INTERNATIONAL STANDARD

ISO 12439

First edition
2010-02-01

Mixing water for concrete

Eau de gâchage pour béton

Reference number
ISO 12439:2010(E)

PDF disclaimer

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.

COPYRIGHT PROTECTED DOCUMENT

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

Foreword iv
Introduction v
1 Scope 1
2 Normative references 1
3 Classification of types of water 1
4 Requirements 2
5 Sampling 4
6 Testing 4
7 Test report 6
Annex A (normative) **Requirements for the use of water recovered from processes in the concrete industry** 7
Annex B (informative) **Testing scheme for mixing water for concrete** 10
Annex C (informative) **Recommended test methods** 13
Bibliography 14

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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

ISO 12439 was prepared by Technical Committee ISO/TC 71, *Concrete, reinforced concrete and pre-stressed concrete*, Subcommittee SC 3, *Concrete production and execution of concrete structures*.

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, it is necessary to consider both the composition of the water and the application of the concrete being produced.

Mixing water for concrete

1 Scope

This International Standard specifies the requirements for water that is suitable for making concrete in accordance with ISO 22965 (all parts) and describes methods for assessing its suitability.

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.

ISO 1920-3, *Testing of concrete — Part 3: Making and curing test specimens*

ISO 1920-4, *Testing of concrete — Part 4: Strength of hardened concrete*

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

ISO 29581-1, *Cement — Test methods — Part 1: Analysis by wet chemistry*

ISO 22965-1, *Concrete — Part 1: Methods of specifying and guidance for the specifier*

ISO 22965-2, *Concrete — Part 2: Specification of constituent materials, production of concrete and compliance of concrete*

3 Classification of types of water

3.1 General

In general, the suitability of water for the production of concrete depends upon its origin. The types given in 3.2 to 3.7 can be distinguished.

3.2 Potable water

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

3.3 Water recovered from processes in the concrete industry

This water, defined in A.2.1, is normally suitable for use in concrete, but shall be in accordance with the requirements of Annex A.

3.4 Water from underground sources

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

3.5 Natural surface water and industrial waste water

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

3.6 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 concrete. It shall not be used for the production of pre-stressed concrete.

For concrete with steel reinforcement or embedded metal, the permitted total chloride content in the concrete is the determining factor; see 4.3.1.

3.7 Sewage water

This water is not suitable for use in concrete.

4 Requirements

4.1 General

Water for use in concrete shall be in accordance with the requirements of 4.2, 4.3.1, 4.3.2 and 4.3.3. The water shall also be in accordance with either the chemical requirements in 4.3.4, or with 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 International Standard.

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

4.2 Preliminary assessment

The water shall be examined in accordance with the test procedures stated in Table 1. Water not in accordance with 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.

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 does not exceed the maximum value permitted for the total chloride content; see ISO 22965-2.

ISO 22965-2 recommends that limits for the total chloride content in concrete be given in a national annex to ISO 22965-2. The values may be different depending on the end use. It can be necessary to amend the recommended values in Table 2 to fit with the limits for the total chloride content.

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

Number	Parameter	Requirement	Test procedure
1	Oils and fats	Not more than visible traces	6.1.1
2	Detergents	Any foam should disappear within 2 min.	6.1.1
3	Colour	Water not from sources classified as potable (3.2): the colour shall be assessed qualitatively as pale yellow or paler	6.1.1
4	Suspended matter	Water from sources classified as potable (3.2)	A.4.4
		Water from other sources: max. 4 ml of sediment	6.1.1
5	Odour	Water from sources classified as potable (3.2): no smell, except the odour allowed for potable water and a slight smell of cement; where blast-furnace slag is present in the water, a slight smell of hydrogen sulfide	6.1.1
		Water from other sources: no smell, except the odour allowed for potable water; no smell of hydrogen sulfide after addition of hydrochloric acid.	
6	Acids	pH $\geqslant$ 5	6.1.1
7	Humic matter	The colour shall be assessed qualitatively as yellowish brown or paler after addition of NaOH.	6.1.2

Table 2 — Maximum recommended values for the chloride content of mixing water

End use	Chloride concentration max. mg/l	Test procedure
Pre-stressed 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 Sulfates

The sulfate 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 it is expected to use alkali-reactive aggregates in the concrete and the exposure conditions of the concrete can promote deleterious alkali-related reactions to occur, 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 exceed 1 500 mg/l, unless it can be shown that the alkali content of the concrete does not exceed the maximum value recommended. If these limits are exceeded, the water may be used only if it can be shown that actions have been taken to prevent deleterious alkali-silica reactions.

NOTE Guidance can be found in technical literature, such as CEN CR 1901.

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 concentration 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 paste samples made with the water shall be not less than 1 h and not differ by more than 25 % from the initial setting time obtained on specimens made with distilled or de-ionized water. The final setting time shall not exceed 10 h and not differ by more than 25 % from the final setting time obtained on specimens made with distilled or de-ionized water. Potable water may be used, provided it has been demonstrated that it gives results similar to those obtained with distilled or de-ionized water.

The mean compressive strength at 7 days and 28 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-ionized water.

5 Sampling

A sample of water of not less than 5 l shall be taken. The sample shall be correctly identified and shall be representative of the water being used, with 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 two weeks of sampling.

6 Testing

6.1 Test methods

6.1.1 Preliminary assessment

A small subsample 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 has 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 s. 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. Set the cylinder in a place free from vibration and allow to stand for 30 min. After 2 min, check the sample for the continuing presence of foam and signs of any oils or fats. After 30 min have elapsed, observe 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 and then smell or test for the presence of hydrogen sulfide.

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 h. 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 in accordance with ISO 29581-1;

— sulfates in accordance with ISO 29581-1;

— alkali in accordance with ISO 29581-1;

— sugars in accordance with standards valid in the place of use;

— phosphates in accordance with standards valid in the place of use;

— nitrates in accordance with ISO 7890-1;

— lead in accordance with standards valid in the place of use;

— zinc in accordance with 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 in accordance with standards valid in the place of use;

— strength of mortar prisms in accordance with standards valid in the place of use;

— making concrete specimens in accordance with standards valid in the place of use or with ISO 1920-3;

— testing concrete specimens in accordance with standards valid in the place of use or with ISO 1920-4.

Methods given in EN 196-1 and EN 196-3 may be used as an alternative.

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

6.2 Frequency for testing

The following frequencies for testing water apply.

— Potable water: no testing is required.

— 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 monthly thereafter until such time that a clear insight into 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 International Standard are expressed as absolute values. For conformity, the mixing water shall be in accordance with the requirements given in Clause 4.

7 Test report

The test report shall contain the following information:

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

b) place of sampling;

c) time and date of sampling;

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

e) date of testing;

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

Annex A
(normative)

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

A.1 General

This annex applies to water recovered from processes in the concrete industry, used alone or combined with other water as mixing water.

A.2 Description of the water

A.2.1 Water recovered from processes in the concrete industry

A.2.1.1 Water recovered from processes in the concrete industry is comprised of

— water that 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.

A.2.1.2 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 a sufficient amount of 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.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 pre-stressed concrete, provided the following requirements are met.

a) 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 % mass fraction of the total mass of aggregates present in the concrete.

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

c) The amount of recovered water shall be spread as evenly as possible over a day's 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 requirements given in A.4.2 to A.4.4.

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 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.

If other densities are measured, the concentration, c_{fl}, expressed in kilograms per litre, of solid material present in the water may be recalculated according to Equation (A.1):

$$c_{fl} = \left(\frac{1 - \rho_w}{1 - \rho_f} \right) \times \rho_f \qquad \text{(A.1)}$$

where

ρ_W is the density of the water, expressed in kilograms per litre;

ρ_f is the particle density of the solid material, expressed in kilograms per litre.

Table A.1 — Solid material in water[a]

Density of the water kg/l	Concentration of solid material kg/l	Volume of mixing water 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

[a] A particle density of 2,1 kg/l was used in calculating the values in this table.

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 homogenized samples taken from the basin containing the water.

During the 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 producer's 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

The testing scheme in Table B.1 is meant only to suggest a practical way of testing water samples. The provisions of the normative text of this International Standard always prevail.

Table B.1 — Testing scheme for mixing water for concrete

			Types of water	
Accept water.	← yes	1	Potable water (3.2)	
Reject water.	← yes	2	Sewage water (3.7)	
See Annex A.	← yes	3	Water recovered from processes in the concrete industry or combined water (3.3)	
Go to box 6.	← yes	4	— Water from underground sources (3.4); — Natural surface water and industrial waste water (3.5)	See also Clause 4.
Use only for concrete without reinforcement or embedded metal.	← yes	5	Sea water or brackish water (3.6)	
			Preliminary assessment	
Go to box 28 or reject water.	← yes	6	Oils and fats: visible traces	For boxes 6 to12, see also Table 1.
Go to box 28 or reject water.	← yes	7	Detergents: stable foam	
Go to box 28 or reject water.	← yes	8	Colour: darker than pale yellow	
Go to box 28 or reject water.	← yes	9	Suspended matter: > 4 ml	NOTE Suspended matter is any solid matter that is suspended in the water, in the form of solid particles.
Go to box 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.

Table B.1 (*continued*)

Go to box 28 or reject water.	← yes	11	Acids: pH < 5	
Go to box 28 or reject water.	← yes	12	Humic matter: colour darker than yellowish brown	
		Test of chemical properties; see 4.3		Filter sample through a 0,45 µm membrane filter and use filtrate for the tests.
Accept water.	← yes	13	Dissolved matter < 100 mg/l	NOTE Dissolved matter is any solid matter that is dissolved in the water in a liquid phase.
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 is shown that the chloride content of the concrete does not exceed the maximum values for the specified class in accordance with ISO 22965-2.
Reject water.	← yes	15	Sulfate 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 it is expected to use alkali-reactive aggregates, and the water may be used only if it can be shown that actions have been taken to prevent deleterious alkali-silica reactions. See, for example, CEN CR 1901 for guidance.
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: $NaCl + Na_2SO_4 \leqslant 100$ mg/l	The amount of Na_2SO_4 is calculated by assuming that sulfate is present as its sodium salt.
Accept water.	← yes	19	Dissolved matter: $NaCl + Na_2SO_4 + Na_2CO_3 \leqslant 100$ mg/l	The amount of Na_2CO_3 is calculated by assuming that carbonates are present as its sodium salt.

Table B.1 (*continued*)

Harmful contamination

Go to box 28.	← a)	Either a) determine the influence on setting time and strength; or b) perform qualitative chemical analyses.	b) → Go to box 20.	
		20 Qualitative tests of — sugars — phosphates — nitrates — lead — zinc		
Accept water.	← yes	21 Qualitative tests are negative.		
Go to box 28.	← a)	Either a) determine the influence on setting time and strength; or b) perform quantitative chemical analyses.	b) → Go to box 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 that contamination remains 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 box 29.	
Reject water.	← yes	29 Strength does not meet the requirements of 4.4.	no →Go to box 30.	
		30 If the sample failed one of the tests specified in boxes 6 through 12, go to the section "**Chemical tests**" and perform the tests indicated in boxes 13 through 19.		
		Accept water.		

Annex C
(informative)

Recommended test methods

Where no test method is designated as required in the text of this International Standard or in the normative references in Clause 2, the test methods given in Table C.1 may be used.

Table C.1 — Recommended test methods

Test	Method
pH	ISO 4316
Carbonate and bicarbonate	ISO 9963-2
Na and K	ISO 9964 (all parts)
Sugars:	
(Semi)qualitative	Mullisch/α-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] CEN CR 1901, *Regional Specifications and Recommendations for the avoidance of damaging alkali silica reactions in concrete*

[2] EN 196-1, *Methods of testing cement — Part 1: Determination of strength*

[3] EN 196-3, *Methods of testing cement — Part 3: Determination of setting times and soundness*

[4] ISO 4316, *Surface active agents — Determination of pH of aqueous solutions — Potentiometric method*

[5] ISO 9963-2, *Water quality — Determination of alkalinity — Part 2: Determination of carbonate alkalinity*

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

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

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

ICS 91.100.30

Price based on 14 pages