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BSI Standards Publication

Chemicals used for treatment of water intended for human consumption — Sodium carbonate

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National foreword

This British Standard is the UK implementation of EN 897:2012. It supersedes BS EN 897:2005 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee CII/59, Chemicals for drinking water treatment.

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

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

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

Produkte zur Aufbereitung von Wasser für den menschlichen Gebrauch - Natriumcarbonat

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Foreword

This document (EN 897:2012) 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of an identical text or by endorsement, at the latest by May 2013, and conflicting national standards shall be withdrawn at the latest by May 2013.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 897:2005.

Significant technical differences between this edition and EN 897:2005 are as follows:

a) Modification of 6.2 on labelling, deletion of the reference to EU Directive 80/778/EEC of 15 July 1980 in order to take account of the latest Directive in force.

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 as to 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. The use of the product covered by this European Standard is subject to regulation or control by National Authorities.

1 Scope

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

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

EN ISO 12846:2012, *Water quality — Determination of mercury — Method using atomic absorption spectrometry (AAS) with and without enrichment (ISO 12846:2012)*

ISO 740, *Sodium carbonate for industrial use — Determination of total soluble alkalinity —Titrimetric method*

ISO 746, *Sodium carbonate for industrial use — Determination of matter insoluble in water at 50 degrees C*

ISO 2460, *Sodium hydrogen carbonate for industrial use — Determination of iron content — 1,10-Phenanthroline photometric method*

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

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

ISO 8213, *Chemical products for industrial use — Sampling techniques — Solid chemical products in the form of particles varying from powders to coarse lumps*

3 Description

3.1 Identification

3.1.1 Chemical name

Sodium carbonate.

3.1.2 Synonym or common name

Soda ash, anhydrous sodium carbonate, light soda ash, heavy soda ash.

3.1.3 Relative molecular mass

105,99.

3.1.4 Empirical formula

Na_2CO_3.

3.1.5 Chemical formula

Na_2CO_3.

3.1.6 CAS Registry Number[1)]

497-19-8.

3.1.7 EINECS reference[2)]

207-838-8.

3.2 Commercial forms

The product is available as dry powder or fine granules and is described as light soda ash or heavy soda ash according to bulk density (see 3.3.2).

3.3 Physical properties

3.3.1 Appearance

The product is a white powder or crystals, slightly hygroscopic.

3.3.2 Density

The density of this product is 2,53 g/cm^3.

The bulk density is:

ranging from 0,5 kg/dm^3 to 0,65 kg/dm^3 (light soda ash);

ranging from 0,8 kg/dm^3 to 1,2 kg/dm^3 (heavy soda ash).

3.3.3 Solubility in water

The product is soluble at 212 g/l at 20 °C.

3.3.4 Vapour pressure

Not applicable.

3.3.5 Boiling point at 100 kPa[3)]

Not applicable.

3.3.6 Melting point

851 °C.

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1) Chemical Abstracts Service Registry Number.

2) European Inventory of Existing Commercial Chemical Substances.

3) 100 kPa = 1 bar.

3.3.7 Specific heat

1,043 J/(kg K).

3.3.8 Viscosity (dynamic)

Not applicable.

3.3.9 Critical temperature

Not applicable.

3.3.10 Critical pressure

Not applicable.

3.3.11 Physical hardness

The hardness of solid sodium carbonate is given as 1 to 2 on the Mohs' scale of hardness.

3.4 Chemical properties

Sodium carbonate reacts exothermically with acids with the formation of carbon dioxide.

Sodium carbonate is slightly hygroscopic and dissolution in water is an exothermic reaction.

4 Purity criteria

4.1 General

This European Standard specifies the minimum purity requirements for sodium carbonate used for the treatment of 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, this shall be notified to the user and when necessary to relevant authorities.

NOTE Users of this product should check the national regulations in order to clarify whether it is of appropriate purity for treatment of water intended for human consumption, taking into account raw water quality, required dosage, contents of other impurities and additives used in the products 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 raw materials leads to significant quantities of impurities, by-products or additives being present, this shall be notified to the user.

4.2 Composition of commercial product

The product shall contain not less than a mass fraction of 99 % of Na_2CO_3.

4.3 Impurities and main by-products

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

The concentration limits refer to pure Na_2CO_3.

Table 1 — Impurities

Impurity		Limit in mg/kg of Na_2CO_3
Iron(II) [1)]	max.	20
Insoluble matters [2)]	max.	200
1) Iron(II) can cause organoleptic problems. 2) Indicate the presence of foreign matter.		

4.4 Chemical parameters

The product shall conform to the requirements specified in Table 2.

Table 2 — Chemical parameters

Parameter		Limit in mg/kg of Na_2CO_3
Arsenic (As)	max.	2
Cadmium (Cd)	max.	2
Chromium (Cr)	max.	2
Mercury (Hg)	max.	0,1
Nickel (Ni)	max.	2
Lead (Pb)	max.	2
NOTE Antimony, selenium, cyanides, pesticides and polycyclic aromatic hydrocarbons are not relevant in sodium carbonate. For parametric values of sodium carbonate on trace metal content in drinking water, see [1].		

5 Test methods

5.1 Sampling

Prepare the laboratory sample (s) required by the relevant procedure described in ISO 8213, observe the recommendations of ISO 3165 and also take into account ISO 6206.

5.2 Analyses

5.2.1 Main product

The mass fraction in % of Na_2CO_3 shall be determined by titration of the total alkalinity with a standard volumetric acid solution in accordance with ISO 740.

5.2.2 Impurities

5.2.2.1 Iron

The iron content shall be determined by a spectrometric method with 1,10-phenanthroline in accordance with ISO 2460 replacing sodium bicarbonate by sodium carbonate.

5.2.2.2 Insoluble matters

The mass fraction in % of the insoluble matter in water shall be determined at 50 °C in accordance with ISO 746.

5.2.3 Chemical parameters

5.2.3.1 Principle

The elements arsenic, cadmium, chromium, lead and nickel are determined by inductively coupled plasma optical emission spectrometry. Mercury is determined by cold vapour atomic absorption spectrometry.

5.2.3.2 Arsenic

The arsenic content shall be determined by inductively coupled plasma optical emission spectrometry (ICP/OES) (see B.1).

5.2.3.3 Cadmium

The cadmium content shall be determined by inductively coupled plasma optical emission spectrometry (ICP/OES) (see B.1).

5.2.3.4 Chromium

The chromium content shall be determined by inductively coupled plasma optical emission spectrometry (ICP/OES) (see B.1).

5.2.3.5 Nickel

The nickel content shall be determined by inductively coupled plasma optical emission spectrometry (ICP/OES) (see B.1).

5.2.3.6 Lead

The lead content shall be determined by inductively coupled plasma optical emission spectrometry (ICP/OES) (see B.1).

5.2.3.7 Mercury

The mercury content shall be determined by cold vapour atomic absorption spectrometry in accordance with EN ISO 12846 (see B.2).

6 Labelling – Transportation – Storage

6.1 Means of delivery

Sodium carbonate can be delivered in bulk, bulk bags or in bags.

In order that the purity of the products is not affected, the means of delivery shall not have been used previously for any different product or it shall have been specially cleaned and prepared before use.

6.2 Labelling according to the EU legislation[4)]

The following labelling requirements shall apply to sodium carbonate at the date of the publication of this standard.

– Signal word :

Warning

– Hazard statement:

H 319 : causes serious eye irritation

Precautionary statements ("P statements") should be provided by the company being responsible for the marketing of the substance. They should be indicated on the packaging label and in the extended safety data sheet (eSDS) of the substance.

Figure 1 GHS 07

The regulation [2], and its amendments for the purposes of its adaptation to technical and scientific progress, contains a list of substances classified by the EU. Substances not listed in this regulation should be classified on the basis of their intrinsic properties according to the criteria in the regulation by the person responsible for the marketing of the substance.

4) See [2]

6.3 Transportation regulations and labelling

Sodium carbonate is not listed under a UN Number [5]. Sodium carbonate is not classified as a dangerous product for road, rail, sea and air transportation.

6.4 Marking

The marking shall include the following information:

— the name "sodium carbonate ", trade name;

— the net mass;

— the name and the address of the supplier and/or manufacturer;

— the statement "this product conforms to EN 897".

6.5 Storage

6.5.1 Long term stability

Sodium carbonate is stable in dry conditions.

6.5.2 Storage incompatibilities

Keep bags tightly closed and dry. Keep away from acids.

5) United Nations Number.

Annex A
(informative)

General information on sodium carbonate

A.1 Origin

A.1.1 Raw materials

Sodium chloride, limestone.

A.1.2 Manufacturing process

Ammonia-soda-process (SOLVAY process).

A.2 Use

A.2.1 Function

Sodium carbonate is mainly used for increase of pH value and alkalinity.

A.2.2 Form in which it is used

Sodium carbonate is mainly used as a solution, at concentration up to a mass fraction of 10 %.

A.2.3 Treatment dose

The treatment dose is variable depending on raw water quality and application. Treatment dose should be such as sodium ions never exceed sodium parametric value (see [1]).

A.2.4 Means of application

The product is usually applied using a positive displacement metering pump.

A.2.5 Secondary effects

Increases in sodium concentration.

A.2.6 Removal of excess product

pH: Neutralization with for example hydrochloric acid, sulfuric acid.

Annex B
(normative)

Analytical methods

B.1 Determination of arsenic, cadmium, chromium, lead and nickel (inductively coupled plasma optical emission spectrometry (ICP/OES))

B.1.1 General

The range covered for each element is given in Table B.1.

Table B.1 - Concentration range

Element	Concentration range, mg/kg of product
Cr, Cd Ni As Pb	0,2 to 50 0,5 to 50 1 to 50 2 to 50

B.1.2 Principle

Dissolution of the sample with nitric acid and direct nebulization of the acid solution into an inductively coupled argon plasma formed by a high frequency. Measurement of the radiations at specific wavelengths using background correction and internal standardization.

B.1.3 Reagents

All reagents shall be of recognized analytical grade and the water used shall conform to grade 3 in accordance with EN ISO 3696.

Store all prepared solutions in polyethylene (polyethene) or polytetrafluoruethylene (polytetrafluorethene) (PTFE) flasks to prevent contamination.

B.1.3.1 Nitric acid solution, $\rho \approx 1{,}40$ g/ml, mass fraction 65 %.

B.1.3.2 Hydrochloric acid solution, $\rho \approx 1{,}19$ g/ml, mass fraction 37 %.

B.1.3.3 Sodium chloride solution, ρ (NaCl) = 250 g/l.

Dissolve 250 g of NaCl (very high purity grade) with water and transfer to a 1 000 ml volumetric flask. Add 10 ml of nitric acid (B.1.3.1), make up to the mark with water and mix.

B.1.3.4 Scandium (internal standard) solution, *c*(Sc) = 50 mg/l.

Transfer 50 ml of a scandium stock solution [*c*(Sc) = 1 000 mg/l] and 10 ml nitric acid (B.1.3.1) to a 1 000 ml volumetric flask. Make up to the mark with water and mix.

B.1.3.5 As, Cd, Cr, Ni or Pb elements stock solution, c(element) = 1 000 mg/l commercial solution.

B.1.3.6 Multi-element solution, *c*(As, Cd, Cr, Ni, Pb) = 100 mg/l

Transfer 10 ml of each stock solution (B.1.3.5) and 10 ml of hydrochloric acid (B.1.3.2) to a 100 ml volumetric flask, make up to the mark with water and mix.

B.1.3.7 Argon, the pressure shall not be less than 700 kPa and the argon used may be compressed or liquefied gas.

B.1.4 Apparatus

Ordinary laboratory apparatus and glassware together with the following:

NOTE All vessels (glassware, polyethylene (polyethene), polypropylene (polypropene) and polytetrafluorethylene (polytetrafluorethene) (PTFE) flasks) should be washed with hydrochloric acid *c*(HCl) ≈ 6 mol/l and water successively.

B.1.4.1 Inductively coupled plasma optical emission spectrometer (ICP/OES) fitted with a nebulizer for high salt concentration. This instrument can be simultaneous and/or sequential. The spectrometer parameters and operating conditions are given in Table B.2:

Table B.2 - Parameters and operating conditions of the spectrometer

Parameter	Unit	Specification
Type		monochromator or /and polychromator
Argon humidifier (water)		yes
Argon (B.1.3.7) flows:		
Plasma	l/min	14
Auxiliary	l/min	1,5
Nebulizer (180 kPa)	l/min	0,7
Sample flow	ml/min	1,5
RF power	W	± 1 000
Integration time	s	10

B.1.5 Procedure

B.1.5.1 Test portion

Weigh, to the nearest 0,1 g, 18 g of the laboratory sample.

B.1.5.2 Test solution

Transfer the test portion (B.1.5.1) and 50 ml of water to a 250 ml polyethylene (polyethene) flask. After dissolution, neutralize the solution with hydrochloric acid (B.1.3.2) and add 1 ml nitric acid (B.1.3.1).

After cooling, transfer to a 100 ml volumetric flask, add 5 ml of scandium solution (B.1.3.4), make up to the mark with water and mix.

B.1.5.3 Calibration and verification solutions

Transfer 80 ml of sodium chloride solution (B.1.3.3), 5 ml of scandium solution (B.1.3.4) and the volumes of multi-element solution (B.1.3.6) given in Table B.3 to a series of four 100 ml volumetric flasks. Make up to the mark with water and mix.

Table B.3 - Calibration solutions for the different elements

Calibration solution No	Multi-element solution, ml	Corresponding concentration of each element (As, Cd, Cr, Ni, Pb,) mg/l
1[1)]	0	0
2[2)]	5,0	5,0
3	10,0	10,0
4[3)]	10,0	10,0

1) Blank calibration solution.

2) Linearity standard matching solution.

3) Control solution prepared with different pipettes, flasks and if possible with different stock solutions.

B.1.5.4 Determination

B.1.5.4.1 Preparation of the apparatus

Set all instrument parameters of the optical emission spectrometer (B.1.4.1) in accordance with the operating manual of the instrument's manufacturer.

Prepare the analytical procedure including the lines shown in Table B.4, with background correction, concentrations of calibration solutions 1 and 3 described in (B.1.5.3) and internal standardization (B 1.3.4).

Table B.4 - Wavelength per element

Element	Wavelength nm	
	line	background
As	193,759	193,79
Cd	228,802	228,83
	214,438	-
Cr	267,716	267,75
Ni	231,604	231,63
Pb	220,353	220,38
		-
Sc (internal standard)	424,683 or 361,384	-

B.1.5.4.2 Spectrometric measurements

Repeat the measurements for at least five integration periods.

Rinse with water after each solution.

Calibrate the instrument with the calibration solutions 1 and 3 (B.1.5.3).

Control and check the linearity of the calibration curve by measurement of the following calibration solutions considered as unknown solutions:

- solution 3;
- solution 1;
- solution 1;
- solution 2;
- solution 4;
- solution 3.

Continue the measurements in the following order:

- solution 3;
- solution 1;
- solution 1;
- test solution (B.1.5.2);
- solution 3;
- solution 1 (B.1.5.3.);
- solution 1 (B.1.5.3.).

B.1.6 Expression of results

B.1.6.1 Evaluation

If necessary, correct for drift the results obtained with the test solution and control solutions 2 and 4:

- **for baseline drift** by interpolating in time between both second measurements (the first might be cross-contaminated) of the blank calibration solution (solution 1);

- **for sensitivity drift** by interpolating in time between the measurements of the solution 3.

Samples of unknown composition should be tested for the presence of matrix effects, caused by present components other than sodium carbonate, by the analyte addition technique.

B.1.6.2 Calculation

The element content of the sample, ρ(element) in milligrams per kilogram is given by the formula:

$$\rho(element) = \frac{100 \times \rho}{m}$$

where

m is the mass, in grams, of the test portion (B.1.5.1);

ρ is the corrected concentration of element, in milligrams per litre, in the test solution (B.1.5.2).

B.2 Determination of mercury (cold vapour atomic absorption spectrometry)

B.2.1 General

This method is suitable for the determination of total mercury in sodium carbonate. The method is applicable to samples whose mercury content is greater than 0,05 mg/kg as Hg.

B.2.2 Principle

After mineralization of the sample with sulfuric acid and potassium permanganate, the total mercury is determined by cold vapour atomic absorption spectrometry as described in EN ISO 12846.

B.2.3 Reagents

See 4.3 of EN ISO 12846:2012.

B.2.4 Apparatus

See 4.4 of EN ISO 12846:2012.

B.2.5 Procedure

B.2.5.1 Test portion

Weigh, to the nearest 0,01 g, 2 g of the laboratory sample.

B.2.5.2 Test solution

Transfer the test portion and 50 ml of water to a 250 ml conical flask. After dissolution, neutralize the solution with hydrochloric acid solution c(HCl) = 6 mol/l. Add 1 ml of potassium permanganate solution (50 g/l) and, with care, five 1 ml portions of sulfuric acid (ρ = 1,84 g/ml).

Heat and keep boiling for 1 min.

After cooling, dissolve the precipitate of manganese dioxide, dropwise, with the hydroxylamine hydrochloride solution (100 g/l), add 5 ml of potassium dichromate solution (4 g/l), dilute to 100 ml with water in a volumetric flask and mix.

B.2.5.3 Blank test solution

Prepare a blank test solution according to the instructions detailed in B.2.5.2 but omitting the test portion.

B.2.5.4 Calibration solutions

Just before use, prepare a series of six calibration solutions containing 0 mg/l, 1 mg/l, 2,5 mg/l, 5 mg/l, 7,5 mg/l and 10 mg/l of Hg.

To 100 ml of those solutions add 1 ml of potassium permanganate solution and with care five 1 ml portions of sulfuric acid and continue as described in B.2.5.2 for the test solution.

B.2.5.5 Determination

Proceed with the calibration solutions, test solution and blank test solution as described in 4th paragraph of 4.7.1 in EN ISO 12846:2012 beginning at "Transfer in a flask...".

B.2.6 Expression of results

See 4.8 and 4.9 of EN ISO 12846:2012.

Annex C
(normative)

General rules relating to safety

C.1 Rules for safe handling and use

The supplier shall provide current safety instructions.

C.2 Emergency procedures

C.2.1 First aid

WARNING - In case of contact of aqueous solutions with eyes and with skin, eyes shall be first treated.

In case of inhalation and with a significant nasal irritation, remove the patient to fresh air. Rinse mouth and nose with water or isotonic solution. Seek medical advice.

In case of contact with eyes rinse with running water for at least 15 min, eyelids wide open. In case of persistent symptoms seek medical advice.

In case of contact with skin take off the contaminated clothes and shoes, wash the skin with water. In case of persistent symptoms seek medical advice.

In case of ingestion make patient drink water and milk, make him vomit. In any case seek medical advice.

C.2.2 Spillage

Collect the product then rinse with plenty of water.

C.2.3 Fire

Sodium carbonate is not combustible.

Bibliography

[1] 98/83/EC, *Council Directive of 3 November 1998 on the Quality of Water intended for Human Consumption*

[2] Regulation (EC) No 1272/2008 of the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) No 1907/2006 (REACH)

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