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Čistilne naprave za odpadno vodo - 16. del: Fizična (mehanska) filtracija

Wastewater treatment plants - Part 16: Physical (mechanical) filtration

Kläranlagen - Teil 16: Abwasserfiltration

Stations d'épuration - Partie 16 : Filtration physique (mécanique)

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Kläranlagen - Teil 16: Abwasserfiltration

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European foreword

This document (EN 12255-16:2021) has been prepared by Technical Committee CEN/TC 165 “Waste water 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of an identical text or by endorsement, at the latest by January 2022, and conflicting national standards shall be withdrawn at the latest by January 2022.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

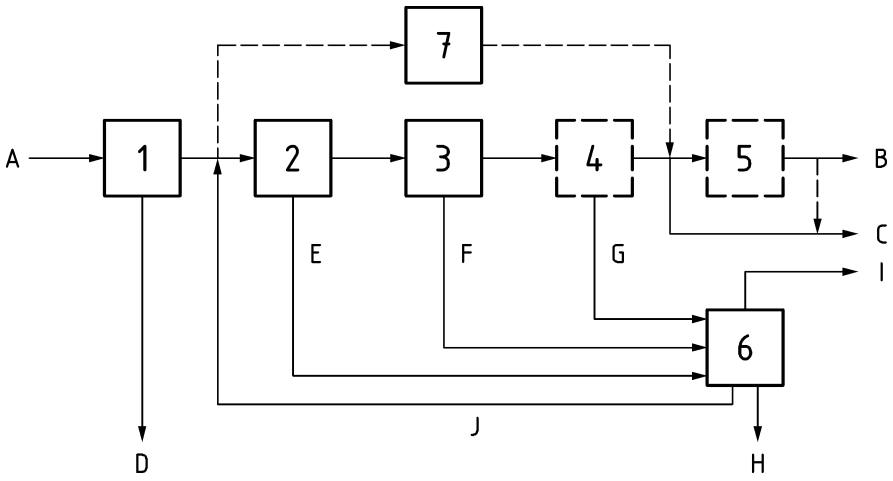
This is the sixteenth part prepared by Working Group CEN/TC 165/WG 40 relating to the general requirements and processes for treatment plants for a total number of inhabitants and population equivalents (PT) over 50.

EN 12255 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”.

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 in Figure 1.



Key

1 preliminary treatment
2 primary 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 may be obtained by referring to the bibliography.

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

Any feedback and questions on this document should be directed to the users' national standards body. A complete listing of these bodies can be found on the CEN website.

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

1 Scope

This document specifies design principles and performance requirements for tertiary clarification (receiving effluent from secondary treatment) by physical filtration plant at wastewater treatment plants serving more than 50 PT.

NOTE 1 Ultrafiltration, nanofiltration and reverse osmosis are not covered within the scope of this document as they are not considered to be used for tertiary clarification.

NOTE 2 Soil filtration is not covered in this document.

NOTE 3 Activated carbon filtration is excluded from the scope of this document as it is not considered to be a form of mechanical filtration.

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 16323:2014, *Glossary of wastewater engineering terms*

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

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 document, the terms and definitions given in EN 16323:2014 and the following apply.

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

- IEC Electropedia: available at https://www.electropedia.org/
- ISO Online browsing platform: available at https://www.iso.org/obp

3.1
filtration
process of retention of matter on or in a filter medium when passed by a fluid

Note 1 to entry: The filter medium can be a porous bed or a surface whereon a filter cake is building up.

[SOURCE: EN 16323:2014, 2.3.5.17, modified, to reflect that dissolved matter can also be removed by some filter types (e.g. granular activated carbon)]

3.2
deep bed filtration
process for the removal of solids from a fluid whereby the fluid flows through a filter medium consisting of a porous bed

3.3
surface filtration
process for the removal of solids from a fluid whereby the fluid flows through a filter cake building up on an essentially two dimensional filter medium

3.4
granular medium filter
deep bed filter with a granular filter medium

[SOURCE: EN 16323:2014, 2.3.5.22, modified, so as not to exclude crossflow and activated carbon]

3.5
sand filter
deep bed filter using natural or artificial fine particles as filter medium

[SOURCE: EN 16323:2014, 2.3.3.12, modified, to not exclude purpose made manufactured media]

3.6
cloth filter
filter with textile fabric as filter medium

3.7
disc filter
surface filter with rotating discs that are covered with a mesh or cloth as filter medium

3.8
drum filter
surface filter with a rotating drum that is covered with a mesh or cloth as filter medium

[SOURCE: EN 16323:2014, 2.3.8.8, modified, to not exclude materials other than cloth and remove limitation on axis orientation]

3.9
microstrainer
type of rotating filter with a fine mesh

Note 1 to entry: Microstrainers can be drum or disc filters.

[SOURCE: EN 16323:2014, 2.3.8.15, modified, so as not to exclude rotation about any axis]

3.10
fuzzy filter
deep bed upstream filter with a filter medium consisting of porous and compressible plastic components

3.11
filter medium
material through which a fluid flows and on which matter contained in the fluid is retained

Note 1 to entry: The filter medium of surface filters is the mesh or cloth on which a filter cake is building up. Most of the solids are retained on or within the filter cake.

[SOURCE: EN 16323:2014, 2.3.8.10]

3.12
particle size ratio
PSR
characteristic of a granular filter medium by means of a sieve analysis and the resulting sieving diagram whereby the ratio of the two mesh sizes, permitting passage of 60 % and 10 % of the granular mass, is determined

4 Symbols and abbreviations

A_{eff}	Effective filter area	m^2
AL	Area load	$kg/(m^2 \cdot h)$
$C_{SS,in}$	Concentration of SS in the inflow	mg/l
g	Acceleration due to gravity	m/s^2
H	Filter bed height	m
$\dot{M}_{AC}$	Load due to addition of powdered activated carbon	kg /h
$\dot{M}_{in}$	SS influent load	kg /h
$\dot{M}_{out}$	SS effluent load	kg /h
$\dot{M}_{prec}$	SS load due to precipitation	kg /h
NH_4-N	Ammonium nitrogen	
NO_3-N	Nitrate nitrogen	
PT	Total Phosphorous	
Q	Filtrate flow	m^3/h
SS	Suspended solids	
VL	Volumetric Load	$kg/(m^3 \cdot h)$
v	Filtration Rate	m/h
Δh	Head Loss	m
Δp	Required air pressure for backwashing	kPa
ρ	Water density	kg/m^3

5 Requirements

5.1 General

Filtering according to this document is used to remove suspended solids from biologically treated wastewater by mechanical filtration. Mechanical filters may also be used for further removal of phosphorous, micro-plastics and micro-pollutants. Mechanical filters may also be used for biological treatment.

Filters take a number of forms. These are summarized in Table 1.

Table 1 — Effluent filter classification

Filter medium	Deep bed			Surface	
Filter type	Moving bed filter	Downflow filter	Upflow filter	Pilecloth filter	Mesh filter
Filter material	Granulate (e.g. sand or activated carbon) or small beads	Granulate (e.g. Sand or activated carbon), beads or plastic foam		Pilecloth	Stainless steel or plastic fibre mesh
Filter effect	Retention of solids in pores or adsorption			Retention of solids on surface and in pores	Retention of solids on mesh and filter cake
Filtration	Continuous	Batch		Continuous	
Filtration flow direction	Up	Down	Up	In	Out
Backwashing	Continuous or intermittent	Intermittent		Continuous or intermittent	
Filter medium layer(s)	Single	Single or dual	Single	Single	
Biological effect	Possible			No	

5.2 Process types

5.2.1 Deep bed filtration

5.2.1.1 General

Deep bed filters include:

— Moving filters;

— Downflow filters;

— Upflow filters.

The filter material can include granulate (e.g. sand or activated carbon), beads or plastic pieces. Solids are retained mechanically or by surface adsorption.

Under certain circumstances deep bed filters can be used for biological processes.

Depending on the type of filter, the filtration process is either continuous or batched (intermittent).

5.2.1.2 Batch filtration

An upflow or downflow of effluent percolates through a bed of filter media trapping solids within the bed. During filtration solids accumulate in the bed and increase the head loss. At intervals, the bed shall be taken out of service and washed using filtered effluent with or without air scouring to remove accumulated solids. Washing can be effected by either a pumped or siphonic upflow of filtered effluent through the entire bed or by a travelling bridge washing individual compartments.

Downflow filters can have one or more layers in addition to a support layer. Upflow filters can only have a single layer.

Fuzzy filters are batch upflow filters with a filter medium of plastic foam pieces. During filtration the foam layer is compressed. For filter cleaning the pressure is released and then the filter is backwashed with water and air. After the cleaning the foam is compressed again.

Because of the intermittent nature of batch filtration several units shall be provided.

5.2.1.3 Continuous filtration

In this style of filter, an upflow of effluent passes continuously through a bed of granular media to remove solids. An air lift raises granular media from the bottom of the bed for washing and returns cleaned media to the top of the bed, enabling continuous filtration. This backwashing can be undertaken continuously or intermittently. Where intermittent backwashing is possible there may be an energy saving.

5.2.2 Surface filtration

Disc filters and drum filters are covered with mesh and rotate horizontally about their longitudinal axis. The filters are partially submerged. The filtration flow is continuous from inside to out. The backwashing with spray water occurs continuously or intermittently from outside to in by using the filtered water.

Disc and drum filters have a lower head loss than deep bed filters, but their solids removal efficiency is usually lower. Disc filters are more compact than drum filters.

5.2.3 Pilecloth filtration

Pilecloth filters can be disc filters or drum filters that are covered with pilecloth and rotate horizontally about the longitudinal axis. The filters are entirely submerged. A filtration flow is continuous from outside to inside. The backwashing is undertaken by forcing water under pressure from the inside to outside.

6 Planning

The choice of physical filtration process depends on the size of the treatment plant, space available, the type, quality, quantity and variability of effluent to be treated, the final quality of effluent required, and the frequency of maintenance that is required for the process.

Physical filtration can be used to supplement secondary clarification. The following primary factors shall be considered during design:

— flow to be treated, including return flows;

— type and efficacy of secondary treatment and clarification processes;

— nature and concentration of solids to be removed;

— required quality of treated effluent;

— ranges of hydraulic or suspended solids loads;

— available head;

— available space (e.g. footprint);

— environmental conditions (e.g. climate).