



NSAI
Standards

Irish Standard Recommendation
S.R. CEN/TR 17310:2019

Carbonation and CO₂ uptake in concrete

S.R. CEN/TR 17310:2019

Incorporating amendments/corrigenda/National Annexes issued since publication:

The National Standards Authority of Ireland (NSAI) produces the following categories of formal documents:

I.S. xxx: Irish Standard — national specification based on the consensus of an expert panel and subject to public consultation.

S.R. xxx: Standard Recommendation — recommendation based on the consensus of an expert panel and subject to public consultation.

SWiFT xxx: A rapidly developed recommendatory document based on the consensus of the participants of an NSAI workshop.

This document replaces/revises/consolidates the NSAI adoption of the document(s) indicated on the CEN/CENELEC cover/Foreword and the following National document(s):

NOTE: The date of any NSAI previous adoption may not match the date of its original CEN/CENELEC document.

This document is based on:

CEN/TR 17310:2019

Published:

2019-01-30

This document was published under the authority of the NSAI and comes into effect on:

2019-02-17

ICS number:

91.100.30

NOTE: If blank see CEN/CENELEC cover page

NSAI
1 Swift Square,
Northwood, Santry
Dublin 9

T +353 1 807 3800
F +353 1 807 3838
E standards@nsai.ie
W NSAI.ie

Sales:
T +353 1 857 6730
F +353 1 857 6729
W standards.ie

Údarás um Chaighdeáin Náisiúnta na hÉireann

National Foreword

S.R. CEN/TR 17310:2019 is the adopted Irish version of the European Document CEN/TR 17310:2019, Carbonation and CO₂ uptake in concrete

This document does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

For relationships with other publications refer to the NSAI web store.

Compliance with this document does not of itself confer immunity from legal obligations.

In line with international standards practice the decimal point is shown as a comma (,) throughout this document.

This page is intentionally left blank

TECHNICAL REPORT

CEN/TR 17310

RAPPORT TECHNIQUE

TECHNISCHER BERICHT

January 2019

ICS 91.100.30

English Version

Carbonation and CO₂ uptake in concrete

Carbonatation et absorption du CO₂ dans le béton

Karbonatisierung und CO₂-Aufnahme von Beton

This Technical Report was approved by CEN on 30 December 2018. It has been drawn up by the Technical Committee CEN/TC 104.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.



EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

Contents	Page
European foreword	4
1 Scope	5
2 Normative references	5
3 Terms and definitions	5
4 Carbonation, the uptake of carbon dioxide	5
4.1 Compounds, chemistry and notation	5
4.2 Carbonation.....	6
4.2.1 Carbonation reactions.....	6
4.2.2 Process of carbonation.....	7
4.2.3 Degree of carbonation	8
4.2.4 Effect of carbonation on cement paste structure.....	10
4.2.5 Carbonation rate	11
4.2.6 Carbonation rate controlling factors	11
4.2.7 Carbonation rate of concrete with blended cements or with additions.....	15
4.3 CO ₂ binding capacity in concrete, Degree of carbonation	16
4.3.1 General.....	16
4.3.2 Theoretical binding capacity of Portland cement	17
4.3.3 Normal binding capacity of Portland cement	17
4.3.4 Normal binding capacity of blended cements.....	18
4.4 Carbonation in different environments.....	19
4.4.1 General.....	19
4.4.2 Dry indoor concrete	19
4.4.3 Concrete exposed to rain.....	20
4.4.4 Concrete sheltered from rain.....	20
4.4.5 Wet or submerged concrete	20
4.4.6 Buried concrete	21
5 Practical experiences of CO₂ uptake in concrete life stages	21
5.1 CO ₂ uptake during product stage (module A)	21
5.2 CO ₂ uptake during use stage (module B)	22
5.3 CO ₂ uptake during end of life stage.....	29
5.3.1 CO ₂ uptake during end of life stage - demolition, crushing and waste handling (module C1-C3)	29
5.3.2 CO ₂ uptake during end of life stage - landfill (module C4)	32
5.4 CO ₂ uptake beyond the system boundary (module D).....	32
6 Figures for "direct estimation" of CO₂ uptake in whole structures during use stage	33
6.1 General.....	33
6.1.1 General.....	33
6.1.2 CO ₂ uptake for a portal frame bridge.....	34
6.1.3 CO ₂ uptake for a residential building.....	35
6.2 Average CO ₂ uptake for construction types, strength classes and exposure.....	36
7 Additional information	37

7.1	CO₂ uptake in the long term, beyond the service life of the structure	37
7.2	CO₂ uptake of crushed concrete in new applications	38
8	Society perspective - Carbonation and CO₂ uptake in mortar	38
9	National calculation models and methods	39
9.1	General	39
9.2	Calculation of Carbonation of concrete in use phase (Swiss approach)	39
9.2.1	General	39
9.2.2	Water/CaO	39
9.2.3	CO₂ concentration, relative humidity and CO₂ buffer capacity	39
9.2.4	A simple approach of assessing the CO₂ uptake of concrete components	40
9.2.5	Ratio of CO₂ uptake/CO₂ emission as a function of thickness of concrete element	43
	Bibliography	45

CEN/TR 17310:2019 (E)

European foreword

This document (CEN/TR 17310:2019) has been prepared by Technical Committee CEN/TC 104 “Concrete and related products”, the secretariat of which is held by SN.

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

1 Scope

This document provides detailed guidance on the carbonation and carbon dioxide (CO₂) uptake in concrete. This guidance is complementary to that provided in EN 16757, *Product Category Rules for concrete and concrete elements*, Annex BB.

Typical CO₂ uptake values for a range of structures exposed to various environmental conditions are presented. These values can be incorporated into EPDs for the whole life cycle for either: a functional unit, one tonne or one m³ of concrete, without necessarily having any detailed knowledge of the structure to be built.

In the rest of the document, the data will be given per m³.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

4 Carbonation, the uptake of carbon dioxide

4.1 Compounds, chemistry and notation

4.1.1 Carbon dioxide: Chemically expressed as CO₂ and present in the atmosphere as a gas. When CO₂ is dissolved in water, H₂O, it may form carbonic acid, H₂CO₃, where this may release carbonate, CO₃²⁻, and bicarbonate, HCO₃⁻ ions.

4.1.2 Calcium hydroxide: Chemically expressed as Ca(OH)₂ and often called Portlandite. It is a product of the hydration of Portland cement and is always present in concrete. For simplicity, cement chemists often denote calcium hydroxide as CH. Calcium hydroxide is not very soluble in water but it does dissolve to the ions Ca²⁺ and 2OH⁻. The presence of calcium hydroxide in concrete is largely responsible for maintaining its alkaline environment, which is at a pH around 12,5. Around 25 % of hardened hydrated cement is Ca(OH)₂.

4.1.3 Calcium oxide: Chemically expressed as CaO. Portland cement clinker contains 61 % to 67 % CaO by oxide analysis, and where typically the assumed value is 65 %. Nearly all the calcium oxide in Portland cement is not present as calcium oxide but as part of more complicated compounds such as di-calcium silicates, tri-calcium silicates, tri-calcium aluminate and tetra-calcium alumina ferrite. Fortunately using the oxide analysis figure of 65 % CaO is sufficient for the calculation of potential carbonation without going into the more complex chemistry.

4.1.4 Calcium silicate hydrates, and other hydration products: When Portland cement reacts with water, that is when it hydrates, it forms calcium hydroxide and a larger proportion of complex hydration products where the bulk of these are made up of calcium and silica. The hydration products, or gel as described by concrete technologists, are called calcium-silica-hydrates, often simplified to CSH.

This is a free preview. Purchase the entire publication at the link below:

[Product Page](#)

-
- [Looking for additional Standards? Visit Intertek Inform Infostore](#)
 - [Learn about LexConnect, All Jurisdictions, Standards referenced in Australian legislation](#)
-