SLOVENSKI STANDARD
SIST EN 12255-14:2004

01-maj-2004

Ļistilne naprave za odpadno vodo - 14. del: Dezinfekcija

Wastewater treatment plants - Part 14: Disinfection

Kläranlagen - Teil 14: Desinfektion

Stations d'épuration - Partie 14: Désinfection

Ta slovenski standard je istoveten z: **EN 12255-14:2003**

ICS:

13.060.30 Odpadna voda Sewage water

SIST EN 12255-14:2004 **en**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 12255-14

December 2003

ICS 13.060.30

English version

Wastewater treatment plants - Part 14: Disinfection

Stations d'épuration - Partie 14: Désinfection

Kläranlagen - Teil 14: Desinfektion

This European Standard was approved by CEN on 11 September 2003.

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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

Management Centre: rue de Stassart, 36 B-1050 Brussels

Ref. No. EN 12255-14:2003: E

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Foreword

This document (EN 12255-14:2003) has been prepared by Technical Committee CEN/TC 165 “Wastewater engineering”, the secretariat of which is held by DIN.

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of an identical text or by endorsement, at the latest by June 2004, and conflicting national standards shall be withdrawn at the latest by June 2004.

This is the fourteenth Part prepared by the Working Groups CEN/TC 165/WG 42 and WG 43 relating to the general requirements and processes for treatment plants for a total number of inhabitants and population equivalents (PT) over 50. EN 12255 with the generic title “Wastewater treatment plants” consists of the following Parts:

— *Part 1: General construction principles*

— *Part 3: Preliminary treatment*

— *Part 4: Primary settlement*

— *Part 5: Lagooning processes*

— *Part 6: Activated sludge processes*

— *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, provided initially as *Part 2: Pumping installations for wastewater treatment plants*, see EN 752-6 *Drain and sewer systems outside buildings — Part 6: Pumping installations*.

EN 12255-1, EN 12255-3 to EN 12255-8 and EN 12255-10 and EN 12255-11 were implemented together as a European package (Resolution BT 152/1998).

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, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This European Standard specifies performance requirements for the disinfection of effluents from wastewater treatment plants.

The primary application is for wastewater treatment plants designed for the treatment of domestic and municipal wastewater for over 50 PT.

Differences in wastewater treatment throughout Europe have led to a variety of systems being developed. This standard gives fundamental information about the systems, this standard has not attempted to specify all available systems.

Detailed information additional to that contained in this standard can be obtained by referring to the bibliography.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places 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 (including amendments).

EN 1085:1997, *Wastewater treatment — Vocabulary.*

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.*

3 Terms and definitions

For the purposes of this European Standard, terms and definitions given in EN 1085:1997 and the following apply.

3.1
residual concentration
concentration of a disinfectant in the final effluent of the wastewater treatment plant

3.2
UV radiation (UV dose)
the received UV-dose over the duration of the UV irradiation along the pathway of an infinitesimal small water volume expressed in J/m²

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. The unit of UV intensity is W/m²

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

3.5
bioassay
method to determine the effective UV radiation of an UV system using a calibrated test organism. Calibration of test organisms is done in a laboratory device with an UV radiation of a homogeneous and measured intensity (see [15], [20])

3.6
ozone demand
amount of ozone required to attain a certain residual ozone concentration in the effluent of a treatment stage. The ozone demand includes the ozone consumption due to the decay of the ozone and due to reactions of ozone with any of the pollutants in the water

3.7
chlorinator
equipment for dosing chlorine gas into water

3.8
contact basin
tank for providing the required detention time for certain reactions to take place

3.9
membrane
semipermeable material used as filter media in membrane filtration processes. Membranes normally are flat sheets, tubes or hollow fibres composed of a thin semipermeable layer on a structural material

3.10
module
unit containing an assembly of membranes and systems for distributing the raw water inflow, and systems for collecting permeate and the concentrate

3.11
permeate
fluids passing through the membrane in membrane filtration processes

3.12
concentrate
fluids enriched with substances not passing the membranes in membrane filtration processes

3.13
flux
membrane surface area specific rate of fluids passing through the membrane in membrane filtration processes normally indicated in l/(m²·h). The flux is mainly determined by the wastewater quality, the type of membrane used, the mode of filtration and the transmembrane pressure

3.14
transmembrane pressure
pressure difference between concentrate and permeate side of the membrane

3.15
cross flow filtration
filtration with a significant flow parallel to the membrane surface, which is intended to prevent substances from accumulating on the surface of the membrane

3.16
dead end filtration
filtration without a significant flow parallel to the membrane surface

3.17
perpendicular mixing
mixing vertical to floating direction

4 Design

4.1 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 be required to contribute to public health to prevent a contamination by human pathogens of:

— waters used for bathing and other recreational activities involving immersion;

— shellfisheries;

— treated wastewater to be reused for unrestricted irrigation or as process water or grey water;

— sources used for potable water supply.

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

— inactivation of micro-organisms rendering micro-organisms incapable of reproduction;

— removing the micro-organisms from an effluent (e.g. by filtration) but not necessarily inactivating them.

Processes most commonly used for disinfecting wastewater by removing inactivating micro-organisms are:

— Ultraviolet (UV)-radiation;

— Chlorination;

— Ozonation.

Processes most commonly used for disinfecting wastewater by removing respectively reducing micro-organisms are:

— membrane filtration;

— effluent maturation ponds;

— soil filtration.

4.2 Planning

4.2.1 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 be preferably disinfected after storage directly prior to discharge in order to limit regrowth hazards.

When planning disinfection systems consideration shall be given to:

a) level of disinfection required;

b) stability and efficiency of disinfection process;

c) technological level of disinfection process;

d) operational requirements;

e) safety hazards;

f) environmental impacts, e.g.:

— effects on the quality of the effluents (reduction of BOD_5,COD, SS, P_{tot});

— deleterious effects of residual disinfectants;

— production of toxic or bioaccumulating by-products;

g) power requirements.

4.2.2 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 minimised. Disinfection processes are not intended to remove all micro-organisms, or even remove all human pathogens.

The level of disinfection is specified by national and local authorities.

The specification of the 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.

4.3 Process Design

4.3.1 General

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

— the required treatment (minimum disinfectant dose) is applied to all wastewater;

— the required level of disinfection is maintained at the maximum effluent flow rate and disinfectant demand (worst case condition).

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 due to the fact that 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.

4.3.2 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 micro-organisms 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 micro-organisms, if due to the UV dose 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).