SLOVENSKI STANDARD
SIST EN 1278:2011

01-november-2011

Nadomešča:
SIST EN 1278:2000

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 à la consommation humaine - Ozone

Ta slovenski standard je istoveten z: EN 1278:2010

ICS:

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

SIST EN 1278:2011 **en,fr,de**

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 1278

April 2010

ICS 71.100.80

Supersedes EN 1278:1998

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

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COMITÉ EUROPÉEN DE NORMALISATION
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Ref. No. EN 1278:2010: E

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Foreword

This document (EN 1278:2010) 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of an identical text or by endorsement, at the latest by October 2010, and conflicting national standards shall be withdrawn at the latest by October 2010.

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 1278:1998.

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Differences between this edition and EN 1278:1998 are editorial to harmonize the text with other standards in this series.

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 verifiable European criteria, existing national regulations concerning the use and/or the characteristics of this product remain in force.

NOTE Conformity with the 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.

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 a test method for determining the ozone concentration in other gases.

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 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.

1) Chemical Abstracts Service Registry Number

2) European Inventory of Existing Commercial Chemical Substances

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/cm^3 at - 183 °C;

Solid : 1,728 g/cm^3.

3.3.3 The gas-liquid partition coefficient

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

Table 1 — The gas-liquid partition coefficient between water and gas phase

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 [2], [3]and [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.

3.3.6 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) 100 kPa = 1 bar

3.4 Chemical properties

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

(E_o^H -values in volts):

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

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

$OH° + H^+ + e^- \rightarrow H_2O \quad E_o^H = 2{,}42\ V$(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 General

This European Standard specifies the minimum purity requirements for Ozone 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 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 chemicals 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

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 metre NTP) at the nominal operating condition of the generators shall be specified in the tendering documents.

4.3 Impurities and main by-products

See A.3.2.

4.4 Chemical parameters

NOTE For the purpose of this standard "chemical parameters" are those defined in the 98/83/EC: Council Directive of 3 November 1998 on the quality of water intended for human consumption. (see [1]).

None of the chemical parameters according to the directive 98/83/EC 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 metre, 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 as volume fraction).

NOTE 1 1 g/m^3 (NTP) equals $466,4 \times 10^{-6}$ (volume fraction) and 0,069 9 % (mass fraction) in oxygen or 0,077 3 % (mass fraction) in air.

NOTE 2 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 phoshate ($Na_2HPO_4.2\ H_2O$) 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.