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Mixing water for concrete

Eau de gâchage pour béton

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Foreword

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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*.

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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.

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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*

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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*

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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.

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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.

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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.

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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.

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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

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

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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.

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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.

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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.

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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.

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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.

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