SLOVENSKI STANDARD
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Čistilne naprave za odpadno vodo - 13. del: Kemijsko čiščenje odpadnih vod z obarjanjem/kosmičenjem

Wastewater treatment plants - Part 13: Chemical treatment - Treatment of wastewater by precipitation/flocculation

Kläranlagen - Teil 13: Chemische Behandlung - Abwasserbehandlung durch Fällung/Flockung

Stations d'épuration - Partie 13: Traitement chimique - Traitement des eaux usées par précipitation/floculation

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ICS:

13.060.30	Odpadna voda	Sewage water

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English Version

Wastewater treatment plants - Part 13: Chemical treatment - Treatment of wastewater by precipitation/flocculation

Stations d'épuration - Partie 13: Traitement chimique - Traitement des eaux usées par précipitation/floculation

Kläranlagen - Teil 13: Chemische Behandlung - Abwasserbehandlung durch Fällung/Flockung

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Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

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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 12255-13:2021) 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 12255-13:2002.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

This is the thirteenth 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.

The EN 12255 series 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*

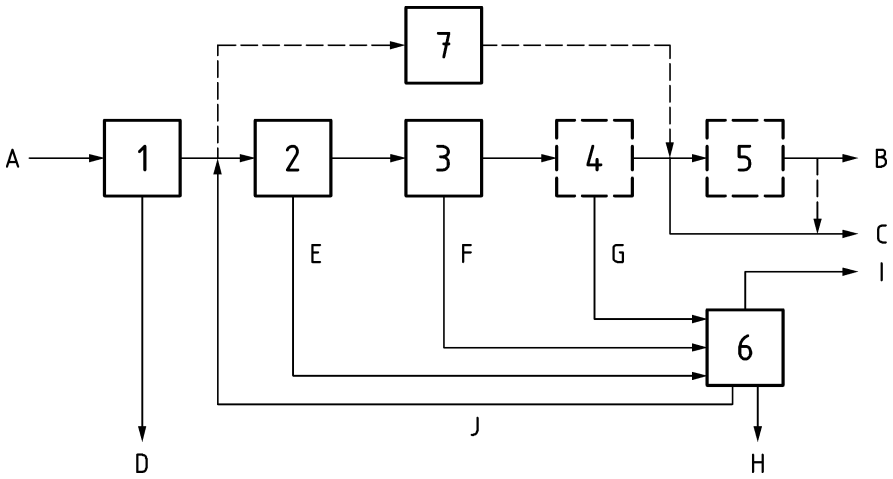
— *Part 14: Disinfection*

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

— *Part 16: Physical (mechanical) filtration*

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 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

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

NOTE For requirements on pumping installations at wastewater treatment plants see EN 752, *Drain and sewer systems outside buildings* and EN 16932, *Drain and sewer systems outside buildings — Pumping systems*:

— *Part 1: General requirements;*

— *Part 2: Positive pressure systems;*

— *Part 3: Vacuum systems.*

1 Scope

This document specifies the requirements for chemical treatment of wastewater by precipitation/flocculation for removal of phosphorus and suspended solids.

The application of polymers is not described in this document.

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

NOTE Chemical treatment can be performed in combination with primary and more commonly with secondary treatment, but it can also be performed as separate tertiary treatment, usually in combination with filtration (see EN 12255-16). Chemical treatment can provide a potential contribution to the **circular economy** through the recovery of materials, such as phosphorus, from wastewater or sludge.

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 10088-2, *Stainless steels — Part 2: Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for general purposes*

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

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

EN 16932-1, *Drain and sewer systems outside buildings — Pumping systems — Part 1: General requirements*

EN 16932-2, *Drain and sewer systems outside buildings — Pumping systems — Part 2: Positive pressure systems*

3 Terms and definitions

For the purposes of this document, the following terms and definitions 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
chemical treatment of wastewater
process involving the addition of chemicals to achieve a specific result

Note 1 to entry: For wastewater, typical chemical treatments comprise: coagulation/precipitation with metal salts (including lime) or organic polymers in order to remove inorganic and organic phosphorus compounds or suspended solids and colloids.

[SOURCE: ISO 6107-1:2004, definition 12]

3.2
chemical precipitation
conversion of components dissolved in water into an undissolved form by chemical reaction with a precipitant

[SOURCE: EN 16323, 2.3.5.8]

3.3
coagulation
destabilisation of dissolved and colloidally dispersed matter to allow aggregation, usually by addition of coagulants

[SOURCE: EN 16323, 2.3.5.9]

3.4
coagulant
chemical added to destabilise suspensions or emulsions

[SOURCE: EN 16323, 2.3.1.21]

3.5
flocculation
formation of separable flocs by aggregation of small particles

Note 1 to entry: Micro-flocculation can be achieved by destabilization and coagulation/aggregation, macro-flocculation can be achieved by addition of bridge building polymers.

[SOURCE: EN 16323, 2.3.5.19]

3.6
destabilisation
compensation of negative charges on the surfaces of particles by addition of positively charged bivalent or trivalent metal ions to achieve particle aggregation

Note 1 to entry: Destabilization is performed by reduction of the zeta-potential.

3.7
tertiary treatment
additional treatment processes which result in further purification than that obtained by primary and secondary treatment

[SOURCE: EN 16323, 2.3.5.51]

3.8
precipitant
chemical to bring about precipitation

[SOURCE: EN 16323, 2.3.5.45]

3.9
aerobic
dissolved oxygen is present

[SOURCE: EN 16323, 2.3.1.1]

Note 1 to entry: The terms oxic and aerobic are synonyms.

3.10
anaerobic
absence of dissolved oxygen, nitrate, nitrite and sulphate

Note 1 to entry: It can be important that other oxidising chemicals are also absent.

[SOURCE: EN 16323, 2.3.1.2]

3.11
anoxic
absence of dissolved oxygen but presence of nitrate or nitrite

[SOURCE: EN 16323, 2.3.1.3]

4 Symbols and abbreviations

4.1 Symbols

Q	wastewater flow (l/s)
OTPc	orthophosphate concentration (mg/l)
OTPL	orthophosphate load (kg/h)/0,031 kg/mol
ω	specific molar weight of the chemical (g/mol)
ρ	density of the chemical (g/l)
β	ratio between the stoichiometric requirement of a precipitant (e.g. Iron) to deal with the known amount of phosphorous load and the real amount that is required

4.2 Abbreviations

ADP	adenine-di-phosphate
ASP	activated sludge plants
ATP	adenine-tri-phosphate
DS	dry solids
EBPR	enhanced biological phosphorus removal
FPD	flow proportional dosing
FST	final settlement tanks
P	phosphorus
TFP	trickling filter plants
TSR	tertiary solids removal

5 Requirements

5.1 General

Chemical treatment of wastewater can be divided into two processes:

— a reaction phase, that consists of precipitation of dissolved phosphates, destabilization of colloids and the formation of flocs; and

— a separation phase, in which the flocs are separated from the water.

The reactors and floc separators (sedimentation tanks, flotation or filtration units etc.) for the chemical treatment can be integrated with the other parts of the wastewater treatment plant (pre-precipitation as part of primary treatment, simultaneous precipitation as part of secondary treatment, see 5.5.2.1 and 5.5.2.2) or be a separate part of the treatment plant (post precipitation, direct precipitation), i.e. tertiary treatment.

The water level in the chemical reactors and tanks may be controlled by fixed or adjustable weirs. It is particularly important where there are multiple parallel reactors.

The design of the process shall take into account variations in flow and load as stipulated in EN 12255-1 and EN 12255-11.

5.2 Regulation

National or local regulations or the relevant authority may set requirements for phosphorus removal, recovery and re-use. This may also include a limit for the metal (iron or aluminium) used in the precipitation/flocculation of phosphorus in its various forms.

Limits would typically be on the remaining concentration of metal in the final effluent or its pH range. The mechanism and risk of over-dosing should be considered in the design phase.

5.3 Phosphorus removal strategies

5.3.1 General

Phosphorus can be removed by primary treatment followed by biological or chemical treatment and may require tertiary (solids removal) to meet tighter consents.

The Total Phosphorus permit limits imposed on sites can typically range from 2 mg/l down to 0,25 mg/l. The recommend strategy for achieving these permits varies depending on a number of factors:

— the total Phosphorus permit;

— the site's biological treatment stage;

— the site's final effluent solids removal performance;

— the precipitant chemical chosen to achieve Phosphorus removal.

5.3.2 Primary treatment

In primary treatment, phosphorus fixed to settleable particles is removed (5 % to 15 % of the total influent phosphorus depending on the character of the wastewater).

5.3.3 Biological treatment

In the biological treatment a certain amount of phosphorus is consumed at the microbial synthesis of new cellular material (10 % to 30 % of the influent phosphorus). By introducing anaerobic zones in activates sludge systems where phosphates are released an increased biological removal of total phosphorus can be reached without addition of chemicals (60 % to 90 % of the influent concentration). The uptake of Phosphorus in the anoxic and aerobic zones is thus increased (so-called luxury uptake). This additional process in activated sludge systems with incorporated anaerobic zones is called “enhanced biological phosphorus removal” (EBPR).

The following table outlines an approach for sites with new total phosphorus permits which have not previously had final effluent total phosphorus permits and do not have existing tertiary solids removal (TSR) e.g. through effluent filtration:

Table 1 — Recommended strategies for meeting proposed total phosphorus permits

Biological treatment stage	Total phosphorus permit			
	≥ 1 mg/l	0,75 mg/l to 1 mg/l	0,5 mg/l to 1 mg/l	< 0,5 mg/l
Activated sludge plant	Single point dosing	Single point dosing with TSR	Dual point dosing	Dual point dosing with TSR
Trickling filters		Single point dosing	Dual point dosing	

NOTE The above table assumes good performance of existing final or humus tanks with respect to solids removal.

5.3.4 Tertiary treatment

If an assessment of the site indicates that final effluent suspended solids is high (>10 mg/l on average), TSR technology shall be considered at less stringent total phosphorus permits than Table 1 recommends.

Where the existing phosphorous or solids removal performance of the plant is poor, or the permit has been made more stringent, refurbishment of assets to improve the performance should be considered as an alternative option to the installation of new TSR technology. This review should consider data from as long a period as possible.

Tertiary solids removal (e.g. the use of: continuous upflow filters, rapid gravity filters, cloth filters or disc filters) may be required downstream of the final settlement tanks (FSTs) to meet permit requirements. This assessment must be made by the designer on a case by case basis.

5.4 Design considerations

5.4.1 Chemical

The reactions involved in the precipitation of phosphate shall be considered in light of the many competing reactions and the associated equilibrium constants. Many parameters may influence a plant's ability to meet a total phosphorus permit or chance for metal break-thorough and shall therefore be considered in any design.

At the commencement of any projects involving chemical phosphate removal, it is essential to establish the level of total phosphorus within the wastewater to be treated. If high levels of phosphorus are present (greater than 10 mg/l), an audit to understand the source(s) should be undertaken to establish if source reduction offers a better option.