BS EN 887:2016

BSI Standards Publication

Chemicals used for treatment of water intended for human consumption — Aluminium iron (III) sulfate

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National foreword

This British Standard is the UK implementation of EN 887:2016. It supersedes BS EN 887:2004 which is withdrawn.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.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

ISBN 978 0 580 90464 6

ICS 13.060.20; 71.100.80

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 30 April 2016.

Amendments issued since publication

Date	Text affected

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 887

March 2016

ICS 71.100.80

Supersedes EN 887:2004

English Version

Chemicals used for treatment of water intended for human consumption - Aluminium iron (III) sulfate

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

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

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Ref. No. EN 887:2016 E

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European foreword

This document (EN 887:2016) 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of an identical text or by endorsement, at the latest by September 2016, and conflicting national standards shall be withdrawn at the latest by September 2016.

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 887:2004.

Significant technical differences between this edition and EN 887:2004 are as follows:

a) addition of CAS Registry Numbers for aluminium sulfate tetradecahydrate, hexadecahydrate and octadecahydrate;

b) addition of normative reference concerning the determination of iron (III) sulfate;

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

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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.

NOTE Conformity with this document 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 document is subject to regulation or control by National Authorities.

1 Scope

This document is applicable to aluminium iron (III) sulfate used for treatment of water intended for human consumption. It describes the characteristics of aluminium iron (III) sulfate and specifies the requirements for aluminium iron (III) sulfate and refers to the corresponding analytical methods. It gives information on its use in water treatment. It also determines the rules relating to safe handling and use of aluminium iron (III) sulfate (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 890:2012, *Chemicals used for treatment of water intended for human consumption - Iron (III) sulfate solution*

EN 1302, *Chemicals used for treatment of water intended for human consumption - Aluminium-based coagulants - Analytical methods*

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

Aluminium iron (III) sulfate.

3.1.2 Synonym or common name

Aluminium and iron sulfate.

3.1.3 Relative molecular mass

Variable (see 3.1.4).

3.1.4 Empirical formula

$(Al_x\ Fe_{1-x})_2\ (SO_4)_3$ where x is 0,70 to 0,95.

3.1.5 Chemical formula

$xAl_2(SO_4)_3.\ (1 - x)\ Fe_2(SO_4)_3.\ n\ H_2O$ where n is variable and x varies from 0,70 to 0,95.

3.1.6 CAS Registry Number[1)]

The following is a list of CAS Registry Numbers for the components:

$Al_2(SO_4)_3$: 10043-01-3;

$Al_2(SO_4)_3 \bullet 14\ H_2O$: 16828-12-9;

$Al_2(SO_4)_3 \cdot 16\ H_2O$: 16828-11-8;

$Al_2(SO_4)_3 \cdot 18\ H_2O$: 7784-31-8;

$Fe_2(SO_4)_3$: 10028-22-5.

3.1.7 EINECS reference[2)]

The following is a list of EINECS reference numbers for the components:

$Al_2(SO_4)_3$: 233-135-0;

$Fe_2(SO_4)_3$: 233-072-9.

3.2 Commercial forms

Aluminium iron (III) sulfate is available in solid hydrated forms, with different particle sizes (slabs, kibbled, ground, granulated), and as aqueous solutions.

3.3 Physical properties

3.3.1 Appearance

The product is a yellow to brown solid or liquid.

3.3.2 Density

The density of aluminium iron (III) sulfate solution varies depending on the composition.

For example:

— 1,330 g/ml for solution containing 36 g/kg of Al and 15 g/kg of Fe at 15 °C.

The bulk density (loose) of granulated solid product is approximately 0,9 g/cm^3.

3.3.3 Solubility in water

The solubility of aluminium iron (III) sulfate varies depending on the content of iron.

For example:

— for a solid form containing 72 g/kg of aluminium and 30 g/kg of iron, at 0 °C the solubility is:

  — 36 g/kg of Al in solution;

  — 15 g/kg of Fe in solution.

3.3.4 Vapour pressure at 20 °C

Not known.

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1) Chemical Abstracts Service Registry Number.

2) European Inventory of Existing Commercial Chemical Substances.

3.3.5 Boiling point at 100 kPa[3)]

120 °C for a saturated solution.

3.3.6 Crystallization point

The crystallization point of aluminium iron (III) sulfate varies, depending on the composition.

For example:

— 13 °C for composition containing 36 g/kg of Al and 15 g/kg of Fe.

3.3.7 Specific heat

Not known.

3.3.8 Viscosity (dynamic)

The viscosity of aluminium iron (III) sulfate solution varies greatly, depending on the composition and content of insoluble matters.

For a typical commercially available solution with a composition containing 36 g/kg of Al and 15 g/kg of Fe, the viscosity is given in Table 1.

Table 1 — Viscosity

Temperature (°C)	**Viscosity** (mPa·s)
- 5	62
0	49
10	29

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

Aluminium iron (III) sulfate is a slightly acidic hydrated salt or solution. Very dilute solutions hydrolyze and form a precipitate of aluminium hydroxide and iron hydroxide.

NOTE The solubility of aluminium and the solubility of iron depend on the pH value and it is advised to use the product within an appropriate pH range.

3) 100 kPa = 1 bar.

4 Purity criteria

4.1 General

This document specifies the minimum purity requirements for aluminium iron (III) sulfate 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 products not stated in this document.

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.

4.2 Composition of commercial product

The concentration of active matter (aluminium and iron ion contents) in the commercial product expressed as grams per kilogram of product shall be within ± 3 % of the manufacturer's declared values.

NOTE The concentration of water-soluble aluminium and water-soluble iron in commercial products varies. Typical values for concentration of active matter depending on the forms are given here below:

	Al (g/kg of product)	**Fe (g/kg of product)**
Solid forms	68 to 80	35 to 12
Solution forms	26 to 40	21 to 6

4.3 Impurities and main by-products

In solid hydrated forms, the content of insoluble matter shall not exceed:

- 25 g/kg of Al + Fe for type 1 and type 2;
- 30 g/kg of Al + Fe in commercial product for type 3.

In solutions, the content of insoluble matter shall not exceed:

- 25 g/kg of Al + Fe for type 1 and type 2;
- 15 g/kg of Al + Fe in commercial product for type 3.

NOTE 1 The three types are defined in Table 2.

NOTE 2 Insoluble matter consist of unreacted silica (SiO_2) and/or aluminium and iron silicates, in various proportions.

4.4 Chemical parameters

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

Table 2 — Chemical parameters

Parameter		Limit mg/kg of Al + Fe		
		type 1	type 2	type 3
Arsenic (As)	max.	14	40	100
Cadmium (Cd)	max.	3	50	100
Chromium (Cr)	max.	30	700	1 000
Mercury (Hg)	max.	4	10	20
Nickel (Ni)	max.	20	700	1 000
Lead (Pb)	max.	40	200	800
Antimony (Sb)	max.	20	40	120
Selenium (Se)	max.	20	40	120
NOTE Cyanide (CN^-) is usually not relevant because of the acidity of the product. 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 the product on trace metal content in drinking water see A.2.				

5 Test methods

5.1 Sampling

5.1.1 General

Observe the general rules of ISO 3165 and take into account ISO 6206.

5.1.2 Solid

Prepare the laboratory sample(s) required by the relevant procedure described in ISO 8213.

5.1.3 Liquid

5.1.3.1 Sampling from drums and bottles

5.1.3.1.1 General

5.1.3.1.1.1 Mix the contents of the container to be sampled by shaking the container, by rolling it or by rocking it from side to side, taking care not to damage the container or spill any of the liquid.

5.1.3.1.1.2 If the design of the container is such (for example, a narrow-necked bottle) that it is impracticable to use a sampling implement, take a sample by pouring after the contents have been thoroughly mixed. Otherwise, proceed as described in 5.1.3.1.1.3.

5.1.3.1.1.3 Examine the surface of the liquid. If there are signs of surface contamination, take samples from the surface as described in 5.1.3.1.2; otherwise, take samples as described in 5.1.3.1.3.

5.1.3.1.2 Surface sampling

Take a sample using a suitable ladle. Lower the ladle into the liquid until the rim is just below the surface, so that the surface layer runs into it. Withdraw the ladle just before it fills completely and allow any liquid adhering to the ladle to drain off. If necessary, repeat this operation so that, when the other selected

containers have been sampled in a similar manner, the total volume of sample required for subsequent analysis is obtained.

5.1.3.1.3 Bottom sampling

Take a sample using an open sampling tube, or a bottom-valve sampling tube, suited to the size of container and the viscosity of the liquid.

When using an open sampling tube, close it at the top and then lower the bottom end to the bottom of the container. Open the tube and move it rapidly so that the bottom of the tube traverses the bottom of the container before the tube is filled. Close the tube, withdraw it from the container and allow any liquid adhering to the outside of the tube to drain off.

When using a bottom-valve sampling tube, close the valve before lowering the tube into the container and then proceed in a similar manner to that when using an open sampling tube.

5.1.3.2 Sampling from tanks and tankers

From each access point, take samples as follows:

a) from the surface of the liquid, using a ladle as described in 5.1.3.1.2;

b) from the bottom of the tank or tanker, using a sampling tube as described in 5.1.3.1.3 or using specially designed bottom-sampling apparatus;

c) from one or more positions, depending on the overall depth, between the bottom and the surface using a weighted sampling can.

5.2 Analyses

Use the relevant methods for aluminium analysis described in EN 1302 and EN 890:2012, B.1 for iron sulfate.

6 Labelling - Transportation - Storage

6.1 Means of delivery

Solids: the product shall be delivered in suitable packages, paper or plastic bags, or by rubber-lined or plastics-lined bulk truck (20 t to 35 t depending on transport regulations if applicable).

Bulk liquids: the products shall be delivered in tankers of corrosion-resistant materials, suitable for the purpose.

NOTE The manufacturer can provide advice on suitable 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.

6.2 Labelling according to the EU legislation[4)]

Classification depends on amount iron sulfate.

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

4) See [2].

Hazard pictogram  **Figure 1 — GHS05**  **Figure 2 — GHS07**	— Signal word: **Danger** — Hazard statements: H290: May be corrosive to metals. H302: Harmful if swallowed. H318: Causes serious eye damage 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.

The legislation [2] 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. Classification and labelling should be carried out in compliance with [2].

6.3 Transportation regulations and labelling

The solid commercial product is not classified as a dangerous product for road, rail, sea and air transportation.

All others should be transported under a UN number[5)] 3264.

Proper Shipping name:

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

Packing Group: III

Hazard Class: 80

5) United Nations Number.

— RID[6]: as above ;

— ADR[7]: as above ;

— IMDG[8]: as above and not a marine pollutant ;

— IATA [9]: as above.

6.4 Marking

The marking shall include the following:

— the name : “aluminium iron(III) sulfate”,

— trade name and type;

— the net mass;

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

— the statement “This product conforms to EN 887”.

6.5 Storage

6.5.1 General

Storage tanks shall be of a corrosion-resistant material suitable for the purpose.

NOTE The manufacturer can provide advice on suitable materials.

6.5.2 Long term stability

Stable.

6.5.3 Storage incompatibilities

Avoid contact with chlorites, hypochlorites, sulphites or alkaline substances. Incompatible with other coagulants, such as polyaluminium chloride, and aluminium and iron chlorides salts. Special care shall be taken regarding mixing with other products used previously, in order to avoid gel formation or precipitation. Seek manufacturer's advice.

This product reacts aggressively with some metal surfaces (e.g. galvanised metal, aluminium, copper, zinc, and alloys of these metals), The reaction releases flammable hydrogen gas, which can be explosive in confined spaces.

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 Dangerous Goods Code
9) International Air Transport Association

Annex A
(informative)

General information on aluminium iron (III) sulfate

A.1 Origin

A.1.1 Raw materials

The typical raw materials are:

a) sulfuric acid ;

b) materials containing aluminium or aluminium oxide such as:

— bauxite or clays of suitable composition;

— aluminium foundry residues, purified if necessary;

c) iron compounds such as:

— iron metal, purified if necessary;

— iron oxides / hydroxides ;

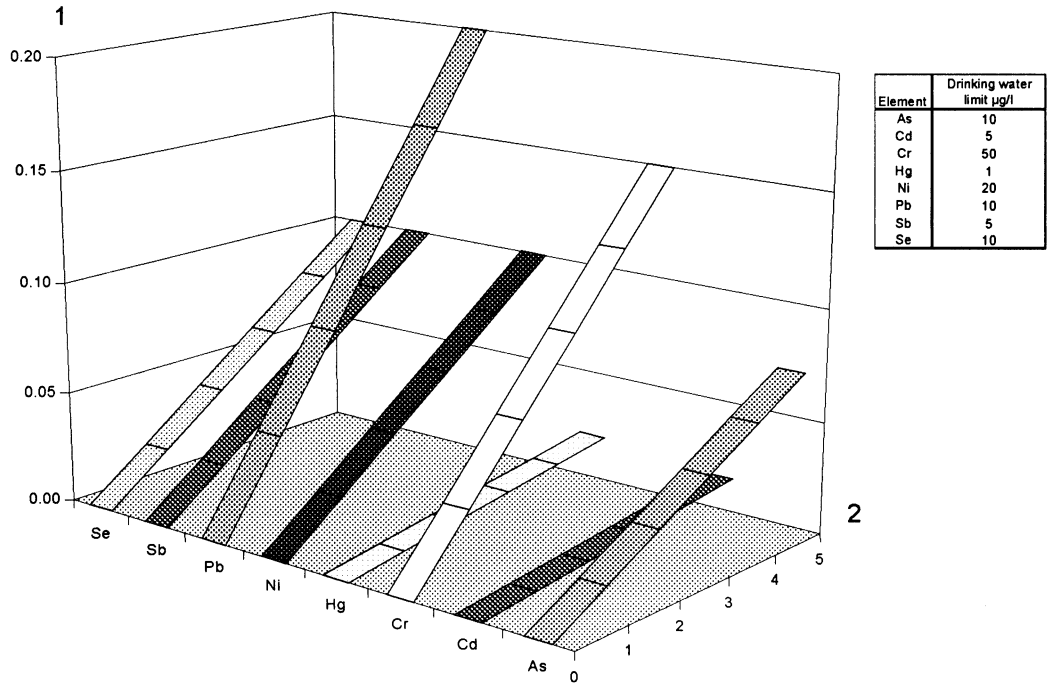
— pickle liquors, purified if necessary.

A.1.2 Manufacturing process

Aluminium iron (III) sulfate is a synthetically manufactured product. A typical manufacturing process is the reaction of aluminium or aluminium compounds and iron compounds with sulfuric acid.

A.2 Quality of commercial product

The three types of aluminium iron (III) sulfate specified in Table 2 reflect the quality of commercially available products. Figures 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 EU Directive 98/83/EC (see [1]) at typical product doses. Furthermore, the figures overstate the concentrations 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.

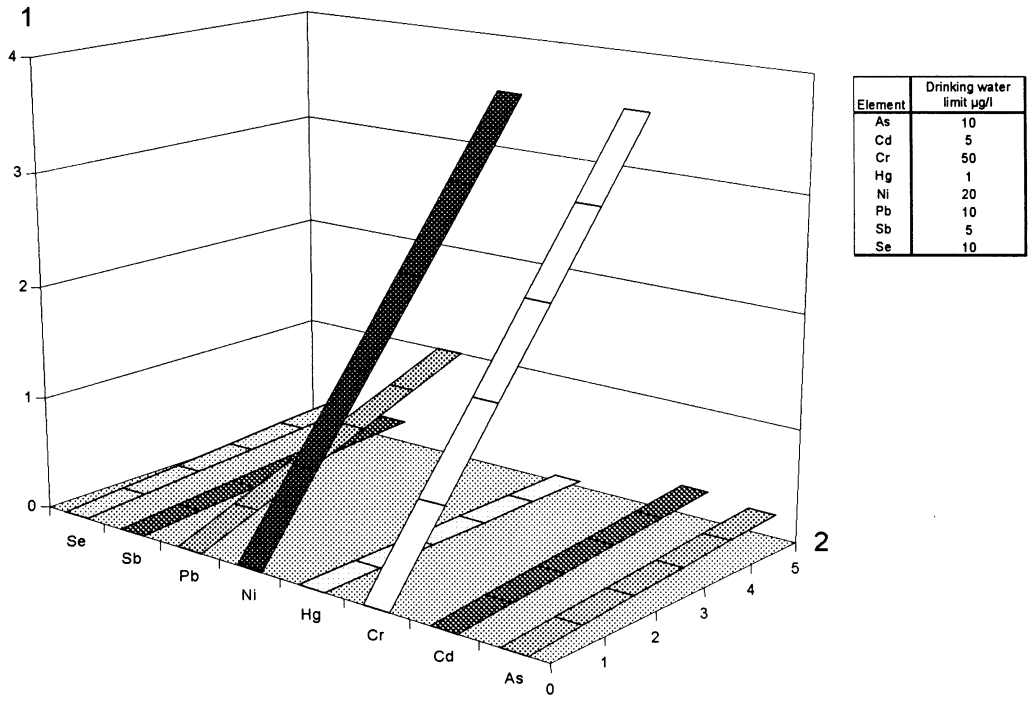


Key

1 maximum addition to water µg/l metal

2 product dosage mg/l Al - Typical dose

Figure A.1 — Maximum impact of aluminium iron (III) sulfate, type 1, on trace metal content of water

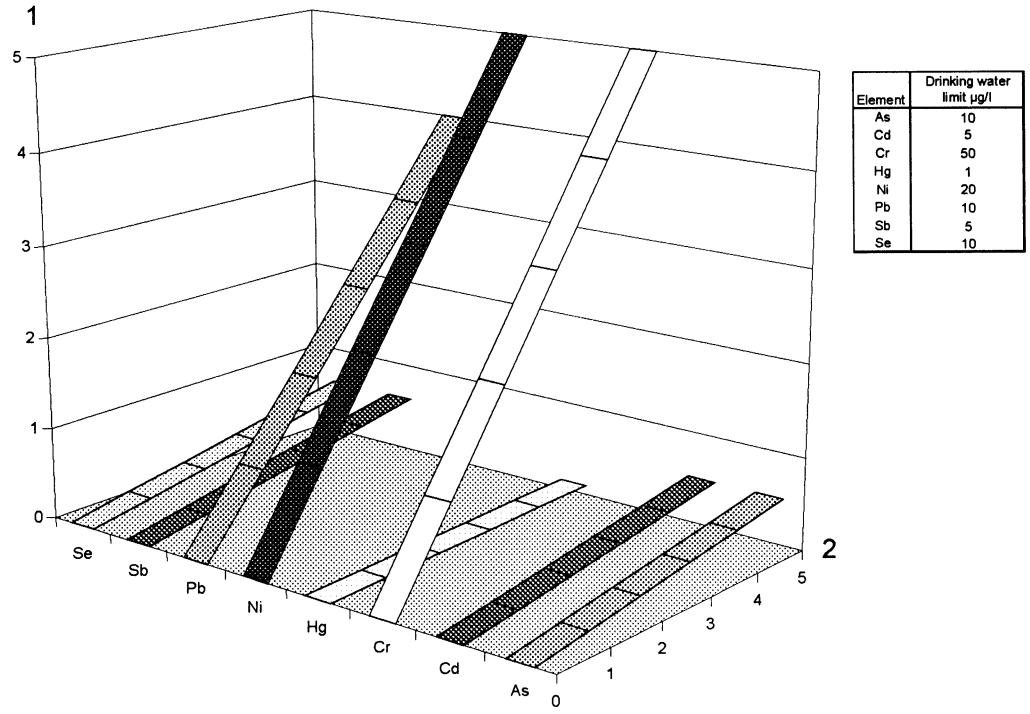


Key

1 maximum addition to water µg/l metal

2 product dosage mg/l Al - Typical dose

Figure A.2 — Maximum impact of aluminium iron (III) sulfate, type 2, on trace metal content of water



Key

1 maximum addition to water µg/l metal

2 product dosage mg/l Al - Typical dose

Figure A.3 — Maximum impact of aluminium iron (III) sulfate, type 3, on trace metal content of water

A.3 Use

A.3.1 Function

Aluminium iron (III) sulfate is used as a coagulant.

A.3.2 Form in which it is used

For a liquid product, the concentration of the solution used, expressed as Al + Fe, is generally about 10 g/l to 40 g/l.

NOTE 1 Very dilute solutions hydrolyse and form a precipitate.

NOTE 2 The form and content of insoluble matter can affect the ability to pump the product and its storage characteristics.

A.3.3 Treatment dose

The treatment dose is generally in the range of 1 mg/l to 15 mg/l expressed as Al + Fe depending on raw water quality.

A.3.4 Means of application

Solutions are usually applied using a positive displacement metering pump. Sufficient turbulence should be provided at the point of addition to promote rapid dispersion.

A.3.5 Secondary effects

— reduction of pH value;

— reduction of alkalinity;

— increase in sulfate concentration.

A.3.6 Removal of excess product

The coagulation process should be operated under conditions (e.g. pH) in which the aluminium and iron ions in the system are precipitated and reduced below the maximum allowable concentration.

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 thoroughly with cold water and seek medical advice if irritation persists.

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

In case of inhalation, remove to fresh air, loosen clothing and seek medical advice.

In case of ingestion, seek medical advice immediately.

NOTE In general, it is advised to treat the product as a weak acid.

B.2.2 Spillage

Refer to 6.5.3 for incompatibilities.

Put on protective clothing. Collect and dispose of spillages carefully.

Dilute small liquid spillages with water and flush to sewer.

Neutralize and dispose of large spillages of liquid.

NOTE 1 Local regulations might apply to the disposal of this product.

NOTE 2 Suitable neutralizing chemicals are dilute sodium hydroxide or sodium carbonate.

B.2.3 Fire

The product is non-flammable. Any extinguishing media can be used. The product can liberate toxic and corrosive fumes of sulfur dioxide and sulfur trioxide under extreme conditions when boiled to dryness or heated above 600 °C.

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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