BRITISH STANDARD

BS EN
883:2004

Chemicals used for treatment of water intended for human consumption — Polyaluminium chloride hydroxide and polyaluminium chloride hydroxide sulfate

The European Standard EN 883:2004 has the status of a British Standard

ICS 71.100.80

BSI
British Standards

National foreword

This British Standard is the official English language version of EN 883:2004. It supersedes BS EN 883:1997 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee CII/59, Chemicals for drinking water treatment, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

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EN 883

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English version

Chemicals used for treatment of water intended for human consumption - Polyaluminium chloride hydroxide and polyaluminium chloride hydroxide sulfate

Produits chimiques utilisés pour le traitement de l'eau destinée à la consommation humaine - Polyhydroxychlorure d'aluminium et Polyhydroxychlorosulfate d'aluminium

Produkte zur Aufbereitung von Wasser für den menschlichen Gebrauch - Polyaluminiumchloridhydroxid und Polyaluminiumchloridhydroxidsulfat

This European Standard was approved by CEN on 30 September 2004.

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Management Centre: rue de Stassart, 36 B-1050 Brussels

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Contents

Foreword

This document (EN 883:2004) 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of an identical text or by endorsement, at the latest by May 2005, and conflicting national standards shall be withdrawn at the latest by May 2005.

This document supersedes EN 883:1997.

Significant technical differences between this edition and EN 883:1997 are as follows:

a) replacement of the reference to EU Directive 80/778 of 15 July 1980 with the latest Directive in force (see[1]);

b) introduction of an annex B (normative) giving general rules relating to safety;

c) expansion of annex A by addition of A.2" Quality of commercial product"

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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 id subject to regulation or control by National Authorities.

1 Scope

This document is applicable to polyaluminium chloride hydroxide and polyaluminium chloride hydroxide sulfate used for treatment of water intended for human consumption. It describes the characteristics and specifies the requirements of polyaluminium chloride hydroxide and polyaluminium chloride hydroxide sulfate and refers to the corresponding analytical methods. It gives information for their use in water treatment. It also determines the rules relating to safe handling and use of these aluminium salts (see Annex B).

2 Normative references

The following referenced documents are indispensable for the application 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 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*.

3 Description

3.1 Identification

3.1.1 Chemical names

a) Polyaluminium chloride hydroxide;

b) Polyaluminium chloride hydroxide sulfate.

3.1.2 Synonym or common names

a) Polyaluminium chloride, PAC, PACl ; basic aluminium chloride, BAC.

NOTE In French, the term "Polychlorure d'aluminium" is deprecated.

b) Polyaluminium chloride, PAC ; polyaluminium chloride sulfate, PACS.

3.1.3 Relative molecular mass

Variable (see 3.1.4).

3.1.4 Empirical formula

a) $Al(OH)_aCl_b$ with $(a + b) = 3$ and a greater than 1,05;

b) $Al(OH)_aCl_b(SO_4)_c$ with $(a + b + 2c) = 3$ and a greater than 1,05.

3.1.5 Chemical formula

Variable (see 3.1.4).

3.1.6 CAS Registry Number [1)]

(a_1) *a* and *b* variable : 1327-41-9 with *a* greater than 1,05;

(a_2) *a* = 2,5 ; *b* = 0,5 : 12042-91-0;

(a_3) *a* = 2 ; *b* = 1 : 10284-64-7;

(b) *a*, *b* and *c* variable : 39290-78-3 with *a* greater than 1,05.

3.1.7 EINECS reference[2)]

(a_1) 215-477-2;

(a_2) 234-933-1;

(a_3) 233-632-2;

(b) 254-400-7.

3.2 Commercial forms

These products are generally available as liquids.

3.3 Physical properties

3.3.1 Appearance

The product is colourless to yellow.

3.3.2 Density

The density depends on the particular composition, especially the aluminium ion content, expressed as mass fraction of aluminium (Al %).

Typical values:

a) Polyaluminium chloride hydroxide : 1,35 g/ml to 1,40 g/ml for 9,5 % Al ;

b) Polyaluminium chloride hydroxide sulfate:

1,18 g/ml to 1,22 g/ml for 5,3 %Al ;

1,16 g/ml for 4,2 % Al .

1) Chemical Abstracts Service Registry Number.

2) European Inventory of Existing Commercial Chemical Substances.

3.3.3 Solubility

All polyaluminium chloride hydroxides and polyaluminium chloride hydroxide sulfates are fully miscible with water.

NOTE Depending on the particular product, dilute solutions can hydrolyze and form a precipitate.

3.3.4 Vapour pressure

Not known.

3.3.5 Boiling point at 100 kPa [3)]

Not known.

3.3.6 Crystallization point

Typical values for solutions:

a) Polyaluminium chloride hydroxide:

- 20 °C for 9,5 % Al ;

0 °C for 12,4 % Al ;

b) Polyaluminium chloride hydroxide sulfate:

- 10 °C to - 15 °C for 5,3 % Al ;

- 5 °C for 4,2 % Al.

3.3.7 Specific heat

Not known.

3.3.8 Viscosity (dynamic)

Typical values for solutions at 20 °C:

a) Polyaluminium chloride hydroxide : 10 mPa.s to 50 mPa.s for 9,5 % Al ;

b) Polyaluminium chloride hydroxide sulfate : 3 mPa.s to 10 mPa.s for 5,3 % Al .

3.3.9 Critical temperature

Not applicable.

3.3.10 Critical pressure

Not applicable.

3.3.11 Physical hardness

Not applicable.

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3) 100 kPa = 1 bar.

3.4 Chemical properties

Polyaluminium chloride hydroxide and polyaluminium chloride hydroxide sulfate are acidic liquids which hydrolyze and form a precipitate of aluminium hydroxide when diluted beyond a particular level.

NOTE 1 Since aluminium compounds are amphoteric in nature, the solubility of aluminium depends on the pH value and the products should be used within an appropriate pH range.

NOTE 2 A characteristic of these products is their high tendency to hydrolyze which restricts their use; this tendency results from the particular oligomeric or polymeric composition.

These products vary in their relative basicity (mole ratio OH/3Al), the percentage of chloride and sulfate ions present and in their method of manufacture.

NOTE 3 These variations may affect their performance in the water treatment plant. Special water plant requirements regarding, but not limited to, such items as: organic matter removal, residual aluminium levels and working pH values should be specified when possible, so that the product which best fits the need can be offered.

4 Purity criteria

4.1 General

This document specifies the minimum purity requirements for polyaluminium chloride hydroxide and polyaluminium chloride hydroxide 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.

NOTE Users of these products 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 ion content) 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 in commercial products varies. Typical values of aluminium content in the products can be between 42 g/kg and 124 g/kg.

The commercial products vary in the proportions of chloride and sulfate ions.

The relative basicity of the polyaluminium chloride hydroxide and polyaluminium chloride hydroxide sulfate, expressed as the mole ratio OH/3Al, shall be greater than 0,35.

4.3 Impurities and main by-products

Impurities derived from the manufacturing or extraction processes include insoluble matter, trace metals and organic compounds.

4.4 Chemical parameters

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

Table 1 — Chemical parameters

Parameter		Limit (mg/kg of Al)		
		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 these products on trace metal content in drinking water see A.2.				

5 Test methods

5.1 Sampling

5.1.1 General

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

5.1.2 Liquid

5.1.2.1 Sampling from drums and bottles

5.1.2.1.1 General

5.1.2.1.1.1 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.

5.1.2.1.1.2 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 5.1.1.2.1.3.

5.1.2.1.1.3 Examine the surface of the liquid. If there are signs of surface contamination, take samples from the surface as described in 5.1.2.1.2; otherwise, take samples as described in 5.1.2.1.3.

5.1.2.1.2 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.

5.1.2.1.3 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.

5.1.2.2 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 5.1.2.1.2 ;

b) from the bottom of the tank or tanker, using a sampling tube as described in 5.1.2.1.3 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 analysis described in EN 1302

6 Labelling - Transportation - Storage

6.1 Means of delivery

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 Risk and safety labelling in accordance with EU rules[4)]

The three following labelling requirements shall apply to polyaluminium chloride hydroxide and polyaluminium chloride hydroxide sulfate at the date of the publication of this document and depending on the relative basicity, composition and concentration :

a)

- symbols and indications of danger:
  - X_i: Irritant;
- nature of special risks attributed to dangerous substances:
  - R 36: Irritating to eyes;
- safety advice concerning dangerous substances:
  - S 26: In case of contact with eyes, rinse immediately with plenty of water and seek medical advice;

b)

- symbols and indications of danger:
  - X_i: Irritant;
- nature of special risks attributed to dangerous substances:
  - R 36/38: Irritating to eyes and skin;
- safety advice concerning dangerous substances:
  - S 26: In case of contact with eyes, rinse immediately with plenty of water and seek medical advice;
  - S 28: After contact with skin, wash immediately with plenty of water;

c):

- symbols and indications of danger:
  - C: Corrosive;
- nature of special risks attributed to dangerous substances:
  - R 34 : Causes burns ;
- safety advice concerning dangerous substances:
  - S 26: In case of contact with eyes, rinse immediately with plenty of water and seek medical advice ;
  - S 27: Take off immediately all contaminated clothing;
  - S 37/39: Wear suitable gloves and eye/face protection.

NOTE Annex I of the Directive 67/548/EEC on Classification, packaging and labelling of dangerous substances and its amendments and adaptations in the European Union contains a list of substances classified by the EU. Substances not in this annex I should be classified on the basis of their intrinsic properties according to the criteria in the Directive by the person responsible for the marketing of the substance.

4) See [2].

6.3 Transportation regulations and labelling

Depending on the composition, the commercial product can be subject to transportation regulations and, if so, these products are listed as UN[5] number 1760 (corrosive liquid not otherwise specified):

— RID[6]: class 8, classification code C9; packing group I;

— ADR[7]: class 8, classification code C9;packing group I;

— IMDG[8]: class 8;

— IATA[9] : class 8.

6.4 Marking

The marking shall include the following:

— the name;

  a) "Polyaluminium chloride hydroxide" or;

  b) "Polyaluminium chloride hydroxide sulfate";

— the 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 883".

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.

6.5 Storage

6.5.1 General

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

NOTE 1 The manufacturer can provide advice on suitable materials..

NOTE 2 Storage tanks located outside can require protection against extreme temperature, depending on freezing point and maximum storage temperature: refer to manufacturer's information on permissible temperatures.

6.5.2 Long term stability

Polyaluminium chloride hydroxide and polyaluminium chloride hydroxide sulfate are usually stable.

6.5.3 Storage incompatibilities

Avoid contact with chlorites, hypochlorites and sulfites.

The products react aggressively with some metals surface (e.g. galvanized metal, aluminium, copper, zinc and alloys of these metals).

These products are incompatible with iron salts and aluminium sulfate and also incompatible with other polyaluminium salts. Special care has to be taken regarding any mixing with products previously used in order to avoid gel formation or precipitation. Seek manufacturer's advice.

Annex A
(informative)

General information on polyaluminium chloride and polyaluminium chloride hydroxide sulfate

A.1 Origin

A.1.1 Raw materials

Depending on product and manufacturer the polyaluminium chloride hydroxide and the polyaluminium chloride hydroxide sulfate are manufactured from:

— aluminium hydroxide ;

— aluminium chloride ;

— aluminium sulfate ;

— aluminium metal ;

— bauxite ;

— hydrochloric acid ;

— sulfuric acid ;

— calcium carbonate ;

— sodium hydroxide ;

— sodium carbonate.

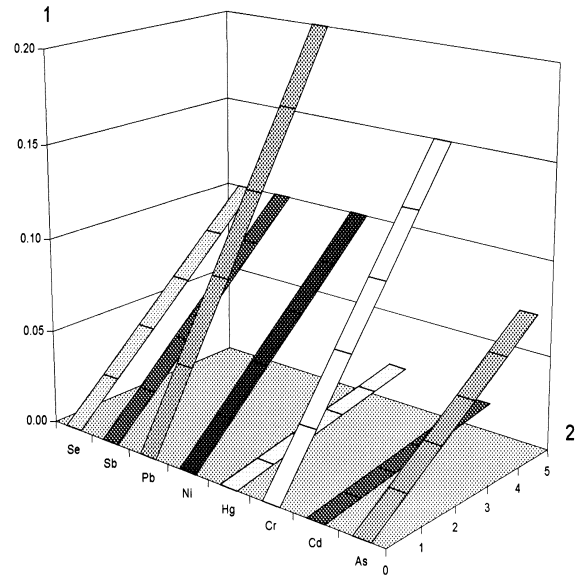
A.1.2 Manufacturing process

Polyaluminium chloride hydroxide and polyaluminium chloride hydroxide sulfate are the results of a complex manufacturing process from producers and should not be, in any case, the result of a mixture of available commercial products (see 3.1.4).

A typical manufacturing process is the digestion of e.g. aluminium hydroxide in suitable acid(s) with or without addition of aluminium chloride in either a substoicheiometric amount of acidic material, or followed by a separate basification step.

A.2 Quality of commercial product

The three types of polyaluminium chloride hydroxide and of polyaluminium chloride hydroxide sulfate specified in Table 1 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 1. 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.

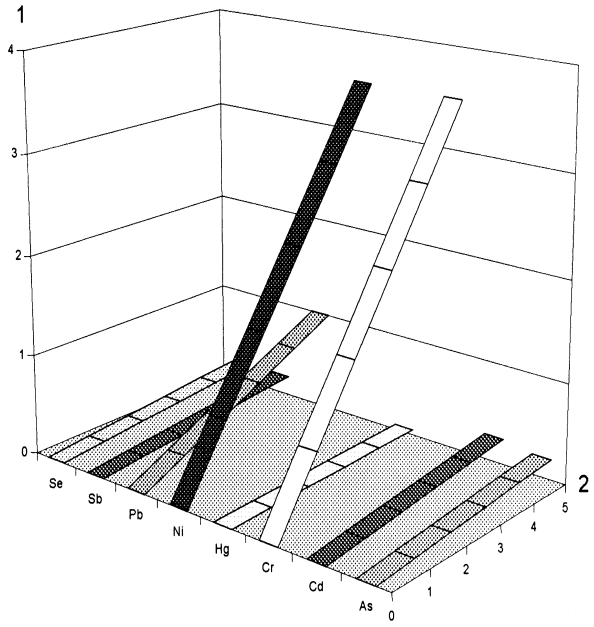


A	B
As	10
Cd	5
Cr	50
Hg	1
Ni	20
Pb	10
Sb	5
Se	10

Key

1 Maximum addition to water µg/l metal
2 Product dosage mg/l Al - Typical dose
A Element
B Drinking water limit µg/l

Figure A. 1 — Maximum impact of polyaluminium chloride hydroxide and polyaluminium chloride hydroxide sulfate, type 1, on trace metal content of water

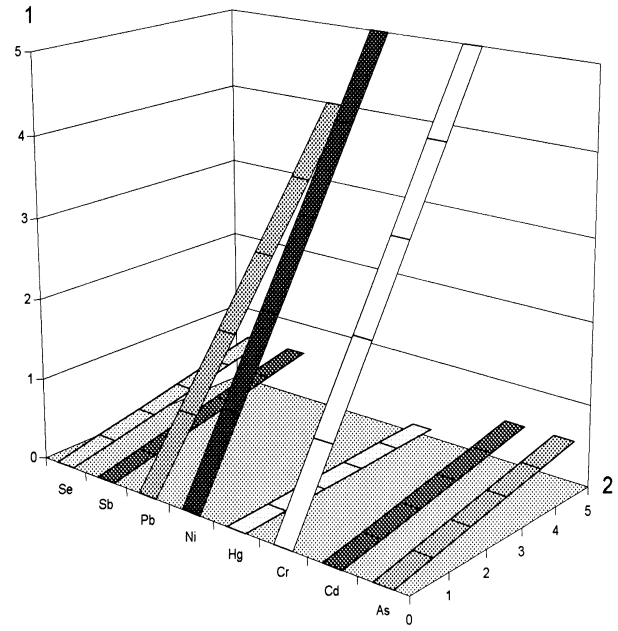


A	B
As	10
Cd	5
Cr	50
Hg	1
Ni	20
Pb	10
Sb	5
Se	10

Key

1 Maximum addition to water µg/l metal
2 Product dosage mg/l Al - Typical dose
A Element
B Drinking water limit µg/l

Figure A.2 — Maximum impact of polyaluminium chloride hydroxide and polyaluminium chloride hydroxide sulfate, type 2, on trace metal content of water



A	B
As	10
Cd	5
Cr	50
Hg	1
Ni	20
Pb	10
Sb	5
Se	10

Key

1 Maximum addition to water µg/l metal

2 Product dosage mg/l Al - Typical dose

A Element

B Drinking water limit µg/l

Figure A.3 — Maximum impact of polyaluminium chloride hydroxide and polyaluminium chloride hydroxide sulfate, type 3, on trace metal content of water

A.3 Use

A.3.1 Function

The products are used as coagulant and sometimes simultaneously as precipitants

A.3.2 Form in which the products are used

The products are used either as delivered or prediluted according to the manufacturer's recommendations.

A.3.3 Treatment dose

The treatment dose is generally in the range of 1 mg/l to 5 mg/l, expressed as Al, depending on raw water quality.

A.3.4 Means of application

The products are usually applied using a positive-displacement metering pump. Sufficient turbulence should be provided at the point of addition to promote rapid dispersion Injection of dosed products by means of carrier water can be advantageous.

A.3.5 Secondary effects

— reduction of pH value and alkalinity;

— increase of respective anion concentration.

A.3.6 Removal of excess product

The water purification process should be operated under conditions (e.g. pH) in which the aluminium 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 Accident

In case of contact with skin, take off immediately all contaminated clothing; wash immediately with plenty of water.

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

In case of ingestion, do not induce vomiting. Seek medical advice immediately.

B.2.2 Spillage

Refer to 6.5.3 for incompatibilities.

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

Dilute small liquid spillages with plenty of water and flush to sewer.

Neutralize and dispose of large spillages of liquids.

NOTE 1 Local regulations might apply to the disposal of these products.

NOTE 2 Suitable neutralizing chemicals are sodium carbonate, lime or calcium carbonate.

B.2.3 Fire

The products are non-flammable liquids. Any extinguishing media can be used. The products can liberate hydrogen chloride (or sulfur oxides) when boiled to dryness or heated above 200 °C.

Bibliography

[1] 98/83/EC: Council Directive of 3 November 1998 on the quality of water intended for human consumption.

[2] 67/548/EEC: Council Directive of 27th June 1967 on the approximation of the laws, regulations and administrative provisions relating to the classification, packaging and labelling of dangerous substances and its amendments and adaptations.

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