/year	1/month		X
Air content	Hydrated lime[k]		2/year	1/month		X
CaO + MgO, MgO[f]	Quicklime Hydrated lime Lime putty		1/week	2/week		X
CO_2[f, n]	Quicklime Hydrated lime Lime putty		1/week	2/week		X
SO_3	Quicklime Hydrated lime Lime putty		1/month	2/month		X
Available lime[f, o]	Quicklime Hydrated lime Lime putty		1/week	2/week		X
Free water	Hydrated lime Lime putty		1/month	2/month		X
Reactivity	Quicklime		1/week	2/week		X

a The methods used to take and prepare samples shall be in accordance with EN 459-2. Tests may be carried out at any time between production and dispatch. The producer shall ensure that the requirements are met at the time of dispatch.

b See 4.3 and Table 1.

c Any other methods may be used provided they are calibrated, either against the reference methods or against internationally accepted reference materials, in order to demonstrate their equivalence.

d The control period for conformity evaluation is twelve months.

e After slaking (see Table 3, footnote a).

f If the test frequency of CaO + MgO and CO_2 is higher than the required frequency (e.g. CaO + MgO > 1/week and CO_2 > 1/week) then the test frequency of available lime may be reduced to twice per year.
If the test frequency of available lime and CO_2 is higher than the required frequency (e.g. available lime > 1/week and CO_2 > 1/week) then the test frequency of CaO + MgO may be reduced to twice per year.

g For hydrated lime: If 30 consecutive test results are less than 10 % of the required value then the test frequency may be reduced to once per month. If any single result is higher than 10 % of the required value then return to daily testing.
For quicklime: If 30 consecutive test results meet the requirement, then the test frequency may be reduced to once per month. If any single result fails the requirement, then return to daily testing.

h If the data are not normally distributed the evaluation shall be made by attributes.

j If the number of samples taken during the control period is at least one per week the evaluation may be made by variables.

k For lime without additives only initial type testing is required.

l See EN 459-3:2001, 4.4.

m See Table 6, footnote g.

n See Table 2, footnote b.

o See Table 2, footnote c.