BS EN 12876:2015

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Chemicals used for treatment of water intended for human consumption — Oxygen

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National foreword

This British Standard is the UK implementation of EN 12876:2015. It supersedes BS EN 12876:2009 which is withdrawn.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.

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EN 12876

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English Version

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

Produits chimiques utilisés pour le traitement d'eau destinée à la consommation humaine - Oxygène

Produkte zur Aufbereitung von Wasser für den menschlichen Gebrauch - Sauerstoff

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EUROPÄISCHES KOMITEE FÜR NORMUNG

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Contents

Page

Foreword

This document (EN 12876:2015) 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of an identical text or by endorsement, at the latest by September 2015, and conflicting national standards shall be withdrawn at the latest by September 2015.

This document supersedes EN 12876:2009.

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.

Significant technical difference between this edition and EN 12876:2009 is as follows:

a) deletion of reference to EU Directive 67/548/EEC of June 27, 1967 in order to take into account the latest Regulation in force (see [3]);

b) 6.2 – updating of risk and safety labelling according to EU Regulation [3] and its latest Adaptations to Technical Progress).

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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 European Standard:

a) this European 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;

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 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 oxygen used for treatment of water intended for human consumption. It describes the characteristics of oxygen and specifies the requirements and the corresponding test methods for oxygen. It gives information on its use in water treatment.

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 1089-3, *Transportable gas cylinders - Gas cylinder identification (excluding LPG) - Part 3: Colour coding*

3 Description

3.1 Identification

3.1.1 Chemical name

Oxygen.

3.1.2 Synonym or common name

None.

3.1.3 Relative molecular mass

32,00

3.1.4 Empirical formula

O_2

3.1.5 Chemical formula

O = O

3.1.6 CAS Registry Number[1)]

7782-44-7

3.1.7 EINECS reference[2)]

231-956-9

3.2 Commercial forms

Gas or cryogenic liquid.

1) Chemical Abstract Service Registry Number.

2) European Inventory of Existing Commercial Chemical Substances.

3.3 Physical properties

3.3.1 Appearance, odour and taste

The product is a colourless, odourless, tasteless gas or a bluish liquid.

3.3.2 Density

— Liquid: 1,141 g/ml at −183 °C.

— Gas: 1,337 g/dm^3 at 15 °C and 101,3 kPa [3)].

3.3.3 Solubility of pure oxygen (in water)

The solubility of oxygen at a pressure of 101,3 kPa [3)] in pure water, depending on the temperature, is:

a) 61 mg/l at 5 °C;

b) 45 mg/l at 15 °C;

c) 36 mg/l at 25 °C.

3.3.4 Vapour pressure

Oxygen is a gas at 273,15 K and 101,3 kPa.

3.3.5 Boiling point at 100 kPa [3)]

- 182,97 °C.

3.3.6 Melting point

Not applicable.

3.3.7 Specific heat

At a constant pressure 100 kPa:

- 919 J/(kgxK) at 15 °C;

- 920 J/(kgxK) at 25 °C.

3.3.8 Viscosity (dynamic)

2,0720 × 10^{-2} mPaxs at 100 kPa and 27 °C.

3.3.9 Critical temperature

118,6 °C.

3.3.10 Critical pressure

5 043 kPa

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3) 100 kPa = 1 bar.

3.3.11 Physical hardness

Not applicable.

3.4 Chemical properties

Oxygen is an oxidizing agent and a supporter of combustion. Dangerous reactions are possible with organic compounds and other combustible substances.

NOTE Oxygen-rich atmospheres (a volume fraction higher than 25 % of oxygen) increase the rate of combustion which can lead to explosive reactions.

4 Purity criteria

4.1 General

This European Standard specifies the minimum purity requirements for oxygen 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 product not stated in the 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(s) to significant quantities of impurities, by-products or additives being present, this shall be notified to the user.

4.2 Composition of commercial product

Two grades of oxygen exist varying from the manufacturing process:

Grade A for cryogenically derived oxygen, the minimum concentration of oxygen shall be a volume fraction of 99,5 %.

Grade B for oxygen manufactured with non cryogenic methods, the minimum concentration of oxygen shall be a volume fraction of 90 %.

4.3 Impurities and main by-products

The hydrocarbons content (as Methane Index) shall not exceed a volume fraction of 50 ppm.

NOTE Depending on the production route, the product can contain quantities of water, nitrogen, argon, carbon dioxide and other rare gases which do not affect its use in water treatment.

4.4 Chemical parameters

NOTE For the purpose of this standard, “chemical parameters” are those defined in the EU Directive 98/83/EC of 03 November 1998 (see [2]).

Commercial oxygen does not contain significant levels of chemical parameters.

5 Test methods

5.1 Sampling

All or part of the gas flow is sent through the analyser. Sample in a volumetric pipette of a few litres with a positive pressure from 150 kPa to 200 kPa or with an automatic sampler.

When sampling gaseous oxygen the following shall apply:

— sample lines and ancillary equipment shall be compatible with use with oxygen, be clean, leak tight and have the appropriate pressure rating to deliver the sample safely and without contamination to the analyser;

— the sample taken shall be representative and apparatus shall be operated in accordance with the manufacturer's recommended operating procedures.

NOTE Flow rates to the analyser can require precise control, following pressure regulation, if automatic flow control devices are not an integral part of the measurement system.

5.2 Analyses

5.2.1 Main product

5.2.1.1 General

The most commonly used method of oxygen content measurement is the paramagnetic method. This method has an accuracy of ± 0,01 % volume fraction.

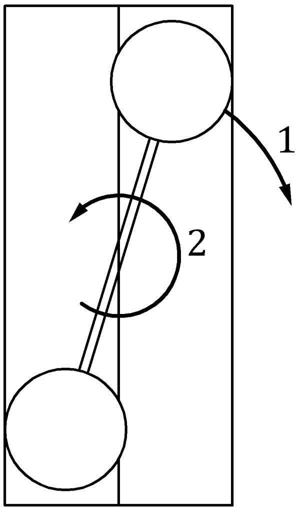
5.2.1.2 Principle

Magneto-dynamic oxygen analyzers are based on Faraday's principle of determining the magnetic susceptibility of a gas by measuring the force developed by a strong non-uniform magnetic field on a diamagnetic test body suspended in the sample gas. The test body of all measuring cells in paramagnetic oxygen analyzers consists of two nitrogen-filled quartz spheres arranged in the form of a dumb-bell, as shown in Figure 1. A single turn of fine platinum wire (the feedback coil) is secured in place around the dumb-bell. A rugged, taut band platinum ribbon suspension attached to the mid-point of the dumb-bell positions the dumb-bell in the strong non-uniform magnetic field existing between the specially shaped pole pieces of the permanent magnetic structure (see Figure 2).

5.2.1.3 Apparatus

A variety of analytical equipment suppliers provides simple, ready to run portable units for this purpose, which may be powered either by battery or mains electricity.

Figure 3 illustrates the configuration of a typical analyser designed for this purpose.



Key

1 Force in sphere

2 Restoring force of suspension

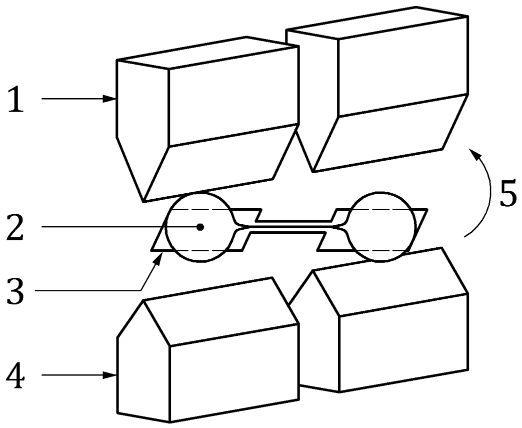
Figure 1 — Dumb-bell system: Forces within the cell

5.2.1.4 Calibration

Calibration of these analyzers shall be carried out using a calibration gas with a volume fraction greater than 99,95 % oxygen and the manufacturer's instructions, and conveyed to the analyser in accordance with 5.1.

5.2.1.5 Procedure

After calibrating the analyser, introduce the sample of the product in accordance with the manufacturer's instructions, and 5.1. Record the oxygen content that is displayed by the analyser.



Key

1 Pole piece

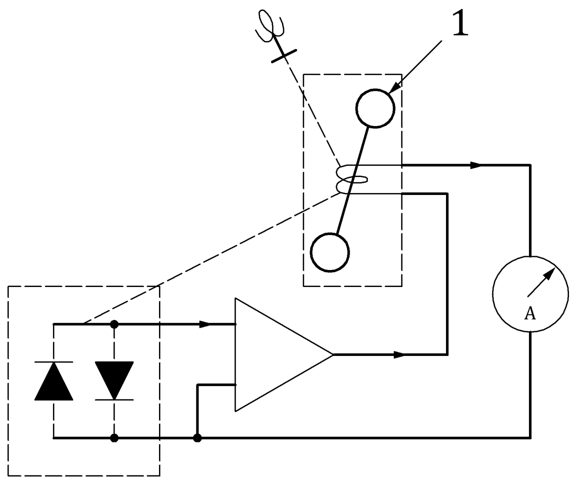
2 Dumb-bell

3 Platinum wire

4 Pole piece

5 Magnetic Field

Figure 2 — Measuring cell configuration



Key

1 Dumb-bell system

Figure 3 — Typical analyser configuration (electronic)

5.2.2 Impurities

The content of hydrocarbons (as Methane Index) shall be determined in accordance with the method given in Annex C.

6 Labelling - Transportation - Storage

6.1 Means of delivery

Gas: Gaseous oxygen is pressurized in cylinders up to 14,7 × 10^3 kPa to 30 x 10^3 kPa;

Liquefied: Oxygen is kept at - 183 °C in cryogenic insulated tanks.

6.2 Labelling according to the EU legislation[4)]

The following labelling requirements shall apply to oxygen.

4) See [3].

Hazard pictogram	
 **Figure 4 — GHS03**  **Figure 5 — GHS04**	Signal word: **Danger** Hazard statements: H270: May cause or intensify fire; oxidizer 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 [3], and its amendments for the purposes of its adaptation to technical and scientific progress 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.

6.3 Transportation regulations and labelling

Gaseous oxygen in gas cylinders is listed as UN Number[5)] 1072, and refrigerated liquefied oxygen is listed as UN Number 1073.

— RID[6)] /ADR[7)]: Class 2, classification code 1 O (liquid oxygen: 3 O)

— IMDG[8)]: Class 2.2, EmS: F-C, S-W

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.

— IATA[9]: Class 2.2 (liquid oxygen: Transportation prohibited).

6.4 Marking

The marking shall include the following:

— the name “oxygen”, trade name and grade;

— identification of the container for the pressurized gas in accordance with EN 1089-3 and for the refrigerated liquid in accordance with transport regulations;

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

— the statement “this product conforms to EN 12876, grade, …”

6.5 Storage

6.5.1 Containers

The full or empty containers (pressurized cylinders or liquid tanks) shall be stored in protected areas and not exposed to temperature above 50 °C.

6.5.2 Long term stability

Stable.

6.5.3 Storage incompatibilities

Keep away from flammable materials. Avoid all sources of ignition; do not smoke nearby. Store only in the original containers conforming to current regulations and never transfer oxygen from one container to another.

WARNING — Do not lubricate the taps, valves and pressure relief valves with organic greases.

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8) International Maritime transport of Dangerous Goods.

9) International Air Transport Association.

Annex A
(informative)

General information on oxygen

A.1 Origin

A.1.1 Raw materials

Air.

A.1.2 Manufacturing process

Oxygen is extracted industrially from air either by a cryogenic process (low temperature distillation of liquefied air), or by a separative process (membranes, adsorption, etc.).

A.2 Use

A.2.1 Function

Oxygen is used as an oxidizing agent, to maintain aerobic conditions, and stimulate biological processes, and as a process gas for the production of ozone (see EN 1278 [1]).

A.2.2 Form in which it is used

Depressurized gas (from cylinder), vaporized gas (from cryogenic tank and evaporator) and gas from a non-cryogenic generator or from a centralized cryogenic production site.

A.2.3 Treatment dose

The treatment dose depends on treatment objectives

A.2.4 Means of application

Oxygen is applied as gas injected into water. All technologies for mass transfer of gas to liquid are potentially applicable to oxygenation: porous diffusors, injectors and dispersing turbines. Any equipment should be specifically designed for use of oxygen.

A.2.5 Secondary effects

None.

A.2.6 Removal of excess product

Stripping with air or nitrogen.

A.3 Monitoring of oxygen

A.3.1 Chromatographic method

Gas phase chromatograph apparatus, equipped with thermal conductivity detector and calibrated against known gaseous standards, should be used. The accuracy of the oxygen concentration measurement is currently of a volume fraction of 0,1 %.

A.3.2 Oxymeters based on electrochemical cells

The presence of oxygen in the cell alters the electrochemical reaction between an anode and a cathode of different metals. The difference of potential in the cell becomes proportional to the oxygen concentration.

A.3.3 Other methods

The volumetric methods or absorption in a suitable oxygen reagent are difficult to use and are not suitable for the measurement of the commercial oxygen purity.

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

First aid for frost bite victims (due to low temperatures of liquefied oxygen): rinse continuously (for 20 min) the affected parts with cold water and seek medical advice.

B.2.2 Leaks

Stop the leak by closing the appropriate valve upstream of the leaking circuit.

In closed areas, ventilate thoroughly by creating a draught.

Prevent any possibility of ignition.

B.2.3 Fire

If possible stop the flow of product.

If the fire persists the fire brigade shall be called.

Move container away or cool with water from a protected position.

Annex C
(normative)

Determination of hydrocarbons content (Methane Index)

C.1 General

This method applies to oxygen with hydrocarbons (methane and other alkanes) contents in the volume fraction range of 0 to 5×10^{-5}.

C.2 Principle

Determination of hydrocarbons by flame-ionization detection.

NOTE The method can be applied to discrete samples or also as a continuous monitoring technique with both fixed or portable equipment. The exact experimental conditions of the technique are instrument-dependent.

The general principle is to feed a sample through a hydrogen-helium (40/60) fuel and air burner placed in an ionization detector. With hydrogen alone a negligible number of ions is produced, however, when hydrocarbons are present in the sample, ions are produced. Due to the electrostatic field produced between the burner and the collector on applying a polarizing voltage (usually the burner is negative and collector is positive), an ionization current is obtained which, for low concentrations, is directly proportional to the hydrocarbon concentration in the flame-gases.

C.3 Apparatus

C.3.1 Gas chromatograph, fitted with a flame ionization detector.

C.3.2 Gas sampling valve.

C.3.3 Suitable valve to enable hydrocarbons to be “backflushed” to the detector.

C.3.4 Nitrogen carrier gas.

C.4 Calibration

The system shall be calibrated with methane-air or methane-oxygen mixture produced in accordance with the manufacturer's instruction and conveyed to the analyser in accordance with 5.1. “Zero-grade” calibration and feed gases are required.

C.5 Procedure

After calibrating the instrument, introduce the sample of the product in accordance with the manufacturer's instructions and in accordance with 5.1. Record the output signal on a computing integrator and calculate the concentration of hydrocarbons in accordance with the computing integrator manufacturer's instructions.

C.6 Accuracy

For a standard measuring the volume fraction range of 0 to 4×10^{-5}, the currently achieved detection limit is 5×10^{-8} volume fraction with a standard deviation of less than 2×10^{-8}.volume fraction. Instrumental drift shall be checked and shall be less than 4×10^{-8} volume fraction in 24 h. The response time level shall be fixed at 95 % of full scale in 1 s.

Bibliography

[1] EN 1278, *Chemicals used for treatment of water intended for human consumption - Ozone*

[2] 98/83/EC, *Council Directive of 3 November 1998 on the quality of water intended for human consumption.*

[3] 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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