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Čistilne naprave za odpadno vodo - 14. del: Dezinfekcija

Wastewater treatment plants - Part 14: Disinfection

Kläranlagen - Teil 14: Desinfektion

Stations d'épuration - Partie 14 : Désinfection

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13.060.30 Odpadna voda Sewage water

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English Version

Wastewater treatment plants - Part 14: Disinfection

Stations d'épuration - Partie 14 : Désinfection

Kläranlagen - Teil 14: Desinfektion

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

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European foreword

This document (prEN 12255-14:2021) has been prepared by Technical Committee CEN/TC 165 “Wastewater engineering”, the secretariat of which is held by DIN.

This document is currently submitted to the CEN Enquiry.

This document will supersede EN 12255-14:2003.

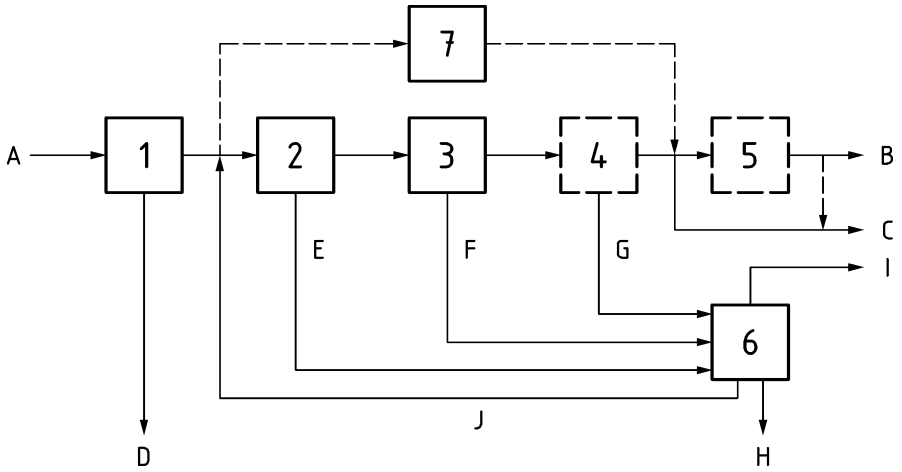
It is the fourteenth part prepared by Working Group CEN/TC 165/WG 40 relating to the general requirements and processes for treatment plants for a total number of inhabitants and population equivalents (PT) over 50. The EN 12255 series with the generic title “Wastewater treatment plants” consists of the following parts:

- *Part 1: General construction principles*
- *Part 2: Storm management systems*
- *Part 3: Preliminary treatment*
- *Part 4: Primary settlement*
- *Part 5: Lagooning processes*
- *Part 6: Activated sludge process*
- *Part 7: Biological fixed-film reactors*
- *Part 8: Sludge treatment and storage*
- *Part 9: Odour control and ventilation*
- *Part 10: Safety principles*
- *Part 11: General data required*
- *Part 12: Control and automation*
- *Part 13: Chemical treatment — Treatment of wastewater by precipitation/flocculation*
- *Part 14: Disinfection*
- *Part 15: Measurement of the oxygen transfer in clean water in aeration tanks of activated sludge plants*
- *Part 16: Physical (mechanical) filtration*

NOTE For requirements on pumping installations at wastewater treatment plants see EN 752, *Drain and sewer systems outside buildings — Sewer system management* and EN 16932 (all parts), *Drain and sewer systems outside buildings — Pumping systems*.

Introduction

Differences in wastewater treatment throughout Europe have led to a variety of systems being developed. This document gives fundamental information about the systems; this document has not attempted to specify all available systems. A generic arrangement of wastewater treatment plants is illustrated below:



Key

1 preliminary treatment
2 treatment
3 secondary treatment
4 tertiary treatment
5 additional treatment (e.g. disinfection or removal of micropollutants)
6 sludge treatment
7 lagoons (as an alternative)
A raw wastewater
B effluent for re-use (e.g. irrigation)
C discharged effluent
D screenings and grit
E primary sludge
F secondary sludge
G tertiary sludge
H digested sludge
I digester gas
J returned water from dewatering

Figure 1 — Schematic diagram of wastewater treatment plants

Detailed information additional to that contained in this document can be obtained by referring to the Bibliography.

The primary application is for wastewater treatment plants designed for the treatment of domestic and municipal wastewater.

1 Scope

This document specifies design principles and performance requirements for disinfection of effluents (excluding sludge) at wastewater treatment plants serving more than 50 PT.

NOTE Sludge disinfection is described in EN 12255-8.

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 12255-1, *Wastewater treatment plants - Part 1: General construction principles*

EN 12255-5, *Wastewater treatment plants - Part 5: Lagooning processes*

EN 12255-10, *Wastewater treatment plants - Part 10: Safety principles*

EN 12255-12, *Wastewater treatment plants - Part 12: Control and automation*

EN 12255-15, *Wastewater treatment plants - Part 15: Measurement of the oxygen transfer in clean water in aeration tanks of activated sludge plants*

EN 16323, *Glossary of wastewater engineering terms*

ISO 15727, *UV-C devices — Measurement of the output of a UV-C lamp*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 12255-1, EN 16323, and the following apply.

ISO and IEC maintain terminological 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/

3.1
residual concentration
concentration of a substance in the final effluent of a treatment stage

3.2
UV radiation
UV dose
received UV dose over the duration of the UV irradiation along the pathway of an infinitesimal small water volume

Note 1 to entry: UV dose is expressed in millijoules per square centimetre (mJ/cm^2).

3.3
UV intensity
quotient of the energy flux of the UV radiation received on the surface of an infinitesimal small area divided by the size of the area

Note 1 to entry: The unit of UV intensity is W/m², measured in accordance with ISO 15727.

3.4
UV-reactor
closed vessel or an open channel section with an assembly of UV-lamps irradiating the water passing through

3.5
bioassay
measurement of the concentration or potency of a substance by its effect on living cells or tissues

[SOURCE: EN 16323:2014, 2.3.5.4, modified to remove limitations]

3.6
specific ozone demand
required dissolved ozone concentration in the wastewater (g O_3/m^3 or g O_3/l) to achieve a level of disinfection

3.7
ozone destructor
device for destruction of residual ozone that has not been consumed in the ozonation process and is accumulated in the gaseous form in an off-gas stream

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

3.8
chlorinator
equipment for dosing chlorine into water

Note 1 to entry: Includes *in situ* generation.

3.9
contact tank
tank for providing the required retention time for certain reactions to take place

3.10
contact time
required retention time at a certain concentration for a specific reaction to occur

3.11
membrane
semipermeable material used as filter media in membrane filtration processes

Note 1 to entry: Membranes normally are flat sheets, tubes or hollow fibres composed of a thin semipermeable layer on a structural material.

3.12
permeate (*noun*)
liquid or gas that diffuses through a permeable membrane

[SOURCE: ISO 3857-4:2012, 2.54]

3.13
concentrate (*noun*)
fluids enriched with substances not passing the membranes in membrane filtration processes

3.14
flux
membrane surface area specific rate of fluids passing through the membrane in membrane filtration processes

3.15
transmembrane pressure
mean pressure exerted across the semipermeable membrane

[SOURCE: ISO 8637-3:2018, 3.7]

3.16
cross flow filtration
filtration with a significant flow parallel to the membrane surface

Note 1 to entry: This is intended to prevent substances from accumulating on the surface of the membrane.

[SOURCE: EN 16323:2014, 2.3.3.5]

3.17
perpendicular mixing
mixing vertical to floating direction

3.18
feed-gas
gas or gas mixture which is supplied to the ozone generation system

4 Symbols and abbreviations

AOX	halogenated organic compounds
BOD_5	biochemical oxygen demand in 5 days (expressed as milligrams of oxygen needed to break down the organic matter contained in a litre of water over five days (mg/l))
COD	chemical oxygen demand
LOX	liquid oxygen
NOx	nitrogen oxides
PAA	peracetic acid
PE	polyethylene
PTFE	polytetrafluoroethylene
PVC	polyvinyl chloride

RH	relative humidity, (expressed as a percentage of present state of absolute humidity relative to a maximum humidity given the same temperature)
SS	suspended solids, (expressed as milligrams of small solids contained in a litre of water (mg/l))
Ptot	concentrations of total phosphorus compounds expressed in milligrams of phosphorous in a litre of water (mg/l)
THM	trihalomethanes
UV	ultraviolet, electromagnetic radiation with wavelength 100 nm to 400 nm

5 Design requirements

5.1 General

Disinfection processes are used to improve the microbiological quality of effluents, if required, e.g. because of sensitive uses of the receiving waters downstream. A disinfection of effluents from wastewater treatment plants can reduce public health risks by preventing contamination by human pathogens in:

- waters used for bathing and other recreational activities involving immersion;
- shellfisheries;
- treated wastewater to be used for irrigation or as process water or other compatible uses;
- sources used for potable water supply.

Disinfection of effluents from wastewater treatment can be attained by two possible mechanisms:

- inactivation of microorganisms rendering microorganisms incapable of reproduction;
- removing the microorganisms from an effluent (e.g. by filtration) but not necessarily inactivating them.

The processes most commonly used for disinfecting wastewater by inactivating microorganisms are:

- ultraviolet (UV)-radiation;
- chlorination;
- ozonation;
- peracetic acid.

The processes most commonly used for disinfecting wastewater by removing respectively reducing microorganisms are:

- membrane filtration;
- effluent maturation ponds;
- soil filtration.

5.2 Planning

5.2.1 General

Disinfection, if required, should be the last stage in the wastewater treatment process. Poor performance by upstream processes will affect the performance of the disinfection process. If an effluent has to be stored prior to discharge – e.g. in case of discharge to tidal water or irrigation – it should preferably be disinfected after storage directly prior to discharge in order to limit regrowth hazards.

When planning disinfection systems consideration shall be given to the:

a) level of disinfection required;

b) stability and efficiency of disinfection process;

c) technological level of disinfection process;

d) operational requirements;

e) monitoring of water quality;

f) safety hazards;

g) environmental impacts, e.g.:

   1) effects on the quality of the effluents (reduction of BOD_5,COD, SS, Ptot);

   2) deleterious effects of residual disinfectants;

   3) production of toxic or bioaccumulating by-products;

h) power requirements.

5.2.2 Level of disinfection

Disinfection processes shall reduce or inactivate human pathogens to a level that the risk of the disinfected wastewater being a source of infections is minimized. Disinfection processes are not intended to remove all micro- organisms, or even remove all human pathogens.

National or local regulations or the relevant authority can specify the required level of disinfection to be achieved.

The specification of the planned level of disinfection shall include procedures for sampling, analysis and evaluation. Statistical criteria for complying with the level of disinfection required shall be named explicitly e.g. for dry weather and storm water conditions. These procedures shall be defined by the customer.

5.3 Process design

5.3.1 General

A disinfection system has to be designed and sized to ensure that:

- the required treatment (minimum level of disinfection) is applied to all wastewater (if necessary);
- the required level of disinfection is maintained at the maximum effluent flow rate and disinfectant demand (worst case condition) defined by the end-user.

With respect to the high required reduction rate no short circuiting, by-passing, or incomplete treatment is permitted. The required treatment has to be applied to all wastewater because the microbiological quality of disinfected wastewater reacts very sensitively to any wastewater not being disinfected properly.

NOTE This is because the required reduction of indicator organisms is usually in the magnitude of 99,9 % to 99,99 %. A leakage or short circuiting of 0,01 % to 0,1 % of the wastewater or a reduced reduction rate of only 99 % in 1 % to 10 % of the wastewater due to incomplete treatment can cause germ counts that already exceed the effluent standards.

5.3.2 UV radiation

UV disinfection is the application of UV radiation artificially generated in UV lamps in UV reactors to the wastewater to be disinfected. An appropriate dose of UV radiation will cause an irreversible inactivation of microorganisms with no other significant effects on the wastewater.

NOTE The disinfection by UV radiation is due to a photochemical effect. UV radiation of germicidal wavelength causes the formation of dimers of neighbouring thymine bases in nucleic acids. These dimers disturb the replication of the nucleic acids and cause an irreversible inactivation of the microorganisms if the formation of dimers is too numerous to be repaired by the cells repair mechanisms.

UV radiation systems for wastewater disinfection can be classified as follows:

- type of UV reactor (open channel gravity flow systems, closed vessel systems);
- type of UV-lamps (low pressure or medium pressure mercury discharge lamps);
- configuration of UV-lamps (in wastewater immersed lamps housed in quartz glass sleeves, non-contact systems).

Radiation systems can consist of one or more UV reactors. UV reactors can be in series or parallel. Designing and sizing a UV radiation system for wastewater disinfection, the following site specific parameters shall be taken into consideration:

- minimum UV dose;
- peak flow;
- minimal UV transmittance of effluent.

The minimum UV-dose is the UV irradiation required to reduce the concentration of microorganisms in an effluent to the requested level of disinfection. The minimum UV dose is independent of the UV radiation system used for the disinfection. The minimum UV dose is only determined by:

a) the level of disinfection required specified in terms of
   - relevant indicator and/or pathogen organisms concentrations;
   - sampling and analysis procedures (photo-reactivation);
   - statistical criteria for approval.

b) characteristics of the wastewater
   - suspended solids concentration;
   - concentrations of microorganisms before disinfection.