SLOVENSKI STANDARD
SIST EN 17971:2024

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Naprave za proizvodnjo biocidov na kraju samem - Ozon

Devices for in-situ generation of biocides - Ozone

Anlagen zur In-Situ Erzeugung von Bioziden - Ozon

Dispositifs de génération de biocides in situ - Ozone

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Devices for in-situ generation of biocides - Ozone

Dispositifs de génération de biocides in situ - Ozone

Anlagen zur In-Situ Erzeugung von Bioziden - Ozon

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
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European foreword

This document (EN 17971:2024) 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of an identical text or by endorsement, at the latest by December 2024, and conflicting national standards shall be withdrawn at the latest by December 2024.

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Introduction

Devices according to this document can be used in different fields of application, e.g. drinking water, swimming pool water, wastewater, air treatment, surface disinfection, water reuse, irrigation water and within food and beverage manufacturing, etc. Additional requirements to this document need to be observed, where appropriate for the specific application.

The *in situ* generation of active substances, in particular ozone, is subject to the specifications of the Biocidal Products Regulation (EU) 528/2012 (BPR) [1]. The use of ozone for the purpose of disinfection/microbiological preservation of water implies compliance with the provisions of the BPR, in particular access by the user or the device manufacturer to a data set required for the authorization of ozone under the BPR.

The *in situ* generation of ozone for non-biocidal applications, e.g. oxidation purposes, is subject to the specifications of the REACH (Registration, Evaluation, Authorization and Restriction of Chemicals) [2] Regulation (EC) 1907/2006. The use for non-biocidal purposes implies access by the user to the data set provided for the authorization of ozone under REACH.

1 Scope

This document is applicable to devices for the generation and dosing of ozone. The ozone is generated in these devices according to the technology of dielectric barrier discharge. According to EN 1278 and EN 15074, ozone is suited for the use of the treatment of water intended for human consumption (drinking water), and for the treatment of swimming pool water respectively. Ozone can be added to the water for disinfection and for oxidative purposes. This document can also be applied for other technologies to generate ozone, e.g. electrolysis or UV irradiation, as far as reasonable or applicable.

This document specifies device's construction, and test methods for the equipment used for *in situ* generation of ozone. It also specifies requirements for instructions for installation, operation, maintenance, safety and for documentation to be provided with the product.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 12876, *Chemicals used for treatment of water intended for human consumption — Oxygen*

EN 1278, *Chemicals used for treatment of water intended for human consumption — Ozone*

EN 15074, *Chemicals used for treatment of swimming pool water — Ozone*

EN 60529, *Degrees of protection provided by enclosures (IP Code)*

EN ISO 13849-1, *Safety of machinery — Safety-related parts of control systems — Part 1: General principles for design (ISO 13849-1)*

EN ISO 13849-2, *Safety of machinery — Safety-related parts of control systems — Part 2: Validation (ISO 13849-2)*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org

NOTE In addition, the terminology contained in Article 3 of the BPR [1] is useful for the application of this document.

3.1
ozone generator
part of the ozone generation device where feed gas is carried through a dielectric barrier discharge field with the purpose of generating ozone

3.2
ozone generation device
entire device that is necessary for the generation of ozone from the feed gas, including e.g. power supply and ozone generator

3.3
ozone system
combination of devices which, in addition to the ozone generation device and ozone dosing device, both described in this document, also comprises devices for the distribution of and reaction with ozone

Note 1 to entry: All ozone exposed equipment or devices, e.g. reaction vessels, pumps, pipes, tanks, residual ozone destructors, or heat exchangers, are considered as part of the ozone system.

3.4
closed ozone system
ozone system where ozone does not leave the ozone system, or such that only negligible release of ozone into the building or into the environment occurs

3.5
open ozone system
any system not considered as a closed ozone system according to 3.4

3.6
feed gas
substance that is fed as a gas to the ozone generation device to generate ozone

3.7
dew point
parameter, in °C, to indicate the content of humidity in a gas

Note 1 to entry: The dew point refers to the temperature to which a gas shall be cooled to become saturated with water vapor, assuming constant air pressure and water content.

Note 2 to entry: When air is cooled below the dew point, its moisture capacity is reduced and airborne water vapor will condense to form liquid water known as dew. When this occurs via contact with a colder surface, dew will form on that surface.

3.8
residual ozone destructor
device for the destruction of residual ozone that has not been consumed by the process in the ozone system and is accumulating in gaseous form in an off-gas flow

Note 1 to entry: The destruction takes places in the gas phase by converting the ozone (O_3) into oxygen (O_2).

3.9
normal temperature and pressure of gas
NTP
gas under the conditions of normal temperature t_n = 0 °C and normal pressure p_n = 101 325 Pa = 1013,25 hPa

[SOURCE: NIST Standard Reference Data Base 7 Users Guide [3]]

3.10
normal cubic meter
m^3_n
cubic meter of gas, usually dry, referenced to 1 atmosphere (101 325 Pa) and 0 °C, i.e. to normal temperature and pressure of gas

Note 1 to entry: the unit is expressed m^3_n. In other documents the unit Nm^3 is sometimes used.

[SOURCE: NIST Standard Reference Data Base 7 Users Guide [3]]

3.11
ozone system operating at negative pressure
system where all parts and pipes carrying ozone-containing gas, are under negative pressure from the ozone generation device up to the mixing device

3.12
ozone system operating at positive pressure
system where all or some parts and pipes, carrying ozone-containing gas, are under positive pressure from the ozone generation device up to the mixing device

3.13
expert
person who, due to their technical scientific training, work experience and knowledge of applicable standards and regulations, is able to assess an ozone system with regards to functions and safety

Note 1 to entry: This person can be from the manufacturer or an independent third-party organization (such as a test institution) without limitations, an inspector according to, EN ISO/IEC 17020 [4] Type C, fulfils this criterion.

3.14
separate lockable installation room
lockable technical room with access for a restricted group of persons, in which the ozone generation device, and eventually other parts of the ozone system are installed, and furthermore in which other technical equipment can be installed

3.15
individual installation room
technical room in which only the ozone generation device is installed and operated

Note 1 to entry: term includes also enclosures for installation of the ozone generation device.

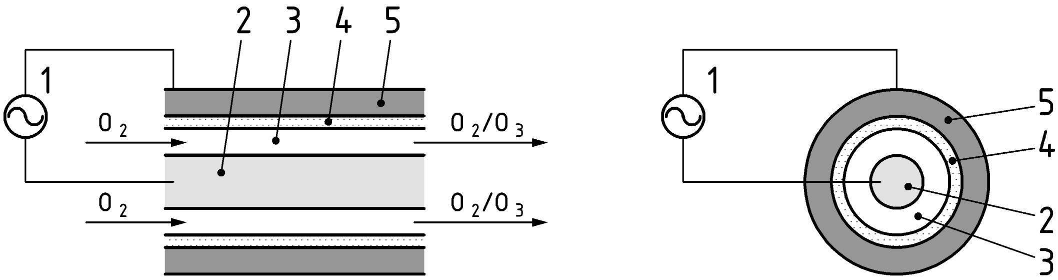
4 Technology of dielectric barrier discharge to generate ozone

Dielectric barrier discharge (DBD) is the basis for most of the commercial ozone generators. In practice, several other terms of the same meaning are in use instead of DBD: silent discharge, silent electrical discharge, silent arc discharge, corona discharge.

In dielectric barrier discharge, ozone is generated using energy from electrons in an electrical field between two electrodes. The electrodes are usually two parallel plates or concentric cylinders arranged with a certain distance to each other to form a single- or a double discharge gap. The electrodes are isolated from each other by a dielectric (non-conducting) barrier material and the discharge gap, see Figure 1.

The precursor is ambient air or oxygen gas, also called feed gas. Ozone (O_3) is generated from oxygen (O_2) of the feed gas that is piped through the discharge gap, see Figure 1. When the electrical field generated by the high voltage applied at the electrodes exceeds the insulation field strength of the feed gas in the discharge gap, the discharge in the feed gas initiates. The discharge creates a current of electric charged particles, consisting of electrons and ions. In the discharge area, the intended chemical reaction takes place: $3\ O_2 \rightarrow 2\ O_3$ (summarized). After a short time, i.e. some microseconds, the discharge current is interrupted by the dielectric being polarized by the discharge current, because the polarization of the dielectric compensates the driving electrical field. As the applied high voltage is an alternating voltage, the process repeats with opposite sign of the driving electrical field, which has consequently, the moment the new discharge initiates, the same direction as the electrical field of the dielectric. As before, the discharge is interrupted when the polarization of the dielectric is inverted and compensates the driving electrical field. Thus, the alternation of the applied high voltage enables an ongoing process generating ozone.

The alternation of the applied voltage occurs rapidly. An alternation period is much shorter than the transition time required for the gas to pass the ozone generator so that the ozone is homogeneously distributed in the gas leaving the device as ozone output. Consequently, the ozone output of DBD-devices is constant and without interruption or drops, if the feed gas supply is continuously guaranteed, if the ambient conditions, e.g. temperature or pressure, are stable, and finally if the high voltage supply runs constant.



Key

1 electric power supply — alternating voltage

2 inner electrode

3 discharge gap

4 dielectric barrier

5 outer electrode

Figure 1 — Example for ozone generation in an alternating electrical field in a single discharge gap formed by concentric electrodes and a dielectric barrier

However, the energy of the electric power supply is only partially consumed to generate ozone. The excess of energy is converted to heat that needs to be dissipated by efficient cooling.

Details of the chemistry of the ozone generation are pointed out in Clause 9 “Chemistry”.

5 Distinguishing characteristics of ozone generation devices

5.1 General

Ozone generation devices are distinguished according to the characteristics of 5.2 to 5.5.

5.2 Design type of the ozone generation devices

Devices of compact or free design, i.e. spatially close grouped or separated installation of equipment (see Clause 8).

5.3 Operating pressure

Ozone generators may be designed for operation at negative or positive pressure. The size of the ozone generating elements substantially depends on the operation frequency of the high voltage as well as on the pressure conditions inside the discharge compartment. Ozone systems can be constructed as ozone systems operating at negative pressure or at positive pressure according to 3.11 and 3.12 respectively.

In negative pressure systems according to 3.11, the release from the ozone system into the ambient air of the installation room is physically impossible. This shall be taken into account in the safety assessment.

5.4 Feed gas

The following types of feed gas shall be used as precursor to generate ozone, for purity requirements of the feed gas see 9.2:

a) ambient air;

b) oxygen.

5.5 Cooling of the ozone generator

Air cooling: convection or forced draft cooling.

Liquid cooling: e.g. water (cooling by direct discharge or by cooling circuit), coolant brine.

6 Technical data of the ozone generation device

The ozone generation device shall be specified by the following technical data, which shall be stated in the operating instructions:

a) manufacturer or distributor and name of device type/model;

b) name and address of the authorization holder for the product registration[1];

NOTE for uses of devices falling under REACH, the operator/user needs access to the REACH-registration for ozone

c) type of feed gas and pressure range[2] as well as purity/quality requirements;

d) maximum allowable dew point of the feed gas inside the direct supply line to the ozone generator under normal temperature and pressure, in °C;

e) volumetric flow rate of the feed gas at the direct supply to the ozone generator at normal temperature and pressure for the nominal output of ozone generation, in $m^3{}_n$/h;

f) type, volumetric flow rate, in l/h or m^3/h, and temperature, in °C, of the cooling agent and other quality requirements of the cooling agent;

g) maximum allowable pressure of the cooling agent, in MPa;

h) nominal output of ozone generation, in g/h, at the nominal ozone concentration, in g/$m^3{}_n$ (the volume is related to normal temperature and pressure);

i) setting or control range of ozone generation, in g/h or in % of the nominal output, stepwise or continuously;

j) operating pressure of the ozone generator; maximum allowable negative or positive pressure, in MPa [3];

[1] At the time of publication of this document, the development for labelling the BPR-authorization is under progress. Hence, this information is not enforced, or included, until this process has been concluded. This is only applicable for new products if the product is intended for biocidal use.

[2] in MPa [rel], stating negative pressure as a negative numerical value

[3] in MPa [rel], stating negative pressure as a negative numerical value