SLOVENSKI STANDARD
SIST EN 1278:2000

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Kemikalije, ki se uporabljajo za pripravo pitne vode - Ozon

Chemicals used for treatment of water intended for human consumption - Ozone

Produkte zur Aufbereitung von Wasser für den menschlichen Gebrauch - Ozon

Produits chimiques utilisés pour le traitement de l'eau destinée a la consommation humaine - Ozone

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13.060.20	Pitna voda	Drinking water
71.100.80	Kemikalije za čiščenje vode	Chemicals for purification of water

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EUROPEAN STANDARD
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EN 1278

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ICS 71.100.80

Descriptors: potable water, water treatment, chemical products, ozone, description, physical properties, chemical properties, impurities, toxic substances, tests, labelling, storage

English version

Chemicals used for treatment of water intended for human consumption - Ozone

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

Produkte zur Aufbereitung von Wasser für den menschlichen Gebrauch - Ozon

This European Standard was approved by CEN on 5 September 1998.

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This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Contents

Foreword

This European Standard 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of an identical text or by endorsement, at the latest by March 1999, and conflicting national standards shall be withdrawn at the latest by March 1999.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland 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 Standard :

1) this 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 ;

2) it should be noted that, while awaiting the adoption of veritable European criteria, existing national regulations concerning the use and/or the characteristics of this product remain in force.

1 Scope

This European Standard is applicable to ozone used for treatment of water intended for human consumption. It describes the characteristics of ozone and specifies the requirements and the corresponding test methods for ozone. It gives information on its use in water treatment.

2 Normative reference

This European standard incorporates by dated and undated reference, provisions from other publications. These normative references are cited at the appropriate place in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN ISO 3696 Water for analytical laboratory use - Specification and test method (ISO 3696:1987)

3 Description

3.1 Identification

3.1.1 Chemical name

Ozone.

3.1.2 Synonym or common name

None (has sometimes been called improperly "allotropic oxygen").

3.1.3 Relative molecular mass

48.

3.1.4 Empirical formula

O_3.

3.1.5 Chemical formula

O_3.

3.1.6 CAS Registry Number [1)]

10028-15-6.

3.1.7 EINECS reference [2)]

Not applicable.

3.2 Commercial form

Ozone is generated on or near the site of use.

3.3 Physical properties

3.3.1 Appearance

Bluish gas,the liquid is dark blue.

NOTE : A weak absorption in the visual range between 435 nm and 475 nm.

3.3.2 Density

Gas : 2,144 kg/m^3 at NTP (Normal Temperature Pressure, 273 K and 101,3 kPa) ;

Liquid : 1,574 g/ml at - 183 °C ;

Solid : 1,728 g/cm^3.

3.3.3 Solubility in water

In pure water, the solubility values (S) expressed in grams per cubic meter water per (grams per cubic meter) gas at 101,3 kPa are given in table 1.

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1) Chemical Abstracts Service Registry Number
2) European Inventory of Existing Commercial Chemical Substances

Table 1 : Solubility in water

Temperature of water °C	Solubility S, in $\frac{g/m^3\ H_2O}{g/m^3\ gas}$
0	0,64
5	0,5
10	0,39
15	0,31
20	0,24
25	0,19
30	0,15
35	0,12

NOTE 1 : Recent surveys of literature data are given in Bibliography. See C.2, C.3 and C.4.

NOTE 2 : S is a ratio, not an absolute concentration.

3.3.4 Vapour pressure

The vapour pressure of ozone depending on temperature is given in table 2.

Table 2 : Vapour pressure

Temperature °C	Vapour pressure kPa
- 183	0,0147
- 180	0,028
- 170	0,188
- 160	0,897
- 150	3,306
- 140	9,892
- 130	25,331
- 120	56,928
- 110	115,322
- 100	2 139,079

3.3.5 Boiling point at 100 kPa [3)]

- 112 °C.

NOTE : Vaporization heat : 681 kJ/m^3 at NTP.

[3)] 100 kPa = 1 bar

3.3.6 Melting point

- 196 °C.

3.3.7 Specific heat (liquid)

Not applicable.

3.3.8 Viscosity (dynamic)

0,004 2 Pa.s at - 195 °C ;

0,0015 5 Pa.s at - 183 °C.

3.3.9 Critical temperature

- 12,1 °C.

3.3.10 Critical pressure

5 460 kPa.

3.3.11 Physical hardness

Not applicable.

3.4 Chemical properties

Ozone is a powerful oxidant. The standard redox potentials (25 °C) are :

(E^H_o -values in volts) :

$O_3 + 2H^+ + 2e^- \rightarrow O_2 + H_2O$ $\quad E^H_o = 2{,}07$ V (1)

$O_3 + H_2O + 2e^- \rightarrow O_2 + 2OH^-$ $\quad E^H_o = 1{,}24$ V (2)

$OH^\circ + H^+ + e^- \rightarrow H_2O$ $\quad E^H_o = 2{,}42$ V(calculated value) (3)

If the pH increases by one unit, the E^H -values shall decrease by 30 mV per electron transferred. At 100 kPa and 25 °C and pH = 7 the E^H -values, versus the normal hydrogen electrode, become:

O_3 (1) = 1,66 V ;

O_3 (2) = 0,82 V ;

$OH°$ (3) = 2,21V.

In water treatment most of the direct reactions of ozone are dipolar cyclo-additions and electrophilic substitution reactions. Moreover ozone, in water, can generate radicals such as $OH°$: ($O_3 + H_2O \rightarrow 2\ OH° + O_2$). The $OH°$ radical is a strong general oxidant.

4 Purity criteria

4.1 Composition of commercial product

Ozone is obtainable in air, oxygen or air enriched in oxygen.

Typical concentrations obtainable in air are in the range of 15 g/m^3 to 45 g/m^3 (NTP) and, in oxygen 40 g/m^3 to 200 g/m^3(NTP).

The concentration (in grams per cubic meter NTP) at the nominal operating condition of the generators shall be specified in the tendering documents.

4.2 Impurities and main by-products

See A.3.2.

4.3 Toxic substances

NOTE : For the purpose of this standard "toxic substances" are those defined in the EU Directive 80/778/EEC of 15 July, 1980 (see C.1).

None of the toxic substances according to the directive 80/778 EEC are found in the gaseous ozone phase. Pesticides and polycyclic aromatic hydrocarbons are not by-products of the ozone manufacturing processes.

5 Test methods

5.1 Sampling

Ozone generation is usually based on a continuous process gas flow mode positive pressure. Sampling of a volume is to be controlled with a totalizing volumetric flow meter, the volumes being expressed at Normal Temperature and Pressure (NTP).

In continuous monitoring methods the gas exit shall be open to ambient air or the gas pressure shall be controlled and the results corrected for effects of pressure.

Sampling lines shall be in stainless steel (see table A.1) or in polyfluorocarbone material resistant to ozone. The transfer of the gas from the sampling point to the analyzer shall be kept shorter than 1 min.

Expression of concentrations : concentration of ozone in a gas in g/m^3 (NTP), or kg/m^3 (NTP), and for traces in cm^3/m^3 (equivalent to ppm volume per volume (*V/V*)) (1 g/m^3 (NTP) equals 466,4 ppm (*V/V*) and 0,069 9 % *(m/m)* in oxygen or 0,077 3 % *(m/m)* in air).

NOTE : At conventional concentrations of about 20 g/m^3 (NTP), the effect of difference in gas densities between ozone and oxygen-nitrogen is negligible. This is not the case when higher ozone concentrations are generated i.e. in oxygen.

5.2 Analyses

5.2.1 General

The present method concerns the determination of ozone in air, oxygen or other process gases. The method is directly applicable for ozone concentrations in the range of 1 g/m^3 to 200 g/m^3 (NTP).

5.2.2 Principle

Direct iodometric titration.

5.2.3 Reagents

All reagents shall be of a recognized analytical grade and the water used shall conform to grade 2 in accordance with EN ISO 3696.

5.2.3.1 Potassium iodide (KI) buffered solution.

Potassium iodide (KI) solution at 20 g/l with sodium hydrogen phosphate ($Na_2HPO_4.2\ H_2O$) solution at 7,3 g/l and potassium dihydrogen phosphate (KH_2PO_4) solution at 3,5 g/l.

5.2.3.2 Sodium thiosulfate : standard volumetric, solution $c(Na_2S_2O_3)$ = 0,1 mol/l.

5.2.3.3 Sulfuric acid, solution at 9 mol/l.

5.2.3.4 Potassium iodate (KIO_3) powdered.

5.2.3.5 Potassium iodide (KI) crystalline

5.2.3.6 Hydrochloric acid standard volumetric solution c(HCl) = 0,1 mol/l or sulfuric acid $c(H_2SO_4)$ = 0,05 mol/l.

5.2.3.7 Zinc iodide (ZnI_2)-starch indicator. Disperse 4 g starch into a small quantity of water. Add the dispersion to a solution of 20 g zinc chloride ($ZnCl_2$) in 100 ml water. The solution is boiled until the volume has been reduced to 100 ml and finally diluted to 1 l while adding 2 g of ZnI_2.