BRITISH STANDARD

BS EN 12255-14:2003

Wastewater treatment plants —

Part 14: Disinfection

The European Standard EN 12255-14:2003 has the status of a British Standard

ICS 13.060.30

National foreword

This British Standard is the official English language version of EN 12255-14:2003.

The UK participation in its preparation was entrusted to Technical Committee B/505, Wastewater engineering, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this committee can be obtained on request to its secretary.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the *BSI Catalogue* under the section entitled "International Standards Correspondence Index", or by using the "Search" facility of the *BSI Electronic Catalogue* or of British Standards Online.

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CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

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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EUROPÄISCHES KOMITEE FÜR NORMUNG

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Contents

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of an identical text or by endorsement, at the latest by June 2004, and conflicting national standards shall be withdrawn at the latest by June 2004.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

¾ *Part 1: General construction principles*

¾ *Part 3: Preliminary treatment*

¾ *Part 4: Primary settlement*

¾ *Part 5: Lagooning processes*

¾ *Part 6: Activated sludge processes*

¾ *Part 7: Biological fixed-film reactors*

¾ *Part 8: Sludge treatment and storage*

¾ *Part 9: Odour control and ventilation*

¾ *Part 10: Safety principles*

¾ *Part 11: General data required*

¾ *Part 12: Control and automation*

¾ *Part 13: Chemical treatment — Treatment of wastewater by precipitation/flocculation*

¾ *Part 14: Disinfection*

¾ *Part 15: Measurement of the oxygen transfer in clean water in aeration tanks of activated sludge plants*

¾ *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 $l/(m^2 \cdot h)$. 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:

¾ waters used for bathing and other recreational activities involving immersion;

¾ shellfisheries;

¾ treated wastewater to be reused for unrestricted irrigation or as process water or grey water;

¾ sources used for potable water supply.

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

¾ inactivation of micro-organisms rendering micro-organisms incapable of reproduction;

¾ 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:

¾ Ultraviolet (UV)-radiation;

¾ Chlorination;

¾ Ozonation.

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

¾ membrane filtration;

¾ effluent maturation ponds;

¾ 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.:

¾ effects on the quality of the effluents (reduction of BOD_5,COD, SS, P_{tot});

¾ deleterious effects of residual disinfectants;

¾ 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

¾ the required treatment (minimum disinfectant dose) is applied to all wastewater;

¾ 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:

¾ type of UV reactor (open channel gravity flow systems, closed vessel systems);

¾ type of UV-lamps (low pressure or medium pressure mercury discharge lamps);

¾ configuration of UV-lamps (in wastewater immersed lamps housed in quartz glass sleeves, non-contact systems).

UV 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:

¾ minimum UV dose;

¾ peak flow;

¾ minimal UV transmittance of effluent.

The minimum UV-dose is the UV irradiation required to reduce the concentration of micro-organisms 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

 ¾ relevant indicator and/or pathogen organisms concentrations;

 ¾ sampling and analysis procedures (photo-reactivation);

 ¾ statistical criteria for approval.

b) characteristics of the wastewater

 ¾ suspended solids concentration;

 ¾ concentrations of micro-organisms before disinfection.

The required minimum UV-dose can be estimated on the basis of experimental data determined by collimated beam tests, pilot plant studies, or experience from other installations.

On the basis of the minimum UV dose, peak flow, and minimum UV transmittance a UV radiation system can be designed and sized appropriate to deliver the required minimum UV dose to all wastewater to be disinfected. Design and sizing of UV radiation systems are system specific. Contractors should provide a verifiable UV dose calculation based on a bioassay study or on an UV intensity distribution calculation combined with a detention time distribution study (tracer study).

For a safe disinfection and a good efficiency of a UV radiation system the hydraulic design and the efficiency of the UV-lamps are most important. For the UV-lamp-ballast-systems contractors should provide an expertise on efficiency and out-put drop over time from an independent source. The hydraulic design of UV radiation system should ensure that

¾ no wastewater to be disinfected can by-pass the UV radiation system at any time;

¾ all the cross sections of the UV reactors are irradiated (no shadowed areas);

¾ hydraulic flow is as close to perfect plugflow as practicable;

¾ hydraulic flow is as close to perfect perpendicular mixing as practicable.

Efficiencies of UV radiation systems claimed by contractors can be verified by

¾ bioassay studies (see [15], [24]);

¾ pilot plant studies;

¾ full scale experience.

For systems with submerged UV-lamps a cleaning routine for the quartz glass sleeves of the UV-lamps has to be established. For systems with low pressure mercury discharge UV-lamps cleaning frequencies of less than once every two weeks can be expected. For systems using medium pressure mercury discharge UV-lamps cleaning might be required much more frequently.

UV-lamps should be replaced at intervals recommended by the manufacturers.

4.3.3 Ozonation

An ozonation system for wastewater disinfection includes:

¾ ozone generator;

¾ contactor;

¾ reactor;

¾ ozone destructor for waste gas.

Ozone is an extremely reactive and unstable gas that can not be stored and has to be produced on site.

Ozone is toxic. Ozonation can lead to the formation of other by products (chlorates, bromates and organic peroxides). In designing an ozonation plant all relevant safety regulations for generating and handling ozone have to be respected.

Ozone is very corrosive. All parts that get in contact with ozone have to be ozone resistant. Especially all sealants have to be ozone resistant.

Of great importance for the efficiency of the ozonation process is the ozone transfer into the effluent. This is done in a contactor. The following types of contactors are commonly used:

¾ diffused bubble (co-current and counter current);

¾ positive pressure injection;

¾ negative pressure injection (venturi);

¾ mechanical agitation;

¾ packed tower.

The efficiency of the ozone transfer into the effluent can be improved by a multistage counter current contacting of the ozone and the effluent.

The reactor should provide sufficient detention time for the disinfection reactions of the ozone to be completed. Flow conditions in the reactor should be as near to plug flow as is practicable. Short circuiting shall be avoided. Contactor and reactor can be integrated systems.

With respect to its toxicity any residual ozone in the waste gas has to be destroyed. All ozone bearing parts of an ozonation plant shall be a closed vessel system only vented through an ozone destructor. Ozone concentration in waste gas has to be monitored and shall not exceed 0,02 mg/m³. In the case of an elevated ozone concentration (> 0,02 mg/m³) being detected the ozone generators shall shut down automatically. Systems used for ozone destruction in the waste gas include

¾ thermal destruction (T > 350 °C, t_R > 2 s);

¾ catalytic destruction (i.e. Palladium/CuO-MnO, T = 60 °C to 80 °C);

¾ active carbon (active carbon is oxidised and consumed by the ozone destruction).

The ozone dosage required for disinfection will depend on the level of disinfection required and the ozone demand of the effluent. The ozone dosage necessary to meet the ozone demand will be site specific and should be determined by experiments, if possible, before design is undertaken. Contact times should be assessed using a pilot plant with the same type of contactor as will be used for the full-scale installation. Residual concentration of ozone in the wastewater should be in the range of 0,1 g/m^3 to 1 g/m^3.

4.3.4 Chlorination

The use of chlorine disinfection will result the formation of toxic by products such as AOX, THMs, PCB, etc. The environmental impact of these by products shall be taken into account when considering the reuse of chlorinated effluents.

Chlorinators for the disinfection of wastewater are technologically similar to the systems used for the chlorination of potable water and include appropriate systems for

¾ storage of disinfectant chemicals;

¾ preparation and dosing of disinfectant solutions;

¾ mixing of wastewater and disinfectant solution;

¾ disinfection reactions being completed in reaction tanks commonly referred to as contact basins;

¾ the dechlorination before discharge.

Disinfecting chemicals are toxic and hazardous. The more commonly used in chlorinators are

¾ Sodium hypochlorite solution;

¾ chlorine gas;

¾ chlorine dioxide.

The systems for the storage, preparation, and dosing of the disinfecting chemicals depend on the type of disinfecting chemicals being used.

Sodium hypochlorite solution can be purchased in concentrations of 5 % to 15 % NaOCl. It can be stored in tanks and dosed with positive displacement pumps. Attention has to be paid to the loss of activity over time. The rate of the loss of activity increases with rising temperatures.

Chlorine gas can be stored in pressurised gas tanks. Any rooms possibly affected by chlorine gas in case of leakage, rupture or misfunctioning have to be controlled by chlorine gas detectors. Chlorine gas can be dosed with negative pressure injection systems (venturi) into a side stream of the effluent, producing a solution of hypochlorous acid, which then is mixed with the effluent. Such chlorinators should have the following components:

¾ a pressure/vacuum regulator;

¾ a feed rate controller;

¾ a venturi operated injection device;

¾ a flow meter.

Chlorine dioxide is an unstable gas that easily can explode. It should not be stored prior to use and should be generated as required for disinfection. Storage and use of chlorine dioxide in a solution of approximately 5 % is possible. The manufacturer's instructions shall be considered. There are a number of methods which can be used to generate chlorine dioxide solution on site. These include the following reactions:

¾ sodium chlorite and chlorine gas;

¾ sodium chlorite and hydrochloric acid;

¾ sodium chlorite, hydrochloric acid and sodium hypochlorite.

Chlorine dioxide reactors should be designed to ensure that there is

¾ an efficient generation of chlorine dioxide from the feed chemicals,

¾ a low concentration of chlorine in the chlorine dioxide solution.

Chlorine dioxide is an effective bactericide over a wide range of pH values and in many circumstances more effective than chlorine. Unlike chlorine, it does not react with ammonia to form chloramines and there seems to be considerably less formation of AOX compounds with chlorine dioxide than with chlorine. It can lead to the formation of other by products (chlorates, bromates, etc.).

The mixing of the effluent and the disinfectant solution should be very intense and should be completed in a very short time (within a period of seconds). In line mixing systems or vigorously stirred tank reactors with a short detention time are appropriate solutions.

Disinfection reactions are completed in contact basins. The objective of the contact basins is to maintain the micro-organisms in the effluent stream in intimate contact with the disinfecting chemical for the required period. A disinfection contact tank should be designed to avoid short circuiting and should be as near to a plug flow system as is practicable. It will normally be a pipeline or a serpentine chamber.

The required dosage of the disinfectant solution depends on the type of disinfectant used and is site specific. The dosage of the disinfectant chemical should be adjusted to the flow rate and the disinfectant consumption rate of the wastewater with the objective to attain a stable residual concentration in the contact basin effluent. The site specific required dosage should be determined by experiments, if possible, before design is undertaken. Residual concentration for chlorination in the contact basin effluent should be approximately 0,2 mg/l of free chlorine. With a lower residual concentration disinfection might not be complete, with a higher residual concentration a severe damage of the bacterial population in the receiving water and excessive concentrations of toxic by-products in the effluent might be the consequence. Negative effects on the receiving water have been reported for chlorine concentrations as low as 0,05 mg/l to 0,1 mg/l. In order to reduce the negative effects of chlorinated effluents in the receiving water chlorinated effluents should be dechlorinated prior to being discharged.

4.3.5 Membrane filtration

The membrane filtration processes used for wastewater disinfection are ultra- and microfiltration. Both membrane filtration processes use porous membranes as filter media and behave as sieving filters. In membrane filtration the effluent is forced through the membrane pores under pressure. The transmembrane pressure is normally generated by a pressure pump on the effluent side, static height difference or a vacuum pump on the permeate side. Membrane filtration systems include the following elements:

¾ modules which contain membranes in the form of hollow fibres, tubes, discs or pleated cartridges, flat or spiral wound sheets and provide adequate systems for distributing the inflowing effluent and for collecting the concentrate and the permeate;

¾ pressure or vacuum pumps that provide an appropriate transmembrane pressure;

¾ systems for backwashing and/or chemical cleaning of the membranes.

Membrane filtration processes are characterised e.g. by:

¾ size of the pores in the membranes (microfiltration or ultrafiltration);

¾ material of the membranes (organic or inorganic);

¾ type of the modules (hollow fibres, tubes, discs or pleated cartridges, flat or spiral wound sheets);

¾ mode of operation (dead end or crossflow filtration);

¾ type of influent (settled effluent or mixed liquor).

Designing and sizing a membrane filtration system the following additional factors shall be considered:

¾ flux achievable in operation just before backwashing or cleaning the membrane;

¾ backwashing and cleaning procedures;

¾ energy consumption.

Consideration shall also be given to the safe disposal of the concentrate. The concentrate may be returned for treatment to the secondary treatment process. Design and operation of the secondary treatment process shall then consider any such additional inputs. Care should be exercised to avoid the build up of solids within such a system which are removed by the membrane filtration process but are not removed by the secondary treatment process. The addition of small amounts of coagulant to the concentrate is one method of avoiding this problem.

A routine for cleaning the membrane should be established. Cleaning can be accomplished using back-washing, air scouring or chemical cleaning. The interval between cleaning will be dependent on the reduction in flux or alternatively can be based on a fixed time interval. An appropriate cleaning regime should be established during commissioning. The cleaning regime should be reviewed periodically.

The integrity of the membranes should be tested periodically. A method shall be provided to identify and isolate membranes that have failed. The membranes should be replaced at intervals recommended by the manufacturers.

4.3.6 Effluent maturation ponds

The basic design requirements for effluent maturation ponds are set out in EN 12255-5. Retention time should be 5 d to 20 d. The design of the ponds should aim at attaining plug flow and avoiding short circuiting. Flow patterns in effluent maturation ponds can be improved by a high length to width ratio, a meandering design of the ponds or by dividing the volume into several ponds in series.

NOTE The efficiency of maturation ponds is generally far less than for other disinfection processes due to climate influences such as solar radiation and temperature.

4.3.7 Soil filtration

Designing and sizing a soil filtration system considerations shall be given to the site specific hydrogeological situation and to the local percolation properties of the soil. The site should be level or on the crest of a convex slope. The area should be well drained. Depressions, the bases of slopes and concave slopes should be avoided. The minimum depth of unsaturated soil between the bottom of the soil field and the bedrock or water table (at its maximum seasonal height) should be 1,2 m.

The soil characteristics that shall be considered include:

¾ texture;

¾ structure;

¾ permeability;

¾ layering.

Sandy or loamy soil is best suited for soil filtration. Gravely or clay soil are less-well suited. The structure of the soil should be strongly granular, blocky or prismatic. Soils which are silty or unstructured should be avoided. The soil should be bright and evenly coloured. Dull or mottled soils often indicate continuous or periodic saturation and are unsuitable. Soils which exhibit distinct layers should be subject to careful evaluation to ensure water movement will not be restricted.

Local regulations concerning the minimum horizontal distance between the soil filter and manmade features and surface waters shall be applied. Such features will include water supply wells, property boundaries and the foundations of buildings.

Percolation tests should be carried out prior to design in order to establish the hydraulic loading rate which the site can sustain. Such data should be used to size the soil filtration system.

5 Requirements

5.1 Process control

The requirements of EN 12255-10 and EN 12255-12 shall apply. In wastewater disinfection process control should be used for:

¾ preventing health and safety hazards caused by disinfectants due to uncontrolled leakage;

¾ preventing negative effects of disinfectants in receiving waters due to overdosing;

¾ safeguarding a disinfectant dosage sufficient to meet the required level of disinfection at all times;

¾ optimising disinfectant and power consumption.

For preventing health and safety hazards caused by disinfectants due to uncontrolled leakage all rooms with installations containing hazardous chemicals have to be equipped with specific detectors safeguarding that any toxic concentration of these chemicals (see 5.3) will cause a shut down and an alarm. Also all waste gas streams form these installations have to be monitored in the same way.

Overdosing of chemical disinfectants is mostly associated with negative effects in receiving waters and can often be avoided by controlling the disinfectant dosage by monitoring the residual disinfectant concentration in the effluent. This method should be applied in chlorination and ozonation processes. This method reacts to variations in the disinfectant demand no matter if they are due to a change of the flow rate or of the disinfectant consumption in the wastewater. For this control to work properly, the sensors monitoring the residual concentrations have to be maintained and calibrated on a regular basis. The control system should be backed up by a flow proportional dosage in case of a breakdown of the sensor systems for monitoring the residual concentrations. If the specific disinfectant demand of the wastewater varies only in a limited range a flow proportional dosage of the disinfectant might be appropriate. If due to pumping also the flow is constant a manual control can be sufficient.

In chemical disinfection processes the same control that prevents overdosing is used for safeguarding a sufficient disinfectant dosage for meeting the required level of disinfection at all times. In UV radiation systems the UV intensity should be monitored at an appropriate reference point in each UV reactor for safeguarding a sufficient UV dosage. If the required UV intensity is not reached the sleeves of the UV-lamps shall be cleaned or UV lamps have to be renewed. In membrane filtration systems process control has to safeguard that there is no leakage from the effluent side to the permeate side. In some cases turbidity or particle counters can be appropriate systems for identifying a leakage in a membrane filtration system.

In chemical disinfection systems by controlling the disinfectant dosage already the most economic operation is attained. In UV radiation systems with more than one UV-reactor proportional to the flow UV-reactors can be switched on and off. This is commonly referred to as flow pacing. In flow pacing it has to be taken into consideration that a frequent switching on and off of UV lamps shortens the UV lamps life expectancy. In UV radiation systems with medium pressure mercury discharge UV-lamps the UV-lamps can be dimmed.

5.2 Structures

The requirements of EN 12255-1 shall apply. Structures shall be designed to be corrosion resistant. This particularly applies to disinfection processes when the disinfectant or its by-products are corrosive.

All confined spaces shall be provided with adequate ventilation.

5.3 Health and safety

The requirements of EN 12255-10 shall apply. International, national or local safety regulations might require additional safety measures and process controls.

The design and operation of a disinfection system shall ensure that there is no threat posed to the health and safety of the general public or the plant operators. All plant operators shall be trained in the health and safety aspects of the disinfection system which they are operating.

In some disinfection processes health and safety aspects deserve special consideration due to the involvement of:

¾ the generation and/or application of chemicals particularly toxic to man;

¾ high voltage equipment;

¾ UV radiation;

¾ in effluent submerged fragile electric equipment.

Chemicals used in disinfection processes and which are particularly toxic to man include:

¾ chlorine gas;

¾ chlorine dioxide gas;

¾ ozone gas.

Risks to health and safety associated with the generation and/or application of toxic chemicals in disinfection processes include:

¾ exposure to toxic gases;

¾ exposure to toxic or corrosive liquids;

¾ explosions caused by storage of gases under pressure;

¾ fire and explosions caused by the build up of flammable gases;

¾ fire and explosions caused by the storage of powerful oxidants or oxygen.

Appropriate safety standards shall be applied in order to minimise the risk of these potential hazards.

Disinfection processes with a generation and/or application of gases particularly toxic to man shall be designed and operated such that the occupational exposure limits to these gases are not exceeded. The building in which these gases are used, generated, or stored shall be monitored regularly and appropriate equipment shall be supplied to deal with releases of gas. Safety equipment (gas masks, etc.) has to be available on site. Evacuation procedures shall be prepared and rehearsed on a regular basis.

UV radiation can irritate eyes and skin. UV radiation systems shall be designed such that no UV irradiation can directly penetrate eyes or skin. Lightlocks and electrical breakers are appropriate systems for preventing direct UV irradiation of eyes and skin.

Bibliography

The following documents contain details which can be used within the framework of this standard.

This list of documents which are published and used by the members of CEN was correct at the time of publication of this European Standard but should not be considered to be exhaustive.

European Standard

[1] EN 170, *Personal eye protection — Ultraviolet filters — Transmittance requirements and recommended use*.

[2] EN 938, *Chemicals used for treatment of water intended for human consumption — Sodium chlorite.*

[3] EN 939, *Chemicals used for treatment of water intended for human consumption — Hydrochloric acid*.

EU-Directive

[4] 76/160/EEC, Council Directive of 8 December 1975 concerning the quality of bathing water, Official Journal L31.8 (1975). Changed by 91/692/CEE of 23 December 1991.

National requirements

Austria

[5] ÖNORM M 5873-1, *Anlagen zur Desinfektion von Wasser mittels Ultraviolett-Strahlen - Anforderungen und Prüfung – Anlagen mit Quecksilberdampf-Niederdruckstrahlern*.

[6] ÖNORM M 5878, *Anforderungen an Ozonungsanlagen zur Wasseraufbereitung.*

[7] ÖNORM M 5879-1, *Anforderungen an Chlorungsanlagen zur Wasserbehandlung - Chlorgas-Anlagen.*

[8] ÖNORM M 5879-2, *Anforderungen an Chlorungsanlagen zur Wasserbehandlung; Anlagen zur Desinfektion und Oxidation durch Chlorverbindungen und deren Lösungen.*

[9] ÖNORM M 5879-3, *Anforderungen an Chlorungsanlagen zur Wasserbehandlung - Chlorgas-Anlagen.*

Germany

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