SLOVENSKI STANDARD
SIST EN 901:2013

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Nadomešča:
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Kemikalije, ki se uporabljajo za pripravo pitne vode - Natrijev hipoklorit

Chemicals used for treatment of water intended for human consumption - Sodium hypochlorite

Produkte zur Aufbereitung von Wasser für den menschlichen Gebrauch - Natriumhypochlorit

Produits chimiques utilisés pour le traitement de l'eau destinée à la consommation humaine - Hypochlorite de sodium

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Chemicals used for treatment of water intended for human consumption - Sodium hypochlorite

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Foreword

This document (EN 901:2013) has been prepared by Technical Committee CEN/TC 164 “Water supply”, the secretariat of which is held by AFNOR.

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of an identical text or by endorsement, at the latest by November 2013, and conflicting national standards shall be withdrawn at the latest by November 2013.

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 901:2007.

Significant technical differences between this edition and EN 901:2007 are as follows:

— replacement of warning and safety precautions notes by labelling according to Regulation (EC) No 1272/2008.

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: 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, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

In respect of potential adverse effects on the quality of water intended for human consumption caused by the product covered by this European Standard:

a) this European Standard provides no information regarding whether the product may be used without restriction in any of the Member States of the EU or EFTA;

b) it should be noted that, while awaiting the adoption of verifiable European criteria, existing national regulations concerning the use and/or the characteristics of this product remain in force.

NOTE Conformity with this European Standard does not confer or imply acceptance or approval of the product in any of the Member States of the EU or EFTA. Use of the product covered by this European Standard is subject to regulation or control by National Authorities.

This product is a biocide and should comply with the relevant legislation in force. In the European Union, at the time of publication, this legislation is Directive 1998/8/EC [1].

1 Scope

This European Standard is applicable to sodium hypochlorite used for treatment of water intended for human consumption. It describes the characteristics of sodium hypochlorite and specifies the requirements and the corresponding test methods for sodium hypochlorite. It gives information on its use in water treatment. It also determines the rules relating to safe handling and use of sodium hypochlorite (see Annex B).

NOTE While this standard is not applicable to sodium hypochlorite generated in-situ (see bibliographic reference [7]), the limits for impurities and chemical parameters apply.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 1233, *Water quality — Determination of chromium — Atomic absorption spectrometric methods*

EN ISO 3696:1995, *Water for analytical laboratory use — Specification and test methods (ISO 3696:1987)*

EN ISO 12846, *Water quality — Determination of mercury — Method using atomic absorption spectrometry (AAS) with and without enrichment (ISO 12846)*

ISO 3165, *Sampling of chemical products for industrial use — Safety in sampling*

ISO 6206, *Chemical products for industrial use — Sampling — Vocabulary*

ISO 8288:1986, *Water quality — Determination of cobalt, nickel, copper, zinc, cadmium and lead — Flame atomic absorption spectrometric methods*

3 Description

3.1 Identification

3.1.1 Chemical name

Sodium hypochlorite.

3.1.2 Synonym or common names

Liquid bleach, soda bleach, bleach lye.

3.1.3 Relative molecular mass

74,44.

3.1.4 Empirical formula

NaClO.

3.1.5 Chemical formula

NaClO.

3.1.6 CAS Registry Number [1)]

7681-52-9.

3.1.7 EINECS reference [2)]

231-668-3.

3.2 Commercial form

The product is supplied as an aqueous solution with an available (active) chlorine concentration up to a mass fraction of 18 %.

3.3 Physical properties

3.3.1 Appearance and odour

The product is a clear yellowish-green solution with a faint chlorinous odour.

3.3.2 Density

The density of the product varies between 1,13 g/ml and 1,30 g/ml at 20 °C.

3.3.3 Solubility in water

The product is capable of being mixed with water in any proportion.

3.3.4 Vapour pressure

Approximately 2,5 kPa at 20 °C.

3.3.5 Boiling point at 100 kPa [3)]

Not applicable.

3.3.6 Crystallisation and freezing point

At about – 10 °C crystallisation of NaOCl . 6 H_2O starts.

Freezing of the concentrated product takes place between - 20 °C and - 30 °C.

3.3.7 Specific heat

The specific heat is 3,48 kJ/(kg.K) for a solution with an available active chlorine concentration of mass fraction between 14 % and 15 %.

3.3.8 Viscosity (dynamic)

2,6 mPa.s at 20 °C.

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1) Chemical Abstracts Service Registry Number.

2) European Inventory of Existing Commercial Chemical Substances.

3) 100 kPa = 1 bar.

3.3.9 Critical temperature

Not applicable.

3.3.10 Critical pressure

Not applicable.

3.3.11 Physical hardness

Not applicable.

3.4 Chemical properties

The product is an alkaline solution with a pH value greater than 11 at 20 °C.

It reacts with acids and acidic salts to form chlorine.

Vigorous reactions occur with reducing chemicals. It is a strong oxidant ($E°_{Red}$ for (ClO^-) = 0,89 V).

$$ClO^- + 2H^+ + 2e^- \rightarrow Cl^- + H_2O$$

4 Purity criteria

4.1 General

This European Standard specifies the minimum purity requirements for sodium hypochlorite used for treating water intended for human consumption. Limits are given for impurities commonly present in the product. Depending on the raw material and the manufacturing process, other impurities may be present and, if so, the user, and when necessary the relevant authorities, shall be notified.

Users of the product should check the national regulations to clarify whether it is of appropriate purity for treating water intended for human consumption, taking into account raw water quality, required dosage, contents of other impurities and additives used in the product that are not stated in this product standard.

Limits have been given for impurities and chemical parameters where these are likely to be present in significant quantities from the current production process and raw materials. If the production process or the raw materials bring about the presence of significant amounts of impurities, by-products or additives, the user shall be notified.

4.2 Composition of commercial product

Sodium hypochlorite is available only in solutions with concentrations up to 18 % active chlorine at the time of delivery by the producer. Common concentrated products contain a minimum of 12 % active chlorine. Diluted solutions are also available.

The concentration of sodium hypochlorite shall be equal to or greater than the value specified by the manufacturer.

4.3 Impurities and main by-products

The product contains sodium chloride (NaCl) in equimolar amounts at minimum, and a small portion of sodium hydroxide (NaOH) which keeps the product alkaline. Thus a little amount of sodium carbonate (Na_2CO_3) can be present, too.

The sodium chlorate ($NaClO_3$) content shall not exceed a mass fraction of 5,4 % of available chlorine at the time of delivery by the producer. The product shall be visibly free from deposits or suspended matter.

NOTE Sodium chlorate is a by-product of the manufacturing process and can be formed during storage (see 6.5.1).

4.4 Chemical parameters

The product shall conform to the requirements specified in Table 1.

Table 1 — Chemical parameters

Parameter		Limit in mg/kg of available chlorine	
		Type 1	Type 2
Arsenic (As)	max.	1	5
Antimony (Sb)	max.	20	25
Cadmium (Cd)	max.	2,5	5
Chromium (Cr)	max.	2,5	5
Lead (Pb)	max.	15	15
Mercury (Hg)	max.	3,5	5
Nickel (Ni)	max.	2,5	10
Selenium (Se)	max.	20	25
		Limit in g/kg of available chlorine	
Sodium bromate[a]	max.	2,5	5,0
[a] Sodium bromate is a by-product of the manufacturing process.			
NOTE Cyanide, which does not exist in a strong oxidising medium such as sodium hypochlorite, is not a relevant chemical parameter. Pesticides and polycyclic aromatic hydrocarbons are not by-products of the manufacturing process. For parametric values of sodium hypochlorite on trace metal content in drinking water, see bibliographic reference [1].			

5 Test methods

5.1 Sampling

Observe the general recommendations of ISO 3165 and take account of ISO 6206.

5.2 Analysis

5.2.1 Determination of available chlorine content (main product)

5.2.1.1 General

This method applies to all commercial products with available chlorine contents within the range of 70 g/l to 170 g/l.

NOTE It detects all oxidising agents being active in weak acidic solutions, i.e. hypochlorite/chlorine, iodate, and partially chloramines, Fe(III), etc. Bromate and chlorate are not covered under these conditions.

5.2.1.2 Principle

Sodium hypochlorite reacts with potassium iodide to release iodine in the presence of acetic acid. The iodine is titrated with sodium thiosulfate standard volumetric solution in the presence of starch indicator solution.

The titration may also be carried out potentiometrically by the aid of titration automates, in which case the addition of soluble starch is unnecessary.

5.2.1.3 Reagents

All reagents shall be of a recognised analytical grade and the water used shall conform to grade 3, as specified in EN ISO 3696:1995 (de-ionised water for common laboratory purposes).

5.2.1.3.1 Potassium iodide solution, mass fraction 10 %

Weigh, to the nearest 0,1 mg, 100 g of potassium iodide, iodate-free, and dissolve in water and dilute to 1 l.

5.2.1.3.2 Acetic acid concentrated, of purity at least of mass fraction 99 %

5.2.1.3.3 Sodium thiosulfate standard volumetric solution, c(Na2S2O3.5H2O) = 0,1 mol/l

Standard volumetric solutions are commercially available, which might have to be diluted.

Alternatively, a standard volumetric solution may be prepared by the following procedure:

Dissolve 24,8 g $Na_2S_2O_3.5H_2O$ in a 1 000 ml one-mark volumetric flask in 0,75 l of water. After the temperature has equalised, make up to the mark with water and mix thoroughly.

To standardise: Weigh, to the nearest 0,1 mg, 3,600 g (m) of dry potassium iodate. Dissolve in water in a 1 000 ml one-mark volumetric flask, make up to the mark with water and mix (standard reference solution c(1/6 KIO_3) = 0,1 mol/l). Place 200 ml of water in a 500 ml stoppered conical flask, add (2 ± 0,5) g of potassium iodide and stir to dissolve. Then introduce, by means of a pipette, 10,0 ml of sodium thiosulfate solution for standardization, add (15 ± 1) ml of hydrochloric acid solution (diluted 1 + 1 by volume) and (5 ± 1) ml of starch solution (5.2.1.3.4). Titrate immediately with the potassium iodate standard reference solution until the appearance of a blue coloration that persists for 30 s. Record the volume (V_1) of iodate used.

The actual concentration, c, of the sodium thiosulfate standard volumetric solution ($Na_2S_2O_3.5H_2O$), expressed in moles per litre is given by Formula (1):

$$c = \frac{V_1 \times c_1}{V} \qquad (1)$$

where

c_1 is the concentration, expressed in moles per litre, of the potassium iodate standard reference solution [c(1/6 KIO_3) = 0,1 mol/l];

V is the volume, in millilitres, of the sodium thiosulfate standard volumetric solution used for the standardization (V = 10 ml);

V_1 is the volume, in millilitres, of potassium iodate standard reference solution used in the titration.

5.2.1.3.4 Starch solution, mass fraction of 1 %

Make a slurry with (1 ± 0,1) g of starch and (5 ± 1) ml of water. Add (90 ± 5) ml of boiling water to the slurry. Stir to dissolve it and cool the solution. This solution needs to be refrigerated to avoid the decomposition of the starch which results in a vague end point. Keep the solution cool and use it within one week.

Commercial indicators for iodine titration exist and may be used in place of the described starch solution, provided that their efficiency has been previously tested.

5.2.1.4 Apparatus

Ordinary laboratory apparatus and glassware.

5.2.1.5 Procedure

5.2.1.5.1 Test solution

Weigh to the nearest 0,1 mg 1 g of the laboratory sample (record mass m_1 in grams) into a 250 ml conical flask and dilute with water up to 100 ml.

5.2.1.5.2 Determination

Add 10 ml of the potassium iodide solution (5.2.1.3.1) and 5 ml of concentrated acetic acid (5.2.1.3.2).

Titrate at once with the sodium thiosulfate standard volumetric solution (5.2.1.3.3) until the iodine colour is nearly gone. Add 3 ml of the starch indicator solution (5.2.1.3.4) and complete the titration until the disappearance of the blue-black colour. Record the volume V_1, of the sodium thiosulfate standard volumetric solution added.

5.2.1.6 Expression of results

The available chlorine (Cl_2) content, C_2, expressed in mass fraction in %, is given by Formula (2):

$$C_2 = (V_1 \times c \times 3{,}545) / (m_1) \quad (2)$$

where

V_1 is the volume, in millilitres, of the sodium thiosulfate standard volumetric solution (5.2.1.3.3);

c is the concentration in moles per litre, of the sodium thiosulfate standard volumetric solution (see 5.2.1.3.3);

3,545 is the mass in milligrams of chlorine (Cl_2) corresponding to 1 ml of sodium thiosulfate solution of $c(Na_2S_2O_3.5H_2O)$ = 0,100 mol/l;

m_1 is the mass in grams of the laboratory sample used to prepare the test solution (5.2.1.5.1).

5.2.2 Impurities

5.2.2.1 Determination of sodium chlorate content ($NaClO_3$)

5.2.2.1.1 General

This method is used to determine the chlorate content, in the range between 3,75 g/l and 15 g/l, in sodium hypochlorite solutions for commercial use; it is specific for these species.

5.2.2.1.2 Principle

Direct determination of chlorate ions in a diluted solution of sodium hypochlorite by ion chromatography with suppressed conductimetric detection.