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Čistilne naprave za odpadno vodo – 7. del: Biološki reaktorji s pritrjeno biomaso

Wastewater treatment plants - Part 7: Biological fixed-film reactors

Kläranlagen - Teil 7: Biofilmreaktoren

Stations d'épuration - Partie 7: Réacteurs biologiques a cultures fixées

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Wastewater treatment plants - Part 7: Biological fixed-film reactors

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Kläranlagen - Teil 7: Biofilmreaktoren

This European Standard was approved by CEN on 9 November 2001.

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 Management Centre 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 Management Centre 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

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Foreword

This European Standard 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of an identical text or by endorsement, at the latest by July 2002, and conflicting national standards shall be withdrawn at the latest by December 2002.

It is the seventh part prepared by the Working Groups CEN/TC 165/WG 42 and 43 relating to the general requirements and processes for treatment plants for a total number of inhabitants and population equivalents (PT) over 50. The Parts of the series are as follows:

— 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[1)]

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".

The parts 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).

[1)] In preparation.

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

1 Scope

This European Standard specifies the design principles and performance requirements for secondary treatment by biological fixed-film reactors at wastewater treatment plants for more than 50 PT.

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

Biological fixed film reactors include biological trickling filters, rotating biological contactors, submerged bed reactors and biofilters.

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

Detailed information additional to that contained in this standard may 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 752-6, *Drain and sewer systems outside buildings — Part 6: Pumping installations.*

EN 1085, *Wastewater treatment — Vocabulary.*

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

EN 12255-6, *Wastewater treatment plants — Part 6: Activated sludge processes.*

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

EN 12255-11, *Wastewater treatment plants — Part 11: General data required.*

3 Terms and definitions

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

3.1
wastewater dose
volume of wastewater discharged on to a trickling filter from a single pumping cycle or a single siphoning from a filter dosing chamber

3.2
flushing intensity
surface hydraulic loading rate divided by the number of arms of a rotary distributor and divided by the number of revolutions per hour

NOTE This value gives information on the hydraulic forces to wash excess sludge out of the bed.

3.3
submerged bed reactor
bed of packed or suspended inert media which is typically open structure plastic and is submerged in the flow to allow the active biological film attached to the media to purify the wastewater

NOTE A clarifier can be required.

4 Requirements

4.1 General

4.1.1 Biological fixed film processes

Biological fixed film processes may include:

— trickling filters;

— rotating biological contactors;

— submerged bed reactors;

— biofilters.

Biological fixed-film processes can treat the following types of influent:

— primary treated wastewater;

— finely-screened or sieved wastewater;

— effluent from secondary treatment.

These are processes in which support media is used to support growth of a film of microorganisms which flocculate and biodegrade soluble, colloidal and suspended matter in wastewater.

The processes can operate under aerobic and/or anoxic or anaerobic conditions and provide intimate contact between influent and the biological film. Solids present in treated effluent should be removed before final discharge.

In the case of biofilters the solids are retained within the reactors.

4.1.2 Trickling filters

In trickling filters, wastewater is distributed over and percolates down through a bed of support media, contacting the biological film growing on the surface of elements of the media. The bed shall contain continuous open spaces between elements of support media to promote natural or induced ventilation. Operating conditions on the bed shall support the growth of larger organisms such as protozoa and macro-invertebrates, often termed ‘grazing organisms', to control the growth of biological film and reduce surplus sludge. Humus tanks should be used to clarify wastewater discharged from the filter.

4.1.3 Rotating biological contactors

A rotating biological contactor consists of discs or packs of support media, which are arranged along a shaft and are partially immersed in wastewater.

The shaft rotates, enabling biological film, which grows on the support media, to alternately contact wastewater and air and bring about treatment. Performance can be improved by adopting the principle of a plug flow system. Rotating biological contactors may be supplied either as stand-alone biological treatment units or as package plants, incorporating primary and secondary settlement zones. Plant shall be designed to ensure that sludge flows to points that provide practical access for its removal.

4.1.4 Submerged bed reactors and biofilters

In these reactors, wastewater flow should be uniformly distributed through a submerged bed of support media. Air utilised for aeration should be supplied by a blower and distributed from pipework. The design of the aeration systems should distribute the air evenly over the fixed bed.

Denitrifying submerged bed reactors shall have a system for controlling deposits of sludge accumulating on the bottom or inside the bed of media.

In submerged bed reactors using an open structure media backwashing is not required, as the excess sludge is removed by aeration. Backwashing is typically required if media of a granular type is used.

Carbonaceous oxidation, nitrification and denitrification can be carried out in single or separate stages of biofiltration as well as achieving suspended solids removal.

Biofilters may be designed for upward or downward flow of wastewater. They may be required to be taken out of service for backwashing or may operate continuously with a separate washing system. The media may be single or multi-layer and can have a specific gravity greater or lower than that of water.

4.2 Planning

The following factors shall be considered in the design:

— characteristics of incoming wastewater;

— the capacity and dimensions of the biological reactors;

— the prevention of dead zones and detrimental deposition in tanks/channels;

— the establishment of multiple lines/units or other technical means to ensure maintenance of required final effluent quality if one or more line/unit is out of operation;

— the surface area, volume and depth of the clarifiers where used;

— the treatment and final destination of the sludge produced;

— the head loss to be minimised;

— measurement and control;

— media specification.

Reference should be made to EN 12255-1, EN 12255-6, EN 12255-10 and EN 12255-11 for further considerations.

4.3 Process

4.3.1 Design

The following operational parameters shall be considered and shall be appropriate for the type of treatment required:

— volumetric loading rate [kg/(m^3 ·d)] (as BOD_5, COD, NH_4-N or NO_3-N);

— mass surface loading rate [kg/(m^2·d)] (as BOD_5, COD, NH_4-N or NO_3-N);

— support media specific surface [m^2/ m^3];

— recirculation ratio;