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Chemicals used for treatment of water intended for human consumption — Iron (III) sulfate solution

National foreword

This British Standard is the UK implementation of EN 890:2023. It supersedes BS EN 890:2012, which is withdrawn.

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

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

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English Version

Chemicals used for treatment of water intended for human consumption - Iron(III) sulfate solution

Produits chimiques utilisés pour le traitement de l'eau destinée à la consommation humaine - Sulfate de fer (III) liquide

Produkte zur Aufbereitung von Wasser für den menschlichen Gebrauch - Eisen(III)sulfat-Lösung

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European foreword

This document (EN 890:2023) 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of an identical text or by endorsement, at the latest by August 2023, and conflicting national standards shall be withdrawn at the latest by August 2023.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 890:2012.

EN 890:2023 includes the following significant technical changes with respect to EN 890:2012:

- removal of the analytical methods from this document and addition of reference to EN 17215 as analytical method standard;
- update of the information of risk and safety labelling of the product to comply with the new regulations (see 7.2 and [2]);
- update of the information related to Drinking Water Directive.

Any feedback and questions on this document should be directed to the users' national standards body. A complete listing of these bodies can be found on the CEN website.

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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 document:

- a) this document 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.

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1 Scope

This document is applicable to iron (III) sulfate solution of various iron and/or acid contents (see 4.2) used for treatment of water intended for human consumption. It describes the characteristics of iron (III) sulfate solution and specifies the requirements and the corresponding analytical methods for iron (III) sulfate solution and gives information on its use in water treatment. It also determines the rules relating to safe handling and use of iron (III) sulfate solution.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

EN 17215, *Chemicals used for treatment of water intended for human consumption — Iron-based coagulants — Analytical methods*

3 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

4 Description

4.1 Identification

4.1.1 Chemical name

Iron (III) sulfate, solution.

4.1.2 Synonym or common names

Ferric sulfate liquor, red iron liquor.

4.1.3 Relative molecular mass

399,87 g/mol.

4.1.4 Empirical formula

$\text{Fe}_2(\text{SO}_4)_3$.

4.1.5 Chemical formula

$\text{Fe}_2(\text{SO}_4)_3$.

4.1.6 CAS Registry Number¹⁾

10028-22-5.

¹⁾ Chemical Abstract Service Registry Number.

4.1.7 EINECS reference²⁾

233-072-9.

4.2 Commercial forms

Iron (III) sulfate is available as a solution.

4.3 Physical properties

4.3.1 Appearance

Iron (III) sulfate is a red/brown solution.

4.3.2 Density

The density of iron (III) sulfate is approximately 1,5 g/cm³ at 20 deg.

4.3.3 Solubility (in water)

The iron (III) sulfate solution is dilutable (see A.3.2).

4.3.4 Vapour pressure

Not known.

4.3.5 Boiling point at 100 kPa³⁾

Higher than 100 °C.

4.3.6 Freezing point

The freezing point of an aqueous solution is lower than -15 °C.

4.3.7 Specific heat

Not known.

4.3.8 Viscosity (dynamic)

The viscosity of the commonly used solution varies in the range of 5 mPa·s to 130 mPa·s at 10 °C.

4.3.9 Critical temperature

Not applicable.

4.3.10 Critical pressure

Not applicable.

4.3.11 Physical hardness

Not applicable.

4.4 Chemical properties

The solutions of iron (III) sulfate are acidic and corrosive.

²⁾ European Inventory of Existing Commercial Chemical Substances.

³⁾ 100 kPa = 1 bar.

5 Purity criteria

5.1 General

This document specifies the minimum purity requirements for iron (III) sulfate solution 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 can be present and, if so, this shall be notified to the user and when necessary to relevant authorities.

NOTE Users of this product can check the national regulations in order to verify 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 lead to significant quantities of impurities, by-products or additives being present, this shall be notified to the user.

5.2 Composition of commercial product

The product typically contains not less than a mass fraction of 30 % of $Fe_2(SO_4)_3$ and shall be within ± 3 % of the manufacturer's declared values.

5.3 The grade of the product

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

The concentration limits refer to Fe (III).

Table 1 — Limit values for the grades 1, 2 and 3

Limit values in mass fraction of Fe (III) content %

Parameter		Limit		
		Grade 1	Grade 2	Grade 3
Manganese	max.	0,5	1	2
Iron (II) ^a	max.	2,5	2,5	2,5
Insoluble matters ^b	max.	0,5	0,5	0,5
^a Fe (II) has a lower coagulant efficiency compared to Fe (III). Also hydrolysis of Fe (II) starts at pH value 8, and therefore Fe (II) can remain into the water at lower pH values. ^b An excess of insoluble matters indicates the presence of foreign matter (see A.2). Iron is a component of the product that will usually be removed in the treatment process.				

5.4 The type of the product

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

The concentration limits are specified in milligrams per kilogram of Fe (III).

Table 2 — Limit values for the types 1, 2 and 3

Limit values in mg/kg in Fe (III)

Parameter		Limit		
		Type 1	Type 2	Type 3
Arsenic (As)	max.	1	20	50
Cadmium (Cd)	max.	1	25	50
Chromium (Cr)	max.	100	350	500
Mercury (Hg)	max.	1	5	10
Nickel (Ni)	max.	300	350	500
Lead (Pb)	max.	10	100	400
Antimony (Sb)	max.	10	20	60
Selenium (Se)	max.	1	20	60

NOTE Cyanide (CN⁻), pesticides and polycyclic aromatic hydrocarbons are not relevant since the raw materials used in the manufacturing process are free of them. For maximum impact of iron (III) sulfate on trace metal content in drinking water see A.2.

6 Test methods

6.1 Sampling

Use the relevant method described in the EN 17215.

6.2 Analyses

Use the relevant methods described in EN 17215.

7 Labelling - Transportation - Storage

7.1 Means of delivery

The product shall be delivered in tankers or containers made of suitable non-corrosive materials.



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.

7.2 Risk and safety labelling according to the EU Directives⁴⁾

The following Table 3 is an example of labelling. The manufacturer should confirm the classifications for their product. Users are instructed to read the manufactures data sheet.

⁴⁾ See [2].

Table 3 — Labelling requirements

Hazard pictogram	Hazard statements	Signal word
 <p>Figure 1 — GHS05</p>  <p>Figure 2 — GHS07</p>	<p>H290: May be corrosive to metals. H302: Harmful if swallowed. H315: Causes skin irritation. H317: May cause an allergic skin reaction. H318: Causes serious eye damage. NOTE: H317 depends on Ni content.</p>	<p>Danger</p>
<p>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.</p>		

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NOTE The legislation [2] contains a list of substances classified by the EU. Substances not listed in this regulation can 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. Classification and labelling can be carried out in compliance with [2].

7.3 Transportation regulations and labelling

Iron (III) sulfate solution is listed as UN number ⁵⁾: 3264.

Proper Shipping name:

CORROSIVE LIQUID, ACIDIC, INORGANIC, N.O.S. (Iron sulfate solution).

ADR⁶⁾ / RID⁷⁾: Class 8; classification code C1; packing group II or III

IMDG⁸⁾: Class 8; classification code C1; packing group II or III IMDG page 8134.

IATA⁹⁾: Class 8; classification code C1; packing group II or III

⁵⁾ United Nations Number.

⁶⁾ European Agreement concerning the international carriage of Dangerous goods by Road.

⁷⁾ Regulations concerning International carriage of Dangerous goods by rail.

⁸⁾ International Maritime transport of Dangerous Goods.

7.4 Marking

The marking shall include the following information:

- the name “Iron (III) sulfate”, trade name, grade and type;
- the net mass;
- the name and the address of the supplier and/or manufacturer;
- the statement “This product conforms to EN 890”.

7.5 Storage

7.5.1 Long term stability

Storable in appropriate stainless steel, rubber and most plastics containers or tanks.

NOTE Some sedimentation of yellow iron (III) sulfate can occur. To avoid problems caused by sedimentation of iron (III) sulfate, storage tanks can be cleaned every 1 to 2 years.

7.5.2 Storage incompatibilities

Iron (III) sulfate solution is acidic and corrosive:

- avoid contact with metals (except the appropriate stainless steel);
- avoid contact with alkalis;
- avoid contact with oxidizing agents especially chlorites and hypochlorites.

⁹⁾ International Air Transport Association.

Annex A
(informative)

General information on iron (III) sulfate solution

A.1 Origin

A.1.1 Raw materials

The product is manufactured from an iron source, typically iron (II) sulfate or an iron oxide, which is reacted with a combination of sulfuric acid and an oxidising agent, such as nitric acid, oxygen, hydrogen peroxide or air, at elevated temperature or pressure.

A.1.2 Manufacturing process

Iron (III) sulfate is produced by the action of sulfuric acid on a variety of iron salts or ores in combination with an oxidation process as required.

A.2 Quality of commercial product

The three types of iron (III) sulfate solution specified in Table 2 reflect the quality of commercially available products. Tables A.1 to A.3 show the maximum concentrations of trace metals that would be added to the raw water by the addition of products corresponding to the purity levels specified in Table 2. It can be seen that the concentrations of metal added are well below the parametric values given in the Directive (EU) 2020/2184 (see [1]) at typical product doses. Furthermore, the tables overstate the concentration of metals that would be present in the treated water since a substantial proportion of the trace metals will be incorporated in the sludge. Users of this product should select an appropriate grade and type to enable them to achieve treated water quality targets taking into account raw water characteristics, required dosage, process plant conditions and other relevant factors.

Table A.1 — Maximum impact of iron (III) sulfate solution, Type 1, on trace metal content of water. Drinking water limit value is based on Drinking Water Directive

	The max. concentration of trace metal (mg/m ³ = µg/l) with different dosing		Drinking water limit value
	Dosing 4 g Fe/m ³	Dosing 10 g Fe/m ³	
	µg/l	µg/l	µg/l
Arsenic (As)	0,004	0,01	10
Cadmium (Cd)	0,004	0,01	5
Chromium (Cr)	0,4	1	25
Mercury (Hg)	0,000 4	0,001	1
Nickel (Ni)	1,2	3	20
Lead (Pb)	0,04	0,1	10
Antimony (Sb)	0,04	0,1	10
Selenium (Se)	0,004	0,01	20

Table A.2 — Maximum impact of iron (III) sulfate solution, Type 2, on trace metal content of water. Drinking water limit value is based on Drinking Water Directive

	The max. concentration of trace metal (mg/m ³ = µg/l) with different dosing		Drinking water limit value
	Dosing 4 g Fe/m ³	Dosing 10 g Fe/m ³	
	µg/l	µg/l	µg/l
Arsenic (As)	0,08	0,1	10
Cadmium (Cd)	0,1	0,25	5
Chromium (Cr)	1,4	3,5	25
Mercury (Hg)	0,02	0,05	1
Nickel (Ni)	1,4	3,5	20
Lead (Pb)	0,4	1,0	10
Antimony (Sb)	0,08	0,2	10
Selenium (Se)	0,08	0,2	20

Table A.3 — Maximum impact of iron (III) sulfate solution, Type 3, on trace metal content of water. Drinking water limit value is based on Drinking Water Directive

	The max. concentration of trace metal (mg/m ³ = µg/l) with different dosing		Drinking water limit value
	Dosing 4 g Fe/m ³	Dosing 10 g Fe/m ³	
	µg/l	µg/l	µg/l
Arsenic (As)	0,2	0,5	10
Cadmium (Cd)	0,2	0,5	5
Chromium (Cr)	2,0	5,0	25
Mercury (Hg)	0,04	0,1	1
Nickel (Ni)	2,0	5,0	20
Lead (Pb)	1,6	4,0	10
Antimony (Sb)	0,24	0,6	10
Selenium (Se)	0,24	0,6	20

A.3 Use

A.3.1 Function

The product is used as primary coagulant.

A.3.2 Form in which it is used

The product is used as delivered or diluted. Diluted solutions can hydrolyse and form a precipitate.

A.3.3 Treatment dose

The treatment dose is variable depending on raw water quality and corresponds to a treatment dose between 4 g/m³ and 10 g/m³ expressed as Fe.

A.3.4 Means of application

The product can be dosed as delivered by acid resistant pumps. To promote a rapid dispersion a high turbulence at the point of addition and dilution with carrier water is desirable.

A.3.5 Secondary effects

- Increase in sulfate content;
- reduction in alkalinity and pH value.

A.3.6 Removal of excess product

The coagulation process includes the hydrolysis of the ferric ions to ferric hydroxide. This precipitate is removed by sedimentation, flotation and/or final filtration.

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Annex B
(normative)

General rules relating to safety

B.1 Rules for safe handling and use

The supplier shall provide current safety instructions. The user shall read the safety data sheet.

B.2 Emergency procedures

B.2.1 First aid

In case of contact with skin, wash the affected area with water.

In case of contact with eyes, rinse with water and seek medical advice.

If swallowed, provided patient is conscious, wash out the mouth with water, and seek medical advice.

B.2.2 Spillage

Remove with liquid binder as much of the concentrated product as possible, then rinse with water.

B.2.3 Fire

Product is not combustible. However, in contact with metals, iron (III) sulfate can liberate the flammable gas hydrogen.

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Bibliography

- [1] Directive (EU) 2020/2184 of the European Parliament and of the Council of 16 December 2020 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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