**BS EN 12386:2012**

BSI Standards Publication

# Chemicals used for treatment of water intended for human consumption — Copper sulfate

## National foreword

This British Standard is the UK implementation of EN 12386:2012. It supersedes BS EN 12386:2005 which is withdrawn.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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EUROPEAN STANDARD

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**EN 12386**

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Supersedes EN 12386:2005

English Version

# Chemicals used for treatment of water intended for human consumption - Copper sulfate

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

Produkte zur Aufbereitung von Wasser für den menschlichen Gebrauch - Kupfersulfat

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

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# Foreword

This document (EN 12386:2012) 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of an identical text or by endorsement, at the latest by April 2013, and conflicting national standards shall be withdrawn at the latest by April 2013.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 12386:2005.

The significant technical differences between this edition and EN 12386:2005 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.

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 1 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.

NOTE 2 This product is a biocide and will need to comply with the relevant legislation in force. In the European Union, at the time of publication, this legislation is Directive 98/8/EC [1].

# 1 Scope

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

# 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 4793, *Laboratory sintered (fritted) filters — Porosity grading, classification and designation*

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 6332, *Water quality — Determination of iron — Spectrometric method using 1,10-phenanthroline*

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*

# 3 Description

## 3.1 Identification

### 3.1.1 Chemical name

Copper (II) sulfate pentahydrate.

### 3.1.2 Synonym or common names

Copper vitriol, blue vitriol, cupric sulfate.

### 3.1.3 Relative molecular mass

For pentahydrate: 249,69.

### 3.1.4 Empirical formula

$CuSO_4.5H_2O$.

### 3.1.5 Chemical formula

$CuSO_4.5H_2O$.

### 3.1.6 CAS-Registry Number 1)

anhydrous form:7758-98-7.

pentahydrate: 7758-99-7.

### 3.1.7 EINECS reference 2)

231-847-6 (anhydrous form).

## 3.2 Commercial form

The product is a powder or crystals.

## 3.3 Physical properties

### 3.3.1 Appearance

The product is a powder or crystals, with a deep blue colour.

### 3.3.2 Density

The density of the copper (II) sulfate pentahydrate is 2,28 g/cm³ at 20 °C.

### 3.3.3 Solubility in water

The solubility of the copper (II) sulfate pentahydrate is 266 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

The product decomposes above 300 °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

Copper (II) sulfate pentahydrate dehydrates partially at 29 °C and entirely at 250 °C. The pH value of an aqueous solution with a concentration of 10 g/l $CuSO_4$ is in the range 3,5 to 4. If thermal decomposition occurs, $SO_2$ is released.

## 4 Purity criteria

### 4.1 General

This European Standard specifies the minimum purity requirements for copper (II) sulfate pentahydrate 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 content of copper (II) sulfate pentahydrate shall not be less than a mass fraction of 98 %.

### 4.3 Impurities and main by-products

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

**Table 1 — Impurities**

| Impurity | | Limit in product (pentahydrate) |
|---|---|---|
| Insoluble matter | max | Mass fraction 0,5 % |
| Moisture | max | Mass fraction 0,5 % |
| Free sulfuric acid | max | Mass fraction 0,2 % |
| Iron (Fe) | max | 200 mg/kg |

## 4.4 Chemical parameters

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

**Table 2 — Chemical parameters**

| Parameter | | Limit<br>mg/kg of product (pentahydrate) |
|---|---|---|
| Antimony (Sb) | max | 1 |
| Arsenic (As) | max | 5 |
| Cadmium (Cd) | max | 10 |
| Chromium (Cr) | max | 5 |
| Lead (Pb) | max | 70 |
| Mercury (Hg) | max | 0,1 |
| Nickel (Ni) | max | 100 |
| Selenium (Se) | max | 1 |
| NOTE Cyanides ($CN^-$), pesticides and polycyclic aromatic hydrocarbons are not relevant because the raw materials used in the manufacturing process are free of them. For parametric values of copper (II) sulfate pentahydrate on trace metal content in drinking water, see [2]. | | |

# 5 Test methods

## 5.1 Sampling

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

## 5.2 Analyses

### 5.2.1 Main product

#### 5.2.1.1 General

For routine method, see Annex C.

### 5.2.1.2 Principle

The copper content is determined electrolytically.

### 5.2.1.3 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.

**5.2.1.3.1 Nitric acid** concentrated, $\rho$ = 1,40 g/ml.

**5.2.1.3.2 Sulfuric acid** concentrated, $\rho$ = 1,84 g/ml.

**5.2.1.3.3 Ethanol,** solution volumic fraction 95 %.

### 5.2.1.4 Apparatus

Ordinary laboratory apparatus and glassware, together with the following:

**5.2.1.4.1 Direct current supply.**

**5.2.1.4.2 Tared, perforated platinum cylinder cathode.**

**5.2.1.4.3 Platinum wire anode.**

### 5.2.1.5 Test sample

Mix a 500 g sample thoroughly and place approximately 100 g of this material in a properly stoppered glass container.

### 5.2.1.6 Procedure

Weigh out a test portion of approximately 5 g (*m*) of copper (II) sulfate pentahydrate as rapidly as possible and transfer quantitatively to a tall-form 400 ml beaker. Dissolve the test portion in 350 ml water and then add 10 ml $H_2SO_4$ (5.2.1.3.2). Allow the solution to cool to room temperature.

Deposit the copper electrolytically on a tared, perforated, platinum cylinder cathode (5.2.1.4.2), with a straight platinum wire (5.2.1.4.3) for the anode. Cover the beaker carefully with a split watch glass to prevent loss by spraying.

Apply a current density of 0,5 A/dm² of cathode area until deposition is complete. The cathode area equals gross area of inside of cylinder, including perforations. It is customary to conduct this operation overnight. When the solution is colourless, wash down the watch glass, electrodes and sides of beaker, raising the level of the liquid slightly, and continue the electrolysis for 15 min, noting whether or not copper is deposited on the newly exposed surface of the platinum. If copper appears, raise the level of the liquid and continue the electrolysis until none appears on the electrode. The completion of electrolysis can be determined by testing a few drops of the solution on a spot plate with saturated hydrogen sulfide solution. Electrolysis is complete when no copper sulfide colouration is observed.

When electrolysis is complete, remove the cathode quickly while washing with water from a wash bottle and then rinse the cathode in two successive baths of ethanol 95 % (5.2.1.3.3). Dry in oven at 110 °C for 3 min, cool and weigh as metallic copper.

#### 5.2.1.7 Calculation

The content of $CuSO_4 . 5H_2O$, $c_1$, expressed as mass fraction in %, is calculated by the following formula:

$$c_1 = \frac{m_1}{m} \text{x} 3{,}937 \text{x} 100 \quad (1)$$

where

$m_1$ is the increase of the mass of the electrode in grams;

$m$ is the mass of the test portion in grams.

If results obtained for copper are low, it might be desirable to save the solution (from which the copper has been removed) for the electrolytic determination of nickel, which can be an interference in the analysis. When making analyses, instructions that come with the instrument should be followed closely.

### 5.2.2 Impurities

#### 5.2.2.1 Insoluble matter

##### 5.2.2.1.1 Procedure

Weigh 50 g of sample ($m_2$) that has been dried at 95 °C (if the sample is composed of crystals, grind to powder with a mortar and pestle) and transfer to a 500 ml beaker. Dissolve in 400 ml of water; add two drops of concentrated $H_2SO_4$.

Digest with constant stirring at a temperature of 90 °C for 4 h, maintaining the original water level by frequent additions of hot water.

Filter through a tared platinum Gooch crucible or a tared fritted-glass filter of medium porosity (porosity P16 according to ISO 4793). Wash with at least six separate 25 ml portions of boiling water, filter, and then dry at 105 °C to constant mass ($m_3$).

##### 5.2.2.1.2 Calculation

The content of insoluble matter, $c_2$, expressed as mass fraction in %, is calculated by the following formula:

$$c_2 = \frac{m_3}{m_2} \text{x} 100 \quad (2)$$

where

$m_3$ is the mass in grams, of filter residue;

$m_2$ is the mass in grams, of the test portion.

#### 5.2.2.2 Moisture content

##### 5.2.2.2.1 Procedure

Weigh 5 g ($m_2$) of the sample into a broad weighing bottle and heat in an oven at 260 °C to constant mass. Cool in a desiccator and reweigh.

#### 5.2.2.2.2 Calculation

The content of moisture, $c_3$, expressed as mass fraction in %, is given by the following formula:

$$c_3 = \frac{(m_5 - m_6 \text{x} 0{,}564)}{m_4} \text{ x } 100 \quad (3)$$

where

$m_5$ is the loss in mass in grams;

$m_6$ is the mass in grams of the residue;

$m_6$x0,564 is the mass of water of crystallisation in grams;

$m_4$ is the mass in grams of the test portion.

### 5.2.2.3 Free sulfuric acid

#### 5.2.2.3.1 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.

**5.2.2.3.1.1 Sodium hydroxide,** solution, $c(\text{NaOH})$ = 0,05 mol/l.

**5.2.2.3.1.2 Congo-red indicator,** solution of 0,2 g Congo-red (CAS N° 573-58-0) in 100 ml of water.

#### 5.2.2.3.2 Procedure

Dissolve 2 g ($m_7$) of the sample in a beaker in 100 ml water. Add a few drops of Congo-red indicator. Titrate with the sodium hydroxide solution.

#### 5.2.2.3.3 Calculation

The content of free sulfuric acid, $c_4$, expressed as mass fraction in %, is calculated by the following formula:

$$c_4 = \frac{m_8 \text{x} 0{,}245}{m_7} \quad (4)$$

where

$m_8$ is the consumption, in millilitres, of sodium hydroxide solution;

$m_7$ is the mass, in grams, of the test portion.

### 5.2.2.4 Iron

The content of iron (Fe) shall be determined in accordance with ISO 6332 (spectrometric method).

### 5.2.3 Chemical parameters

#### 5.2.3.1 General

The content of chemical parameters shall be determined using the procedures specified in Table 3:

**Table 3 — Procedures for the determination of chemical parameters**

| Element | Reference | Method | Wavelength (nm) | Flame |
|---|---|---|---|---|
| As | see 5.2.3.3 | Hydride<br>AAS | 193,7 | n.a. |
| Sb | see 5.2.3.3 | Hydride<br>AAS | 217,6 | n.a. |
| Cd | ISO 6353-1 GM 29<br>see 5.2.3.2 | AAS | 228,8 | air-acetylene |
| Cr | ISO 6353-1 GM 29<br>see 5.2.3.2 | AAS | 357,8 | air-acetylene |
| Pb | ISO 6353-1 GM 29<br>see 5.2.3.2 | AAS | 217,0<br>or<br>283,3 | air-acetylene |
| Ni | ISO 6353-1 GM 29<br>see 5.2.3.2 | AAS | 232,0 | oxidising acetylene-air |
| Se | see 5.2.3.3 | Hydride<br>AAS | 196,0 | n.a. |
| Hg | in accordance with ISO 5993 | flameless AAS | 253,6 | n.a. |
| AAS = Atomic Absorption Spectroscopy<br>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

**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 an 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, together with the following:

**5.2.3.2.3.1 Atomic absorption spectrometer** with the measurement parameters specified in Table 3.

#### 5.2.3.2.4 Procedure

##### 5.2.3.2.4.1 Test portion

Weigh 1g (*m*) to the nearest 0,01 mg of the laboratory sample into a 100 ml one-mark volumetric flask (*V*) 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.

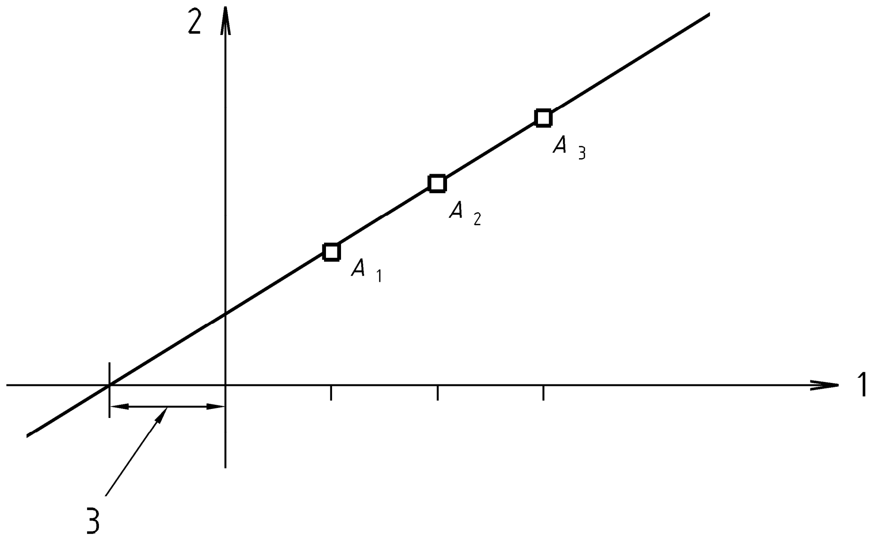
#### 5.2.3.2.5 Expression of results

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 % copper (II) sulfate pentahydrate is given by the following formula:

$$C_3 = \frac{y \times V \times 100 \times 1000}{m \times C_1} \qquad (5)$$

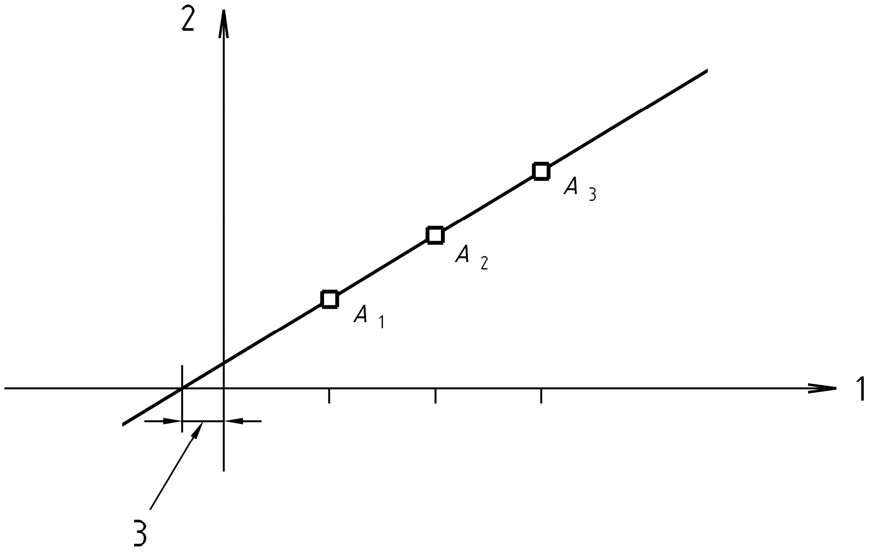
where

$y$ 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 % copper (II) sulfate pentahydrate (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 $\rho$ = 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 3.

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 (the procedure for Sb and Se is 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 10 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. For the purpose of internal calibration, add those quantities of standard solutions (5.2.3.3.2.4) as given in Table 4 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 4 — Standard solution**

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

The product shall be delivered in paper bags with polyethylene linings or in drums.

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)]

The following labelling requirements apply to copper (II) sulfate pentahydrate at the date of the publication of this European Standard:

| Hazard pictograms | |
|---|---|
| <br>**GHS 07**<br><br>**GHS 09** | — Signal word: **Warning**<br>— Hazard statements:<br>H302: Harmful if swallowed<br>H315: Causes skin irritation<br>H319: Causes serious eye irritation<br>H400: Very toxic to aquatic life<br>H410: Very toxic to aquatic life with long lasting effects<br>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. |

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[4)] See [3].

The legislation [3], 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

Copper (II) sulfate pentahydrate is listed as UN Number [5] 2775.

RID [6] /ADR [7]: class 6.1; classification code T7; packing group III.

IMDG [8]: class 6.1.

IATA [9]: class 6.1, packing group III.

## 6.4 Marking

The marking shall include the following:

- the name "copper (II) sulfate (anhydrous)" or "copper (II) sulfate pentahydrate ", trade name and grade;
- the net mass;
- the name and the address of supplier and/or manufacturer;
- the statement "this product conforms to EN 12386".

## 6.5 Storage

### 6.5.1 Long term stability

The product is stable in normal storage conditions, dry and cool.

### 6.5.2 Storage incompatibilities:

The product shall be kept away from moisture.

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[5] United Nations Number.

[6] Regulations concerning International carriage of Dangerous goods by rail.

[7] European Agreement concerning the international carriage of Dangerous goods by Road.

[8] International Maritime transport of Dangerous Goods.

[9] International Air Transport Association.

# Annex A
(informative)

# General information on copper sulfate

## A.1 Origin

### A.1.1 Raw materials

Copper sulfate is manufactured from sulfuric acid and copper.

### A.1.2 Manufacturing process

Dissolution of copper by dilute sulfuric acid in the presence of oxygen or steam.

## A.2 Use

### A.2.1 Function

Copper sulfate is used for the cleaning of the various containers used in drinking water treatment and for the destruction of algae in water works installations.

In order to prevent algal proliferations in containers of raw water to be treated, copper sulfate solution is applied alone or in a mixture with citric acid.

### A.2.2 Form in which it is used

The product is used as an aqueous solution.

### A.2.3 Treatment dose

For cleaning and the prevention of algal growth a solution of up to 5,0 mg/l (typically in the range 0,5 mg/l to 2,0 mg/l) is usually applied, depending on algae type and water pH, alkalinity, hardness and temperature.

Before refilling with water, the containers should be emptied and rinsed with water.

In the case of settlementation tanks, copper sulfate is usually added to raw water in a concentration of 0,2 mg/l $CuSO_4$ $5H_2O$.

The European Drinking Water Directive contains a guideline value for copper of 0,1 mg/l. The use of CuSO4 might result in an unacceptable increase of the Cu content of the drinking water produced. Care should be taken to keep the contribution to the Cu content of drinking water through the use of $CuSO_4$ below 0,01 mg/l.

### A.2.4 Means of application

The product is applied by means of a positive displacement-metering pump to the inlet of a tank or reservoir, or by spraying solution over the surface of a reservoir.

### A.2.5 Secondary effects

At pH greater than 7, copper will precipitate as copper hydroxide and basic copper carbonate. Excessive concentrations of copper (above 2 mg/l Cu) will cause astringent taste.

### A.2.6 Removal of excess product

Not applicable.

# Annex B
(normative)

# General rules relating to safety

## B.1 Rules for safe handling and use

The supplier shall provide current safety instructions.

## B.2 Emergency procedures

### B.2.1 First aid

In case of contact with skin, wash immediately with plenty of water.

In case of contact with eyes, treat by thorough irrigation with water, with the eyelids held open. Consult if necessary a doctor (or eye specialist).

In case of ingestion, let victim vomit.

If there is a risk of unconsciousness, position and transport in stable lateral position. Medical treatment is required as soon as possible.

### B.2.2 Spillage

Take up any spillage avoiding formation of dust.

### B.2.3 Fire

Copper sulfate does not burn.

Extinguishing media: no restrictions in fire situations.

# Annex C
(informative)

# Routine method for the determination of copper in copper sulfate pentahydrate

The routine method for the determination of copper can be carried out in accordance with ISO 6353-2 for the reagent R 9: Copper (II) sulfate pentahydrate ($CuSO_4 .5 H_2O$).

# Bibliography

[1] 98/8/EC, *Council Directive of 16 February 1998 concerning the placing of biocidal products on the market*.

[2] 98/83/EC, *Council Directive of 3 November 1998 on the quality of water intended for human consumption.*

[3] 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)

[4] ISO 6353-2 *Reagents for chemical analysis — Part 2: Specifications — First series*

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