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Čistilne naprave za odpadno vodo - 5. del: Lagunski postopki

Wastewater treatment plants - Part 5: Lagooning processes

Kläranlagen - Teil 5: Abwasserbehandlung in Teichen

Stations d'épuration - Partie 5: Lagunage

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Wastewater treatment plants - Part 5: Lagooning processes

Stations d'épuration - Partie 5: Lagunage

Kläranlagen - Teil 5: Abwasserbehandlung in Teichen

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

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European foreword

This document (prEN 12255-5:2022) has been prepared by Technical Committee CEN/TC 165 “Waste water engineering”, the secretariat of which is held by DIN.

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).

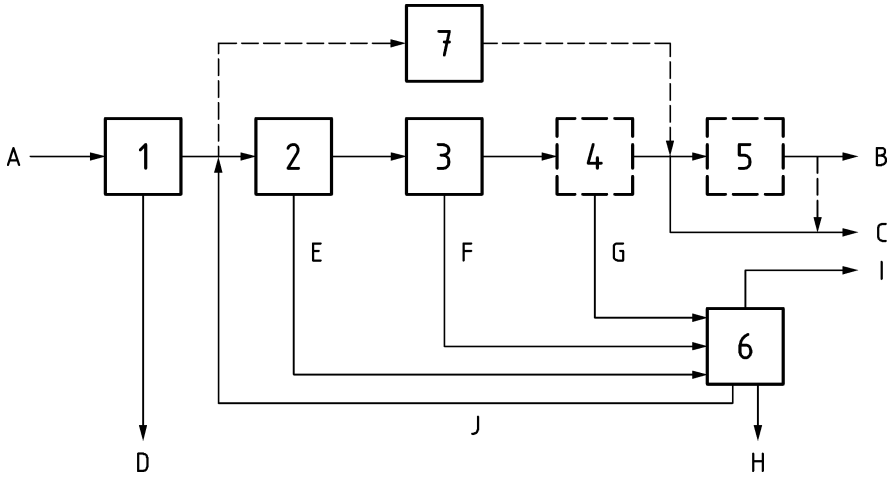
It is the fifth part prepared by Working Group CEN/TC 165/WG 40 relating to the general requirements and processes for treatment plants for a total number of inhabitants and population equivalents (PT) over 50. EN 12255 with the generic title *Wastewater treatment plants* consists of the following parts:

- *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, *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 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.

1 Scope

This document specifies the performance requirements for the installation of Lagooning processes.

This document applies to wastewater Lagooning processes treating municipal wastewater from combined or separate sewage systems and when used as a tertiary treatment.

NOTE Lagooning processes are especially suitable for treatment of wastewater where large variations in flow are experienced (e.g. resulting from stormwater). Lagoon Systems are also especially suitable when there are large variation in load from seasonal industrial or tourism for example.

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

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:

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

3.1
maturation pond
wastewater lagoon used as a tertiary treatment typically for the removal of pathogenic micro-organisms by exposure to solar radiation by competition and predation mechanisms

[SOURCE: EN 16323:2014, term number 2.3.5.27]

3.2
facultative lagoon
wastewater lagoon combining a natural aerated surface layer with a base anaerobic layer

Note 1 to entry: Faculative lagoons are typically used for the removal of carbon and nitrogen.

4 Symbols and abbreviations

BOD	biological oxygen demand
OPEX	operational expenditure
TSS	total suspended solids
UV	ultra violet light

5 Process description

5.1 Natural lagoons

Typically, natural lagooning for wastewater treatment is designed as a cascade of separate ponds operated consecutively. The first pond in the sequence, may be either a settlement or anaerobic pond. Anaerobic lagoons are designed to remove BOD through the digestion processes, they generate methane and carbon dioxide gases as by-products. These ponds are deep in order to accommodate sludge accumulation and to reduce the surface area to volume ratio in order to maintain anaerobic conditions.

The second pond in the sequence, is a facultative pond. This is partly aerobic and serves for the degradation of carbon and nitrogen. Facultative ponds combine a surface layer (which is kept aerobic through photosynthesis and surface reaeration), with a base sludge-rich layer (where anaerobic decomposition processes dominate). Facultative ponds must be relatively shallow in order to have a sufficient surface area to volume ratio to enable adequate algal growth.

Subsequent ponds serve for advanced treatment including the reduction of pathogens and/or organisms by exposure to solar radiation. These polishing ponds are completely aerobic and the pathogen die-off is promoted by the alkaline conditions generated by the algal photosynthetic activity. In order to promote the algal growth and the action of the UV radiation in the removal of pathogens, these ponds are shallower than the facultative ponds.

5.2 Accelerated facultative lagoons

Accelerated facultative lagoons require a minimum of two lagoons in series and can have very low OPEX by using renewable energy (wind powered) mixing systems to optimise oxygen absorption from the air water interface. This maintains a fully aerobic water column above the sludge water interface which provides odour control and optimises biological processing.

Low energy mixing

- avoids lifting solids into suspension,
- eliminates short circuiting,
- prevents ice formation,
- distributes the incoming load across the lagoon eliminating overloading at the inlet,
- optimises disinfection through repeated exposure of the lagoon water column to solar radiation.

As well as BOD/TSS removal, sustainable sludge digestion is provided in the primary lagoon with the secondary lagoon used for further BOD/TSS removal nitrification, disinfection and general polishing.

5.3 Accelerated facultative lagoons

Aerated facultative lagoons require a minimum of two lagoons in series and operate at a deeper depth to reduce surface area while still maintaining the simplicity of the accelerated facultative lagoon process. The increased surface loading requires an aeration/mixing system to be installed in both lagoons to maintain sufficient oxygen for processing and odour control. Large volumes/loads can be treated in multiple parallel trains with the primary lagoons providing BOD/TSS removal and sustainable sludge digestion with the secondary lagoons providing further BOD/TSS removal, nitrification, disinfection and general polishing.

5.4 Aerated lagoons

Aerated lagoons consist of at least two ponds, the first in the series is actively aerated and the second is used for sedimentation.

5.5 Polishing ponds

Polishing ponds are mainly used for further reduction of suspended solids in wastewater received from treatment plants through settlement and as such require periodic desludging.

5.6 Combinations with other systems

Accelerated and Aerated Facultative lagoons can be used in front of small technical systems eliminating primary/storm tanks to reduce load on these small systems and eliminate sludge handling and disposal. Where odour is likely to occur, mixing can be employed to increase oxygen and treatment capacity instead of adding anaerobic lagoons or upflow conical sedimentation tanks. Examples of common combinations of lagoons are given in Table 1.

Table 1 — Combination examples for multi-stage wastewater lagoons

No	Pre-treatment	C elimination	N elimination	Disinfection	Scope of application comment
1	—	faculative lagoon		maturation lagoon	C elimination, large floor space required
2	anaerobic lagoon	faculative lagoon	optional: additional biological treatment (e.g. trickling filter)	maturation lagoon	C elimination, large floor space required
3	anaerobic lagoon	aerated lagoon		maturation lagoon	C elimination, less floor space required than under No. 1 and 2

6 Requirements

6.1 General

The general construction requirements specified in EN 12255-1 and safety requirements specified in EN 12255-10 apply to this part.

Where active aeration is a requirement, reference should be made to EN 12255-3.

6.2 Siting

Where odour is likely to occur (e.g. natural lagooning) plants shall be located a minimum of 200 m from any habitation. The main wind direction, topography, ground water table, geotechnical conditions, risk of flooding and landscape should be taken into account.

Odour from natural lagooning plants can be controlled through the use of mixing systems to increase oxygen in the water column allowing greater flexibility in locating plants.

6.3 Accessibility

It shall be possible to bring appropriate machinery to any point around a lagoon for the maintenance of banks, control of vegetation and de-sludging.

Unauthorized access to the lagoon installation shall be prevented, e.g. fences.

6.4 Design

6.4.1 Process considerations

Typical design parameters for lagoons are given in Annex A. The design of the lagooning system shall ensure it operates with all the earth basins full to the top water level.

The physical design (overflow structures and materials) and the conditions of operation which prevent damage to the structures shall be specified. Information on the climatic conditions shall be specified.

In addition to the requirements specified in EN 12255-1 and EN 12255-11 the following parameters shall be considered for the design of a lagooning system:

a) the climatic conditions for the lagoons treating wastewater under mainly naturally established conditions e.g. anaerobic lagoons, facultative ponds, oxidation ponds, maturation ponds;

b) a minimum depth of 1 m taking account of the volume to be occupied by the sludge before withdrawal and free sedimentation of solids; especially for settlement and anaerobic lagoons;

c) inlet and outlet configuration with respect to sludge blanket level and accessibility for cleaning;

d) the frequency for sludge removal;

e) the type, number and unit size of aeration equipment for the water depth and the protection of the bottom from erosion in aerated lagoons;

f) the minimization of short circuiting by suitable shape, design and location of the lagoon inlet and outlet;

g) the exposure to solar radiation in maturation ponds should not be reduced and the intensified growth of algae and their effect on the receiving waters shall be considered;

h) the way of sludge disposal;

i) the effect of any increased flows arising from storm events received by the structure;

j) the outlet of ponds should be placed at the leeward side.

6.4.2 Watertightness

National or local regulations or the relevant authority may have requirements for how the watertightness is determined and threshold values that may apply. Where such requirements do not exist

- earth basins shall be watertight to a permeability factor of less than 10^{-8} m/s to 0,3 m soil,
- other basins with short detention time of no more than 10 days and treating secondary effluent e.g. polishing ponds shall be watertight to a permeability factor of at least 10^{-7} m/s to 0,3 m soil.