BRITISH STANDARD

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Mixing water for concrete — Specification for sampling, testing and assessing the suitability of water, including water recovered from processes in the concrete industry, as mixing water for concrete

The European Standard EN 1008:2002 has the status of a British Standard

ICS 91.100.30

National foreword

This British Standard is the official English language version of EN 1008:2002. It supersedes BS 3148:1980 which will be withdrawn on 01 December 2003.

The UK participation in its preparation was entrusted by Technical Committee B/517, Concrete, to Subcommittee B/517/1, Concrete production and testing, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

Cross-references

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Mixing water for concrete - Specification for sampling, testing and assessing the suitability of water, including water recovered from processes in the concrete industry, as mixing water for concrete

Eau de gâchage pour bétons - Spécifications d'échantillonnage, d'essais et d'évaluation de l'aptitude à l'emploi, y compris les eaux des processus de l'industrie du béton, telle que l'eau de gâchage pour béton

Zugabewasser von Beton - Festlegungen für die Probenahme, Prüfung und Beurteilung der Eignung von Wasser, einschließlich bei der Betonherstellung anfallendem Wasser, als Zugabewasser für Beton

This European Standard was approved by CEN on 4 March 2002.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Management Centre has the same status as the official versions.

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Contents

Foreword

This document EN 1008:2002 has been prepared by Technical Committee CEN/TC 104 "Concrete and related products", 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 December 2002, and conflicting national standards shall be withdrawn at the latest by December 2002.

This standard has been prepared by CEN/TC 104-WG 5 „Mixing water for concrete“.

Annex A is normative. The annexes B and C 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, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

The quality of the mixing water for production of concrete can influence the setting time, the strength development of concrete and the protection of the reinforcement against corrosion.

When assessing the suitability of water of unknown quality for the production of concrete, both the composition of the water and the application of the concrete to be produced should be considered.

1 Scope

This European Standard specifies the requirements for water that is suitable for making concrete that conforms to EN 206-1 and describes methods for assessing its suitability.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text, and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 196-1, *Methods of testing cement — Part 1: Determination of strength.*

EN 196-2, *Methods of testing cement — Part 2: Chemical analysis of cement.*

EN 196-3, *Methods of testing cement — Part 3: Determination of setting time and soundness.*

EN 196-21, *Methods of testing cement — Part 21: Determination of the chloride, carbon dioxide and alkali content of cement.*

EN 206-1:2000, *Concrete — Part 1: Specification, performance, production and conformity.*

EN 12390-2, *Testing hardened concrete — Part 2: Making and curing specimens for strength tests.*

EN 12390-3, *Testing hardened concrete — Part 3: Compressive strength of test specimens.*

EN ISO 9963-2, *Water quality — Determination of alkalinity — Part 2: Determination of carbonate alkalinity (ISO 9963-2:1994).*

ISO 4316, *Surface active agents — Determination of pH of aqueous solutions — Potentiometric method.*

ISO 7890-1, *Water quality — Determination of nitrate — Part 1: 2,6-Dimethylphenol spectrometric method.*

3 Classification of types of water

In general the suitability of water for the production of concrete depends upon its origin. The following types may be distinguished:

3.1 Potable water

This water is considered as suitable for use in concrete. Such water needs no testing.

3.2 Water recovered from processes in the concrete industry

(This water, defined in A.2.1, will normally be suitable for use in concrete, but shall conform to the requirements of annex A.

3.3 Water from underground sources

This water may be suitable for use in concrete, but shall be tested.

3.4 Natural surface water and industrial waste water

This water may be suitable for use in concrete, but shall be tested.

3.5 Sea water or brackish water

This water may be used for concrete without reinforcement or other embedded metal, but is in general not suitable for the production of reinforced or prestressed concrete.

For concrete with steel reinforcement, or embedded metal, the permitted total chloride content in the concrete is the determining factor.

3.6 Sewage water

This water is not suitable for use in concrete.

4 Requirements

4.1 General

Water for use in concrete shall conform to the requirements of 4.2, 4.3.1, 4.3.2 and 4.3.3. The water shall also conform to either the chemical requirements in 4.3.4, or the requirements for setting time and compressive strength in 4.4.

Water supplied as potable water is deemed to conform to the requirements in this standard.

When waters are to be combined (see A.2.2), the requirements apply to the combined water.

NOTE Water conforming to the European Directive 98/83/EC is potable water and therefore considered as suitable for use in concrete.

4.2 Preliminary assessment

The water shall be examined in accordance with the test procedures stated in Table 1. Water not conforming to one or more of the requirements in Table 1 may be used only, if it can be shown to be suitable for use in concrete, in accordance with 4.4.

Table 1 — Requirements and test procedures for preliminary inspection of mixing water

		Requirement	Test procedure
1	Oils and fats	Not more than visible traces.	6.1.1
2	Detergents	Any foam should disappear within 2 minutes.	6.1.1
3	Colour	Water not from sources classified in 3.2: The colour shall be assessed qualitatively as pale yellow or paler.	6.1.1
4	Suspended matter	Water from sources classified in 3.2	A.4
		Water from other sources: Maximum 4 ml. sediment.	6.1.1
5	Odour	Water from sources classified in 3.2. No smell, except the odour allowed for potable water and a slight smell of cement and where blastfurnace slag is present in the water, a slight smell of hydrogen sulphide.	6.1.1
		Water from other sources. No smell, except the odour allowed for potable water. No smell of hydrogen sulphide after addition of hydrochloric acid.	
6	Acids	pH 4	6.1.1
7	Humic matter	The colour shall be assessed qualitatively as yellowish brown or paler, after addition of NaOH.	6.1.2

4.3 Chemical properties

4.3.1 Chlorides

The chloride content of the water, tested in accordance with 6.1.3, and expressed as Cl^-, shall not exceed the levels given in Table 2, unless it can be shown that the chloride content of the concrete will not exceed the maximum value for the specified class selected from 5.2.7 of EN 206-1:2000.

Table 2 — Maximum chloride content of mixing water

End use	Max. chloride content mg/l	Test procedure
Prestressed concrete or grout	500	6.1.3
Concrete with reinforcement or embedded metal	1 000	
Concrete without reinforcement or embedded metal	4 500	

4.3.2 Sulphates

The sulphate content of the water, tested in accordance with 6.1.3 and expressed as SO_4^{2-} shall not exceed 2 000 mg/l.

4.3.3 Alkali

If alkali-reactive aggregates are expected to be used in the concrete, the water shall be tested for its alkali content in accordance with 6.1.3. The equivalent sodium oxide content of the water shall not normally exceed 1 500 mg/l. If this limit is exceeded, the water may be used only if it can be shown that actions have been taken to prevent deleterious alkali-silica reactions.

NOTE See CEN Report CR 1901 „Regional specifications and recommendations for the avoidance of damaging alkali silica reactions in concrete."

4.3.4 Harmful contamination

In the first instance qualitative tests for sugars, phosphates, nitrates, lead and zinc may be carried out. If the qualitative tests show a positive result, either the quantity of the substance concerned shall be determined or tests for setting time and compressive strength shall be performed.

If chemical analysis is chosen, the water shall conform to the limits given in Table 3.

Table 3 — Requirements for harmful substances

Substance	Maximum content (mg/l)	Test procedure
Sugars	100	6.1.3
Phosphates; expressed as P_2O_5	100	
Nitrates; expressed as NO_3^-	500	
Lead; expressed as Pb^{2+}	100	
Zinc; expressed as Zn^{2+}	100	

4.4 Setting time and strength

When tested in accordance with 6.1.4 the initial setting time obtained on specimens made with the water shall be not less than 1 hour and not differ by more than 25 % from the initial setting time obtained on specimens made with distilled or de-ionised water. The final setting time shall not exceed 12 hours and not differ by more than 25 % from the final setting time obtained on specimens made with distilled or de-ionised water.

The mean compressive strength at 7 days of the concrete or mortar specimens, prepared with the water, shall be at least 90 % of the mean compressive strength of corresponding specimens prepared with distilled or de-ionised water.

5 Sampling

A sample of water of not less than 5 litres shall be taken. The sample shall be correctly identified and representative of the water to be used, due regard being given to the possible effects of seasonal fluctuations.

The sample shall be stored in a clean and sealed container. The container shall be rinsed out with water from the source prior to filling to capacity with the water sample.

The water shall be tested within 2 weeks of sampling.

6 Testing

6.1 Test methods

6.1.1 Preliminary assessment

A small sub sample shall be assessed as soon as possible after sampling for oil and fats, detergents, colour, suspended matter, odour and humic matter.

Bring any material that may have settled back into suspension by shaking the sample. Pour 80 ml of the sample into a 100 ml measuring cylinder. Seal with a suitable stopper and shake the cylinder vigorously for 30 seconds. Smell the sample for any odours other than those of clean water. If in doubt about the odour, test the water for its odour level in accordance with national regulations for potable water. The odour level of the water shall be lower than the maximum level accepted for potable water. Observe the surface for foam. Stand the cylinder in a place free from vibration and allow standing for 30 min. After 2 minutes check for the continuing presence of foam and signs of any oils or fats. At the end of 30 minutes note the apparent volume of the settled solids and the colour of the water. Measure the pH using indicator paper or a pH meter. Then add 0,5 ml hydrochloric acid, mix then and smell or test for the presence of hydrogen sulphide.

6.1.2 Humic matter

Put 5 ml of the sample into a test tube. Bring it to a temperature between 15 °C and 25 °C by allowing it to stand indoors. Add 5 ml of 3 % sodium hydroxide solution shake and leave for 1 hour. Observe the colour.

6.1.3 Chemical tests

The following test methods describe the reference procedures for the mentioned chemical tests. If other methods are used it is necessary to show that they give results equivalent to those given by the reference methods. In case of a dispute, only the reference procedures shall be used:

Chlorides	Relevant extracts of EN 196-21
Sulphates	Relevant extracts of EN 196-2
Alkali	Relevant extracts of EN 196-21
Sugars	According to standards valid in the place of use.
Phosphates	According to standards valid in the place of use.
Nitrates	ISO 7890-1
Lead	According to standards valid in the place of use.
Zinc	According to standards valid in the place of use.

6.1.4 Setting time and strength

The following test methods shall be applied:

Setting time of paste	EN 196-3
Strength of mortar prisms	EN 196-1
Making concrete specimens	EN 12390-2
Testing concrete specimens	EN 12390-3

For strength testing, three mortar or concrete specimens shall be made using the water under investigation and tested. The test results shall be compared with the results of tests on similar specimens made using distilled or de-ionised water.

6.2 Frequency for testing

The following frequencies for testing water apply:

Potable water

no testing;

Water recovered from processes in the concrete industry (as defined in A.2.1)

test in accordance with annex A;

Water from underground sources, natural surface water and industrial waste water

test before first use and thereafter monthly until such time that a clear insight in the fluctuation of the water composition has been established. Thereafter a lower frequency may be adopted;

Sea water and brackish water

test before first use, thereafter once per year and whenever necessary.

6.3 Conformity evaluation

The requirements given in this standard are expressed as absolute values. For conformity the mixing water shall conform to the requirements given in clause 4.

7 Report

The test report shall contain the following information:

a) a description of the type and source of the water;

b) the place of sampling;

c) the time and date of sampling;

d) the name of laboratory and of the person responsible for the test;

e) the date of testing;

f) the test results and the comparison with the requirements of this standard.

Annex A
(normative)

Requirements for the use of water recovered from processes in the concrete industry

A.1 Scope

Water, recovered from processes in the concrete industry used alone or combined with other water as mixing water.

A.2 Terms and definitions

A.2.1 Water recovered from processes in the concrete industry

Water, recovered from processes in the concrete industry comprises:

- water which was part of any surplus concrete;
- water used to clean the inside of stationary mixers, mixing drums of truck mixers or agitators and concrete pumps;
- process water from sawing, grinding and water blasting of hardened concrete;
- water extracted from fresh concrete during concrete production.

The water may be taken from:

- basins provided with suitable equipment that distributes the solid matter evenly throughout the water;
- sedimentation basins or similar installations, provided the water is left in the basin for sufficient time to allow the solids to settle properly.

NOTE Water recovered from processes in the concrete industry contains varying concentrations of very fine particles the size of which is generally less than 0,25 mm.

A.2.2 Combined water

Combined water is a mixture of water recovered from processes in the concrete industry and water of some other origin.

A.2.3 Surplus concrete and mortar

Surplus concrete is fresh concrete, left over after placing or discharged from concrete mixers during cleaning at the concrete plant. Surplus concrete also includes any fresh concrete that is recovered during cleaning of concrete trucks and pumps.

Surplus mortar may be treated in the same way as surplus concrete.

A.2.4 Recovered aggregates

Recovered aggregates are aggregates, recovered from recycling processes.

NOTE Recovered aggregates can be used in accordance with EN 206-1:2000, 5.2.3.3.

A.3 Limitations on the use of water recovered from processes in the concrete industry

Water recovered from processes in the concrete industry or combined water may be used as mixing water for concrete with or without reinforcement or embedded metal and also for prestressed concrete, provided the following requirements are met:

1) The additional mass of solid material in the concrete resulting from the use of water recovered from processes in the concrete industry shall be less than 1 % (m/m) of the total mass of aggregates present in the concrete.

2) The possible influence of the use of this water shall be taken into account if there are special requirements for the concrete to be produced e. g. architectural concrete, prestressed concrete, air entrained concrete, concrete exposed to aggressive environments etc.

3) The amount of recovered water shall be spread as evenly as possible over a days' production.

For some production processes a greater quantity of solid material may be used, provided satisfactory performance in concrete can be demonstrated.

A.4 Requirements

A.4.1 General

All water recovered from processes in the concrete industry or combined water used in concrete shall conform to the requirements specified in clause 4 and the following requirements.

A.4.2 Storage

Water in storage shall be adequately protected against contamination.

A.4.3 Distribution of solid material in the water

A suitable means of ensuring uniform distribution of the solid material in recovered water with a density greater than 1,01 kg/l shall be provided.

Water with a density less than or equal to 1,01 kg/l may be assumed to contain negligible amounts of solid material.

A.4.4 The mass of solid material present in the recovered water

The mass of solid material present in the recovered water shall be estimated from Table A.1, on the basis of its density. The solid material and the water shall be taken into account in the design of the concrete.

Table A.1 — Solid material in water

Density of the water (kg/l)	Mass of solid material (kg/l)	Volume of mixing water (l/l)
1,02	0,038	0,982
1,03	0,057	0,973
1,04	0,076	0,964
1,05	0,095	0,955
1,06	0,115	0,945
1,07	0,134	0,936
1,08	0,153	0,927
1,09	0,172	0,918
1,10	0,191	0,909
1,11	0,210	0,900
1,12	0,229	0,891
1,13	0,248	0,882
1,14	0,267	0,873
1,15	0,286	0,864

In the calculation a particle density of 2,1 kg/l has been used for estimating the solid material present in the water. If other densities are measured the table may be recalculated according to the following formula:

$$W_{fl} = \left(1 - \frac{\rho_w}{\rho_f}\right) \rho_f$$

In which:

W_{fl} mass of solid material present in the water, (in kg/l);

ρ_w density of the water, (in kg/l);

ρ_f particle density of the solid material, (in kg/l).

A.5 Inspection

A.5.1 Density

The density of the water recovered from processes in the concrete industry or combined water shall be determined on homogenised samples taken from the basin containing the water.

When in use for concrete production the density of this water shall be determined at least daily at the time at which the highest density is most likely to occur, unless other procedures to monitor the density are stated in the producers quality manual.

Automatic devices may be used; in which case the concrete producer's quality manual shall describe the method of use and their calibration.

A.5.2 Suitability

The suitability of the water recovered from processes in the concrete industry or combined water shall be determined in accordance with clause 4.

Annex B
(informative)

Testing scheme for mixing water for concrete

NOTE This testing scheme is only meant to suggest a practical way of testing water samples. The provisions of the standard will always prevail.

Types of water

accept water	← yes	**1**	Potable water	
reject water	← yes	**2**	Sewage water	
see annex A	← yes	**3**	Water recovered from processes in the concrete industry or combined water	
Go to **6**	← yes	**4**	— Water from underground sources — Natural surface water and industrial waste water	See also clause 4
Use only for concrete without reinforcement or embedded metal	← yes	**5**	Sea water or brackish water	

Preliminary assessment

Go to **28** or reject water.	← yes	**6**	Oils and fats: visible traces	For boxes 6 to12 see also Table 1
Go to **28** or reject water.	← yes	**7**	Detergents: stable foam	
Go to **28** or reject water.	← yes	**8**	Colour: darker than pale yellow	
Go to **28** or reject water.	← yes	**9**	Suspended matter: > 4 ml	
Go to **28** or reject water.	← yes	**10**	Odour: Strong smell other than the odour of potable water	If slag is present, see Table 1 line 5.
Go to **28** or reject water.	← yes	**11**	Acids: pH < 4	
Go to **28** or reject water.	← yes	**12**	Humic matter: colour darker than yellowish brown	

Continue next page

Chemical tests

Test according to 4.3

(Filtration: Use membrane filter 0,45 µm and use filtrate for further tests.)

accept water	← yes	**13**	Dissolved matter < 100 mg/l	
Reject water unless the maximum chloride level permitted in concrete is not exceeded.	← yes	**14**	Chloride content exceeds levels given in Table 2	The water can be used if it can be shown that the chloride content of the concrete will not exceed the maximum values for the specified class selected from 5.2.7 of EN 206-1:2000.
reject water	← yes	**15**	Sulphate content > 2 000 mg/l	
accept water unless alkali-reactive aggregates are expected to be used in the concrete	← yes	**16**	The equivalent sodium oxide content of the water exceeds 1 500 mg/l	If this limit is exceeded and alkali-reactive aggregates are expected to be used, the water may be used only if it can be shown that actions have been taken to prevent deleterious alkali-silica reactions. See CEN Report CR 1901.
accept water	← yes	**17**	Dissolved matter – NaCl 100 mg/l	The amount of NaCl is calculated by assuming that the measured amount of Cl in the water is present as NaCl.
accept water	← yes	**18**	Dissolved matter – NaCl – Na_2SO_4 100 mg/l	
accept water	← yes	**19**	Dissolved matter – NaCl – Na_2SO_4 – Na_2CO_3 100 mg/l	The amounts of Na_2SO_4 and Na_2CO_3 are calculated by assuming that sulphates and carbonates are present as their sodium salts.

Harmful contamination

Go to **28**	← **a)**	Either: a) Determine the influence on setting time and strength or b) Perform qualitative chemical analyses.	**b)**→	Go to **20**

Continue next page

		20	Qualitative tests of: — Sugars — Phosphates — Nitrates — Lead — Zinc			
accept water	← yes	**21**	Qualitative tests are negative.			
Go to **28**	← **a)**	Either: a) Determine the influence on setting time and strength or b) Perform quantitative chemical analyses.		**b)**→	Go to **22**	
reject water	← yes	**22**	Sugars > 100 mg/l			
reject water	← yes	**23**	Phosphates (expressed as P_2O_5) > 100 mg/l			
reject water	← yes	**24**	Nitrates (expressed as NO_3^-) > 500 mg/l			
reject water	← yes	**25**	Lead (expressed as Pb^{2+}) > 100 mg/l			
reject water	← yes	**26**	Zinc (expressed as Zn^{2+}) > 100 mg/l			
accept water	← yes	**27**	Quantitative tests show contamination to stay below the levels given in Table 3			

Setting time and strength

reject water	← yes	**28**	Setting times do not meet the requirements of 4.4	no →	Go to **29**
reject water	← yes	**29**	Strength does not meet the requirements of 4.4	no →	Go to **30**
		30	If your sample failed one of the tests specified in the boxes **6** up to and including **12**, go to ***Chemical tests*** and perform the tests indicated in the boxes**13** up to and including **19**.		
			Accept water.		

Annex C
(informative)

Recommended test methods

Where not mentioned in the test or in the reference standards in clause 2 the following test methods can be used:

pH	ISO 4316
carbonate and bicarbonate	ISO 9963–2
Na and K	ISO 9964
Sugars.	
(Semi)qualitative	Mullisch/ -naftol
Quantitative	Use a method agreed nationally
Zinc as Zn^{2+}	
(Semi)qualitative	Colour reaction by means of ammonium-mercury-rhodanate.
Quantitative	Use a method agreed nationally
Lead as Pb^{2+}	
(Semi)qualitative	Use a method agreed nationally
Quantitative	Use a method agreed nationally

Bibliography

[1] 75/440/EEC, *European directive: „Quality of surface water for production of potable water.“*

[2] 98/83/EC, *European directive: „On the quality of water intended for human consumption."*

[3] CEN Report CR 1901, *„Regional specifications and recommendations for the avoidance of damaging alkali silica reactions in concrete.“*

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

EN 12350-1, *Testing fresh concrete — Part 1: Sampling.*

EN ISO 7887, *Water quality — Examination and determination of colour (ISO 7887:1994).*

ISO 6878, *Water quality — Spectrometric determination of phosphorus using ammonium molybdate.*

ISO 9280, *Water quality — Determination of sulphate — Gravimetric method using barium chloride.*

ISO 9297, *Water quality — Determination of chloride — Silver nitrate titration with chromate indicator (Mohr's method).*

ISO 9964-1, *Water quality — Determination of sodium and potassium — Part 1: Determination of sodium by atomic absorption spectrometry.*

ISO 9964-2, *Water quality — Determination of sodium and potassium — Part 2: Determination of potassium by atomic absorption spectrometry.*

ISO 9964-3, *Water quality — Determination of sodium and potassium — Part 3: Determination of sodium and potassium by flame emission spectrometry.*

ISO 10530, *Water quality — Determination of dissolved sulphide — Photometric method using methylene blue.*

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