

**KENYA STANDARD**

**KS 2767-  
5:2021**

ICS [##.###]

[1<sup>st</sup>] Edition

# **Wastewater treatment plants — Part 5: Lagooning processes**



## TECHNICAL COMMITTEE REPRESENTATION

The following organizations were represented on the Technical Committee:

1. [CSI International Ltd
2. Dousglobal Management solutions
3. Ecosave Africa Ltd
4. Embu Water and Sanitation Company LTD
5. Environment Institute of Kenya
6. Green Kenya Investment Corporation
7. Jomo Kenyatta university of agriculture and technology
8. KenGen PLC
9. Kenya Chemical Society
10. Kenya water Institute
11. Kenyatta university
12. Nairobi City Water and Sewerage Company
13. National Environment Management Authority
14. National Public Health Laboratory
15. Synergy Ltd
16. Taita Taveta University
17. TANATHI Water Works Development Agency
18. United States International University-Africa
19. Kenya Bureau of Standards — Secretariat ]

## REVISION OF KENYA STANDARDS

In order to keep abreast of progress in industry, Kenya Standards shall be regularly reviewed. Suggestions for improvements to published standards, addressed to the Managing Director, Kenya Bureau of Standards, are welcome.

© Kenya Bureau of Standards, [yyyy]

*Copyright. Users are reminded that by virtue of Section 25 of the Copyright Act, Cap. 130 of 2001 of the Laws of Kenya, copyright subsists in all Kenya Standards and except as provided under Section 25 of this Act, no Kenya Standard produced by Kenya Bureau of Standards may be reproduced, stored in a retrieval system in any form or transmitted by any means without prior permission in writing from the Managing Director.*

# Wastewater treatment plants — Part 5: Lagooning processes

Kenya Bureau of Standards, Popo Road, Off Mombasa Road,  
P.O. Box 54974 - 00200, Nairobi, Kenya



+254 020 6948000, + 254 722202137, + 254 734600471



info@kebs.org



@KEBS\_ke



kenya bureau of standards (kebs)



## **Foreword**

This Kenya Standard was prepared by the Water and Sanitation Technical Committee under the guidance of the Standards Projects Committee, and it is in accordance with the procedures of the Kenya Bureau of Standards

[During the preparation of this standard, reference was made to the following document (s): EN 12255-5 : Wastewater treatment plants — Part 5: Lagooning processes.

Acknowledgement is hereby made for the assistance derived from this (these) source (s) ]

The parts of these 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 automatization<sup>1)</sup>
- Part 13: Chemical treatment
- Part 14: Disinfection<sup>1)</sup>
- Part 15: Measurement of the oxygen transfer in clean water in activated sludge aeration tanks
- Part 16: Physical (mechanical) filtration<sup>1)</sup>



## Wastewater treatment plants — Part 5: Lagooning processes

### 1 Scope

This Standard specifies the performance requirements for the installation of lagooning processes.

This part applies to wastewater lagooning processes treating municipal wastewater from combined or separate sewerage 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).

### 2 Normative references

This Standard incorporates by dated or undated references provision 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 Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

KS 2766 Wastewater treatment - Vocabulary

KS 2767-1 Wastewater treatment plants - Part 1: General construction principles

KS 2767-3 Wastewater treatment plants - Part 3: Preliminary treatment

KS 2767-6 Wastewater treatment plants - Part 6: Activated sludge process

KS 2767-10 Wastewater treatment plants - Part 10: Safety principles for the construction of wastewater treatment plants

KS 2767-11 Wastewater treatment plants - Part 11: General data

### 3 Definitions

The definitions given in KS 2766 apply. In addition, for the purposes of this standard, the following definition also applies:

#### 3.1

##### **maturation pond**

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

### 4 Process description

#### 4.1 Natural lagoons

Natural lagooning for wastewater treatment is designed as a cascade of singular ponds operated consecutively. The first pond may be either a settlement or anaerobic pond. The following pond is partly aerobic (facultative pond) and serves for the degradation of carbon and nitrogen. Subsequent ponds serve for advanced treatment including the reduction of pathogens and/or organisms by exposure to solar radiation.

#### 4.2 Aerated lagoons

Aerated lagoons consist of at least two singular ponds, one with artificial air supply by technical devices and the second for sedimentation.

### **4.3 Polishing ponds**

Polishing ponds are mainly used for the further reduction of suspended solids in wastewater received from treatment plants.

### **4.4 Combinations with other systems**

A combination of ponds and small technical systems (e.g. trickling filter, rotating disc) may be installed in cases of overloaded lagoons or where there is a need for advanced treatment. Where odour is likely to occur Imhoff tanks may be installed instead of anaerobic lagoons.

Screening should be carried out before the wastewater enters aerated lagoons. Additional preliminary treatment may be required (see KS 2767-3).

## **5 Requirements**

### **5.1 General**

The requirements specified in KS 2767-1 and KS 2767-10 apply to this part.

Where technical aeration is a requirement reference should be made to KS 2767-6 and where additional preliminary treatment is required, e.g. screening, reference should be made to KS 2767-3.

### **5.2 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.

### **5.3 Accessibility**

It shall be possible to bring 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.

### **5.4 Design**

#### **5.4.1 Process considerations**

The design of the lagooning system shall ensure it operates with all the earth basins full to the top water level. If not otherwise agreed, the conditions of operation which prevent damage to the structures shall be specified.

In addition to the requirements specified in KS 2767-1 and KS 2767-11, 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. Information on the climatic conditions shall be specified;
- 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) avoidance of floating debris from moving from one chamber to another by use of a siphoning pipe placed not more than 1/3 of the depth of the chamber.
- h) the intensified growth of algae and their effect on the receiving waters shall be considered;
- i) the way of sludge disposal;
- j) the effect of storm water.

#### 5.4.2 Watertightness

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  $10^{-7}$  to 0.3 m soil. Validation of watertightness should be carried out in accordance with national procedures.

Where watertightness is to be ensured by soil compaction, the optimum compacting conditions e.g. load and moisture content, shall be assessed by preliminary tests. Watertightness shall be tested by laboratory test before filling with water by at least three permeability measurements per basin.

Where watertightness is ensured by a synthetic lining system, the lining shall be, opaque, abrasion resistant and UV resistant. Special precautions shall be provided to prevent gas accumulation under the lining.

Synthetic linings should be a minimum of 3 mm in thickness.

Where watertightness is ensured by clay, the layer should be a minimum of 0.3 m thickness.

When emptying lagoons or where there is a rise in the level of ground water, measures shall be established to protect the watertight construction.

#### 5.4.3 Banks

In natural soil and subsoil the banks above and under water of lagoons should not be steeper than 1:2. The banks of lagoons should be protected against erosion. Aerated lagoons should be especially protected 0.3 m below and above the water level where wave action is likely.

Where banks are covered with a clay layer they shall not be steeper than 1:3 and measures shall be taken to prevent this layer from cracking (e.g. cracking by desiccation).

#### 5.4.4 Structures and pipeworks

The inlet to the first lagoon within a system shall be fitted with a device for retention and easy removal of floating matter. There should be a bypass facility for each lagoon. The interconnecting channel or pipework system between lagoons shall be designed to permit cleaning from the bank and shall prevent deposits and floating matter from being conveyed downstream. The outlet of the final basin shall be designed to permit measurement of flow and sampling.

**KS 2767-5:2021**