BS EN 12125:2012

BSI Standards Publication

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

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National foreword

This British Standard is the UK implementation of EN 12125:2012. It supersedes BS EN 12125:2005 which is withdrawn.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 thiosulfate

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

Produkte zur Aufbereitung von Wasser für den menschlichen Gebrauch - Natriumthiosulfat

This European Standard was approved by CEN on 23 September 2012.

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Contents

Foreword

This document (EN 12125:2012) 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of an identical text or by endorsement, at the latest by May 2013, and conflicting national standards shall be withdrawn at the latest by May 2013.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 12125:2005.

The significant technical differences between this edition and EN 12125:2005 are as follows:

- 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.

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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 thiosulfate used for treatment of water intended for human consumption. It describes the characteristics and specifies the requirements of sodium thiosulfate and refers to the corresponding analytical methods. It gives information for its use in water treatment.

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)*

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

ISO 5993, *Sodium hydroxide for industrial use — Determination of mercury content — Flameless atomic absorption spectrometric method*

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

ISO 6353-1*, Reagents for chemical analysis — Part 1: General test methods*

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

ISO 10636, *Photography — Processing chemicals — Specifications for anhydrous sodium thiosulfate and sodium thiosulfate pentahydrate*

ISO 22743, *Water quality — Determination of sulfates — Method by continuous flow analysis (CFA)*

3 Description

3.1 Identification

3.1.1 Chemical name

Sodium thiosulfate.

3.1.2 Synonym or commons names

Sodium thiosulfate, sodium hyposulfite.

3.1.3 Relative molecular mass

158,11 (anhydrous).

3.1.4 Empirical formula

$Na_2S_2O_3$.

3.1.5 Chemical formula

$Na_2S_2O_3$.

3.1.6 CAS-Registry Number 1)

7772-98-7 (anhydrous); 10102-17-7 (pentahydrate).

3.1.7 EINECS reference 2)

231-867-5.

3.2 Commercial form

The product is a crystalline powder.

3.3 Physical properties

3.3.1 Appearance

The hydrated product is colourless crystal. The anhydrous product is a white powder.

3.3.2 Density

The particle density of the hydrated product is 1,69 g/cm^3 to 1,73 g/cm^3 at 20 °C.

3.3.3 Solubility in water

The solubility of the product in water is 700 g/l at 20 °C (anhydrous); for pentahydrate : 2910 g/l at 45 °C.

3.3.4 Vapour pressure

Not applicable.

3.3.5 Boiling point at 100 kPa 3)

Not applicable.

3.3.6 Crystallisation point

The product starts to decompose at 45 °C to 50 °C.

3.3.7 Specific heat

Not known.

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1) Chemical Abstracts Service Registry Number.

2) European Inventory of Existing Commercial Chemical Substances.

3) 100 kPa = 1 bar.

3.3.8 Viscosity, dynamic

Not applicable.

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 pH value of a diluted aqueous solution of sodium thiosulfate is approximately neutral (6,5 to 8). Sodium thiosulfate dissolves silver halogenids and other silver salts.

At elevated temperatures (> 50 °C), sulfur dioxide is generated.

Sodium thiosulfate releases sulfur dioxide when mixed with acids.

Sodium thiosulfate reacts violently with oxidising agents; e.g. with sodium hypochlorite or hydrogen peroxide. It shall not come into contact with acids, iodine, lead and silver salts.

4 Purity criteria

4.1 General

This European Standard specifies the minimum purity requirements for sodium thiosulfate 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.

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 product 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 concentration of sodium thiosulfate anhydrous shall not be less than a mass fraction of 95 % of $Na_2S_2O_3$.

The concentration of sodium thiosulfate pentahydrate shall not be less than a mass fraction of 95% of $Na_2S_2O_3.5\ H_2O$.

4.3 Impurities and main by-products

The content of sodium sulfate shall not exceed a mass fraction of 5 % .

4.4 Chemical parameters

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

Table 1 — Chemical parameters

Parameter		Limit mg/kg of commercial product
Antimony (Sb)	max	2
Arsenic (As)	max	0,5
Cadmium (Cd)	max	0,1
Chromium (Cr)	max	5
Lead (Pb)	max	5
Mercury (Hg)	max	0,1
Nickel (Ni)	max	5
Selenium (Se)	max	2

NOTE Pesticides and polycyclic aromatic hydrocarbons and cyanides (CN) are not relevant in sodium thiosulfate because the raw materials used in the manufacturing are free of them. For parametric values of sodium thiosulfate on trace metal content in drinking water, see [1].

5 Test methods

5.1 Sampling

Observe the general recommendations of ISO 3165 and take account of ISO 6206. Prepare the laboratory sample(s) required by the relevant procedure described in ISO 8213.

5.2 Analyses

5.2.1 Main product

The sodium thiosulfate content shall be determined in accordance with ISO 10636.

5.2.2 Impurities

5.2.2.1 Sulfate

The content of sodium sulfate (Na_2SO_4) shall be determined in accordance with ISO 22743.

5.2.3 Chemical parameters

5.2.3.1 General

The content of chemical parameters shall be determined using the procedures specified in Table 2:

Table 2 — Procedures for the determination of chemical parameters

Element	Reference	Method	Wavelength (nm)	Flame
As	see 5.2.3.3	Hydride AAS	193,7	n.a.
Sb	see 5.2.3.3	Hydride AAS	217,6	n.a.
Cd	ISO 6353-1 GM 29 see 5.2.3.2	AAS	228,8	air-acetylene
Cr	ISO 6353-1 GM 29 see 5.2.3.2	AAS	357,8	air-acetylene
Pb	ISO 6353-1 GM 29 see 5.2.3.2	AAS	217,0 or 283,3	air-acetylene
Ni	ISO 6353-1 GM 29 see 5.2.3.2	AAS	232,0	oxidising acetylene-air
Se	see 5.2.3.3	Hydride AAS	196,0	n.a.
Hg	in accordance with ISO 5993	flameless AAS	253,6	n.a.
AAS = Atomic Absorption Spectroscopy. n.a. = not applicable.				

5.2.3.2 Determination of cadmium (Cd), chromium (Cr), lead (Pb) and nickel (Ni)

5.2.3.2.1 Principle

The elements cadmium (Cd), chromium (Cr), lead (Pb) and nickel (Ni) are determined using atomic absorption spectrometry with the standard additions technique.

5.2.3.2.2 Reagents

All reagents shall be of a recognised analytical grade and the water used shall conform to the grade 3 specified in EN ISO 3696.

5.2.3.2.2.1 Standard solution (100 µg/l Cd, Cr ,Pb or Ni)

The standard solution shall be freshly prepared on the day of use by individual dilution of a stock solution. This stock solution with a Cd, Cr, Pb or Ni content of at least 1 mg/l shall be made by dilution of standard solutions of Cd, Cr, Pb and Ni which are available from all major suppliers of laboratory chemicals. This stock solution shall be kept in containers of tetrafluoroethylene-hexafluoropropylene copolymer (FEP), polytetrafluoroethylene (PTFE) or polyethylene (PE).

The stock solution should not be kept for longer than four weeks.

5.2.3.2.3 Apparatus

Ordinary laboratory apparatus and the following:

5.2.3.2.3.1 Atomic absorption spectrometer with the measurement parameters specified in Table 2.

5.2.3.2.4 Procedure

5.2.3.2.4.1 Test portion

Weigh 1 g (m) to the nearest 0,01 mg of the laboratory sample into a 100 ml one-mark volumetric flask and make up to the mark at 20 °C with water.

5.2.3.2.4.2 Determination

The reference solutions shall be made by spiking the sample with the standard solutions, which contain stepwise increasing contents of the elements to be determined.

NOTE The amount of internal standard to be added can be estimated from a preliminary investigation, determining roughly the element content of the test sample from simple calibration.

The steps in which internal standards have to be added shall be at least as high as the estimated content of the test sample. With the spectrometer (5.2.3.2.3.1), carry out the measurement with the parameters specified in Table 3 in accordance with the manufacturer's instructions.

Repeat the procedure with all reagents and the same volume of standard solution to be added using water in place of the sample as a blank determination.

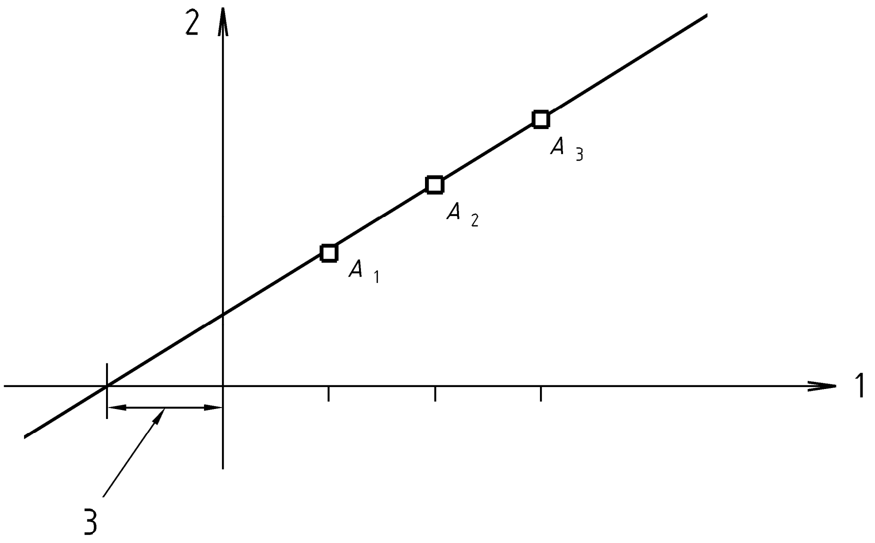
5.2.3.2.5 Expression of results

Prepare a calibration curve using the measured absorbencies of the spiked measurement solutions.

Read the concentration of each element in the test solution by extrapolation of the correlation line to absorbance A = 0 (see Figure 1). Similarly determine the element concentration of the blank solution (see Figure 2) and subtract from the result obtained for the test solution.

Alternatively, the evaluation can be carried out by linear regression. Additional dilution steps shall be compensated in the calculation.

The interim result (y) expressed in micrograms per litre is converted to give the final concentration according to 5.2.3.2.6.



Key

1	concentration of added standard in micrograms per litre
2	absorbance A
3	concentration in the test solution in micrograms per litre
A_1; A_2; A.3	spiking

Figure 1 — Calculation of the element concentration in the test solution

5.2.3.2.6 Calculation

From the interim result (y) (see 5.2.3.2.5), the content, C_3, of each element in the laboratory sample, expressed in milligrams per kilogram of a mass fraction of 100 % sodium thiosulfate is given by the following formula:

$$C_3 = \frac{y \times V \times 100 \times 1\,000}{m \times C_1} \qquad (1)$$

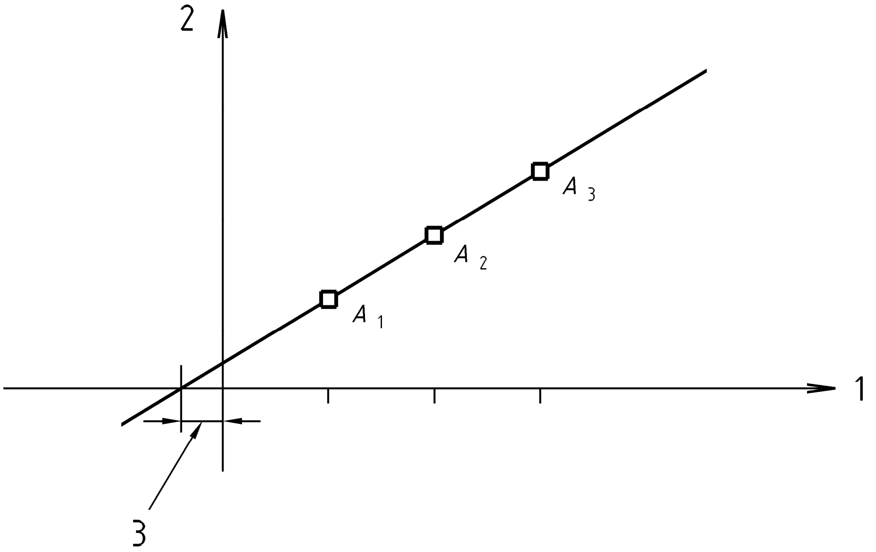
where

y is the interim result (5.2.3.2.5);

V is the volume, expressed in millilitres, of the test solution;

m is the mass, expressed in grams, of the test portion;

C_1 is the concentration, expressed in mass fraction in % sodium thiosulfate (see 5.2.1).



Key

1	concentration of added standard in micrograms per litre
2	absorbance A
3	concentration in the blank solution in micrograms per litre
A_1; A_2; A_3	spiking.

Figure 2 — Calculation of the element concentration in the blank solution

5.2.3.3 Determination of arsenic (As), antimony (Sb) and selenium (Se)

5.2.3.3.1 Principle

The elements arsenic, antimony, and selenium are determined by hydride-atomic absorption spectrometry. The elements are reduced by reducing agents (sodium borohydride ($NaBH_4$)) to form the hydrides. These volatile compounds flow through the heated measuring cuvette of an atomic absorption spectrometer where the content of the individual element is determined.

5.2.3.3.2 Reagents

5.2.3.3.2.1 Hydrochloric acid, high purity analytical grade, mass fraction of 30 %, density ρ = 1,15 g/ml.

5.2.3.3.2.2 Preliminary reduction agent.

Dissolve 10 g sodium iodide and 100 g *L*-ascorbic acid in 1 000 ml of water.

5.2.3.3.2.3 Reduction agent.

Dissolve with water $NaBH_4$ and NaOH in concentrations specified in the manufacturer's handbook for the spectrometer.

5.2.3.3.2.4 Standard solution (100 µg/l As, Sb or Se)

The standard solution shall be freshly prepared on the day of use by individual dilution of a stock solution. This stock solution with an As, Sb or Se content of at least 1 mg/l shall be made by dilution of standard solutions of Se, As and Sb which are available from all major suppliers of laboratory chemicals. This stock solution shall be kept in containers of tetrafluoroethylene-hexafluoropropylene copolymer (FEP), polytetrafluoroethylene (PTFE) or polyethylene (PE).

The stock solution should not be kept for longer than four weeks.

5.2.3.3.3 Apparatus

5.2.3.3.3.1 One one-mark volumetric flask, 100 ml.

5.2.3.3.3.2 Nine one-mark volumetric flasks, 10 ml.

5.2.3.3.3.3 Pipettes 5 ml, 10 ml and 20 ml.

5.2.3.3.3.4 Three one-mark volumetric flasks, 50 ml.

5.2.3.3.3.5 Micropipettes, volume adjustable to maximum 500 µl.

5.2.3.3.3.6 Atomic absorption spectrometer with the measurement parameters specified in Table 2.

The width of the slit, the measuring time, rinsing with argon before and after the measurement and the reaction time shall be adjusted in accordance with the manufacturer's instructions. The background compensation shall be activated for the measurement of As and Sb, but not for the measurement of Se.

5.2.3.3.4 Procedure

For As (procedure for Sb and Se in parentheses if different from As procedure): pipette 10 ml (Sb: 10 ml; Se: 20 ml) of this solution prepared in 5.2.3.2.4.1 into a 50 ml one-mark volumetric flask (5.2.3.3.3.4) and add 5 ml HCl (5.2.3.3.2.1) and 5 ml preliminary reduction agent (5.2.3.3.2.2). Do not add preliminary reduction agent to the flasks for Sb and Se determination. Allow 3 h for reaction to occur and fill to the mark with water. Pipette 5 ml of this solution into three 10 ml one-mark volumetric flasks (5.2.3.3.3.2) labelled A, B, C. Add 0,8 ml of HCl (5.2.3.3.2.1) to each flask. For the purpose of internal calibration, add those quantities of standard solutions (5.2.3.3.2.4) as given in Table 3 to the flasks B and C. With the spectrometer (5.2.3.3.3.6), carry out the measurement with the addition of the reduction agent (5.2.3.3.2.3) and the parameters of measurement in accordance with the manufacturer's instructions for the spectrometer.

Repeat the procedure with all reagents and the same volume of standard solution to be added using water in place of the sample as a blank determination.

Table 3 — Standard solution

	Volume of standard solution to be added		
	As	Sb	Se
Flask B	50 µl	100 µl	200 µl
Flask C	100 µl	200 µl	500 µl

5.2.3.3.5 Expression of results

See 5.2.3.2.5.

5.2.3.3.6 Calculation

See 5.2.3.2.6.

6 Labelling – Transportation – Storage

6.1 Means of delivery

Sodium thiosulfate shall be delivered in paper bags with polyethylene lining.

In order that the purity of the product 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]

At the date of the publication of this European Standard, no labelling requirements apply to sodium thiosulfate.

The legislation [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.

6.3 Transportation regulations and labelling

Sodium thiosulfate is not classified as a dangerous product for road, rail, sea and air transportation.

6.4 Marking

The marking shall include the following:

- name "sodium thiosulfate", trade name and grade;
- net mass;
- name and the address of supplier and/or manufacturer;
- statement "this product conforms to EN 12125".

6.5 Storage

6.5.1 Long term stability

The product is stable when stored in containers in a cool and dry place.

6.5.2 Storage incompatibilities

The product shall be kept away from acids, such as hydrochloric acid and sulfuric acid, to avoid the risk of sulfur dioxide evolution.

The product shall be kept away from oxidising substances, such as sodium hypochlorite, hydrogen peroxide.

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4) See [2].

Annex A
(informative)

General information on sodium thiosulfate

A.1 Origin

A.1.1 Raw materials

Sodium thiosulfate is manufactured from sodium hydroxide, sodium hydrogen sulfite (solution) and sulfur.

A.1.2 Manufacturing process

The raw materials react under pressure at elevated temperatures.

A.2 Use

A.2.1 Function

Sodium thiosulfate is used as a reducing agent to remove excess chlorine, chlorine dioxide or ozone in the drinking water:

$Na_2S_2O_3 + 4\ Cl_2 + 5\ H_2O \text{ -- > } 2\ NaHSO_4 + 8\ HCl$

A.2.2 Form in which it is used

Sodium thiosulfate is used as an aqueous solution with a content of mass fraction of 40 % $Na_2\ S_2\ O_3$.

A.2.3 Treatment dose

The treatment dose depends on the content of oxidants in the water. For chlorine, for example, in water the stoichiometric dose is 0,56 mg of $Na_2S_2O_3$ for 1 mg of Cl_2, but in practice an excess over the stoichiometric dose can be required.

A.2.4 Means of application

It is usually applied using a metering pump.

A.2.5 Secondary effects

The use of sodium thiosulfate increases content of sodium and and can consume oxygen dissolved in the water.

A.2.6 Removal of excess product

The excess product is removed by oxidation.

A.3 General rules relating to safety

A.3.1 Rules for safe handling and use

The supplier will provide current safety instructions.

A.3.2 Emergency procedures

A.3.2.1 First aid

In case of contact with the eyes or the skin, it is recommended to rinse with plenty of water.

In case of ingestion, it is recommended to seek immediately medical advice.

A.3.2.2 Spillage

It is recommended to collect and to remove any spillage avoiding the formation of dust.

Any remaining product can be flushed away with plenty of water to which an oxidising agent is added.

A.3.2.3 Fire

The product is not combustible.

Decomposition can be caused by fire with release of sulfur dioxide. It is recommended to wear suitable respiratory equipment.

There are no restrictions on extinguishing media in fire situations.

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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