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Čistilne naprave za odpadno vodo – 4. del: Primarni usedalnik

Wastewater treatment plants - Part 4: Primary treatment

Kläranlagen - Teil 4: Vorklärung

Stations d'épuration - Partie 4: Traitement primaire

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13.060.30 Odpadna voda Sewage water

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English Version

Wastewater treatment plants - Part 4: Primary treatment

Stations d'épuration - Partie 4: Traitement primaire

Kläranlagen - Teil 4: Vorklärung

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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 12255-4:2021) has been prepared by Technical Committee CEN/TC 165 “Waste water engineering”, the secretariat of which is held by DIN.

This document is currently submitted to the CEN Enquiry.

This document will supersede EN 12255-4:2002.

It is the fourth part prepared by the 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.

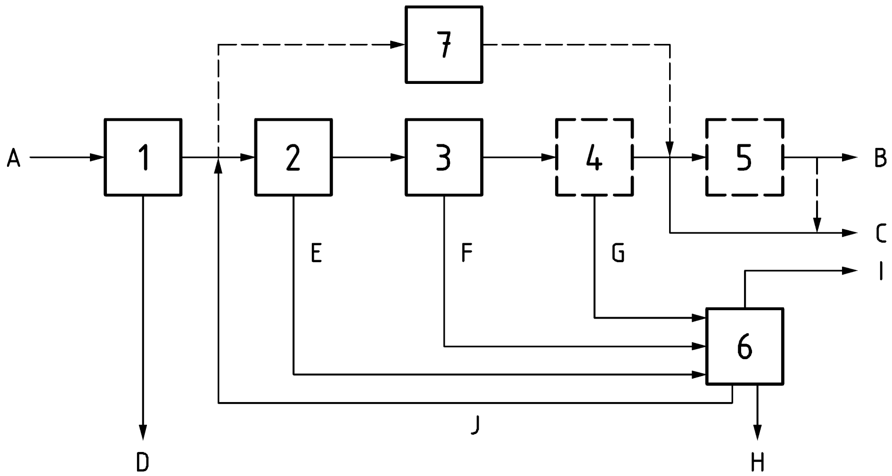
The parts of the series are as follows:

- *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 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.

1 Scope

This document specifies the design requirements for plant and equipment to remove solids, other than screenings and grit, from raw wastewater, at wastewater treatment plants for over 50 PT.

It includes primary treatment with sedimentation, fine screens and micro-screens

NOTE 1 The removal of screenings and grit, are covered in EN 12255, Part 3.

NOTE 2 Dissolved air flotation (DAF) is not covered in detail in this document because it is not commonly used for primary treatment in municipal wastewater treatment plants. It may be used for primary treatment of industrial wastewater, but then the design is specific to the application.

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

EN 16323:2014, *Glossary of wastewater engineering terms*

EN ISO 14122-2:2016, *Safety of machinery - Permanent means of access to machinery - Part 2: Working platforms and walkways (ISO 14122-2:2016)*

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:

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

3.1
dissolved air flotation (DAF)
separation of solids from wastewater whereby air is dissolved in recirculated wastewater under pressure, generates micro-bubbles when the pressure is released within a tank, which attach to particles and floats them to the wastewater surface as scum

3.2
lamella separator
device comprising regularly spaced, inclined plates or tubes designed to increase the effective settling area

[SOURCE: EN 16323:2014, term number 2.3.2.6]

3.3
micro-screen
screen with a typical mesh size between 0,1 mm and 1,0 mm

4 Symbols and abbreviations

BOD	Biochemical Oxygen Demand
COD	Chemical Oxygen Demand
FOG	Fat, Oil and Grease
rbCOD	readily biodegradable COD
SS	Suspended Solids
TKN	Total Kjeldahl Nitrogen
TS	Total Solids
TSS	Total Suspended Solids

5 Requirements

5.1 General

Primary treatment has the objective of removing solids and the associated organic load from raw wastewater (solid-liquid separation). Retained solids are removed continuously or on a regular basis in the form of primary sludge. The kind of solids removed depends on the process employed: primary clarifiers and lamella separators remove solids depending on their size and density by sedimentation (settable solids) or by flotation (fat, oil and grease), but they do not effectively remove solids with a density close to that of the wastewater. Screens remove solids from wastewater based on their particle size and rigidity, independent of their density.

The type and size of units employed will depend on the overall system, on the inflow and solids load and their variabilities, on the available space and ground conditions.

Primary treatment may include the following units:

a) Primary clarifier (settling tank or lamella separator):

- upward flow;
- horizontal flow;
- clarifier/sludge storage tank combination;
- lamella Separator;
- imhoff tank;);

Figure A.1 to A.6 in Appendix A show sketches of typical gravity clarifiers and lamella separators.

b) Micro-screen:

- rotating cylindrical screens with flow from the inside out;
- continuous belt screen which is horizontal or slightly sopped upwards;
- other micro-screens which might be developed.

Figure A.7 in Appendix A shows sketches of typical micro-screens, i.e. of a belt and drum screen.

c) Dissolved air flotation:

- system with or without addition of coagulants or flocculants,
- system with or without lamella separators.

Figure A.8 in Appendix A shows a sketch of a typical dissolved air flotation unit.

Primary treatment is not required where secondary wastewater treatment and sludge stabilization is achieved by extended aeration. However, upstream preliminary treatment with fine screens for the removal of solids and grit removal is always required.

Primary treatment can be enhanced through coagulant and flocculant (polymer) addition.

5.2 Planning

5.2.1 Required Data and Information

Performance requirements shall be determined considering the following factors:

- the nature and quantity of flow, including its variation (in particular storm events);
- chemical Oxygen Demand (COD) and Suspended Solids (SS) loads and their variations;
- ratio of dissolved (or particulate) COD to total COD;
- ratio of readily biodegradable COD (rbCOD) to total COD; knowledge of this ratio is required where biological Nitrogen removal is performed during subsequent biological treatment; the ratio of Biochemical Oxygen Demand (BOD) to COD may be used as a substitute;
- total Kjeldahl Nitrogen (TKN) load; this parameter is also required where biological Nitrogen removal is performed during subsequent biological treatment;
- slot or perforation width of the headworks screens; lamella separators and micro-screens require fine screens (see Part 3) with a maximum slot width of 4 mm or a perforation diameter of maximum 6 mm;
- the quantity and quality of primary sludge generated, including its peak during storm events, which depends on the quality and operation of the sewer system;
- type of sludge stabilization and requirements concerning the primary sludge solids concentration (gravity or mechanical sludge thickening is usually needed);
- the quantity and quality of the effluent and its variation; where nitrogen removal is required, the COD/TKN-ratio of the effluent should not be below 6:1 so that enough rbCOD for denitrification remains in the effluent. More specifically, the ratio of rbCOD to TKN in the effluent should not be lower than 1:2;
- redundancy requirements;
- health and safety requirements;
- concentrations of Sulfide and Chloride in the influent (they can cause concrete and metal corrosion).

Figure 1 shows the composition of COD and SS in raw wastewater. Typical average specific loads are shown, but they can vary depending on local conditions. It should be noted that 85-Percentiles of the specific loads are about 20 % higher.

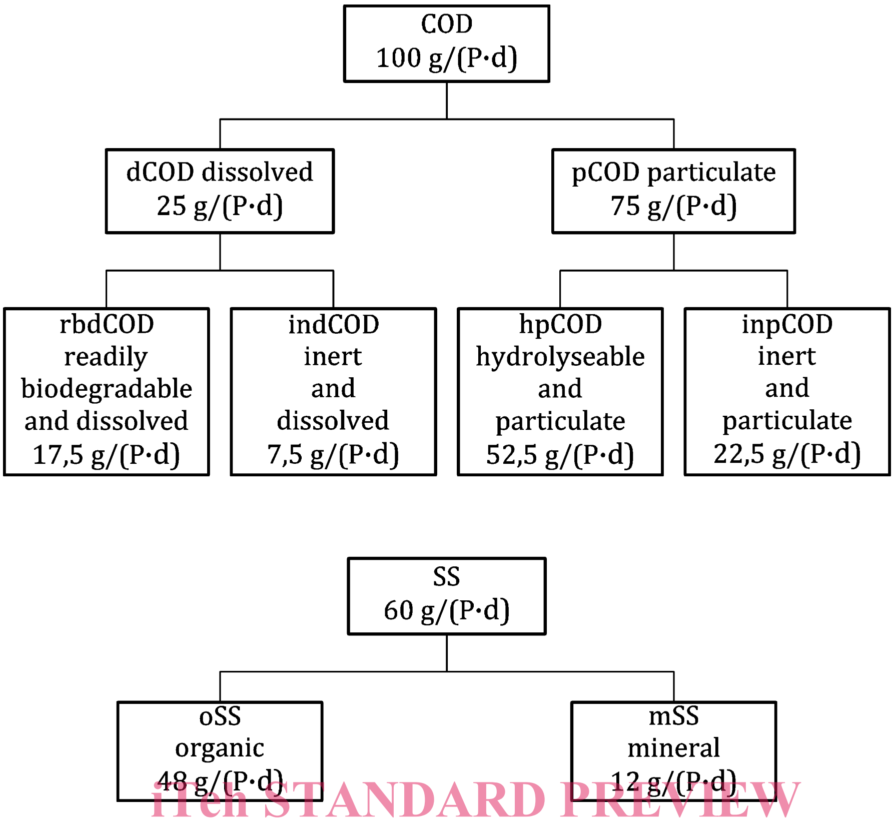


Figure 2 — Typical composition of COD and SS

5.2.2 Advantages and Disadvantages of Primary Treatment Systems

Lamella separators have the following pros and cons in comparison with conventional clarifiers:

Pros:

- their footprint is about half that of primary clarifiers,
- savings of construction costs,
- better flow distribution.

Cons:

- additional costs of mechanical equipment and its maintenance,
- need for regular cleaning,
- inconsistent performance due to more frequent blockages from fat and rags which can be mitigated by good preliminary treatment (see Part 3).

Lamella separators are typically taken into consideration where:

- existing primary clarifiers need upgrading or
- where the available footprint for conventional primary clarifiers is insufficient.

Micro-screens have the following pros and cons in comparison with conventional clarifiers:

Pros:

Micro-screens require only about 10 % of the footprint of primary clarifiers;

- savings of construction and investment costs;
- smaller variation of removal ratios depending on flow [1];
- removal ratios can be adjusted by changing the mesh;
- removal of fibres and thus protection of subsequent treatment stages from cording;
- removal of micro-plastic;
- can be used to thicken primary sludge (saving pre-thickening storage and separate thickeners).

Cons:

- micro-screens generate a head loss of up to 0,4 m and thus may need inflow pumping (this may be comparable to a flow splitter chamber and traditional clarifiers); however, pumping offers the benefit of flow control;
- power consumption is higher;
- need for redundancy: Failure of one unit shall not result in total loss of primary treatment capacity;
- increased reliance on mechanical equipment which requires maintenance.

Micro-screens are typically taken into consideration where:

- an existing primary clarifier needs upgrading; instead a portion of the inflow can be mechanically treated by micro-screening;

- there is a lack of available space for a conventional clarifier;
- a wastewater plant with aerobic sludge stabilization is changed into a plant with anaerobic sludge stabilization and it is difficult to add a primary clarifier (lack of space or requirement for pumping);
- sea or river outflows need mechanical treatment (with or without prior coagulation or flocculation).