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Waste water treatment plants —

Part 2: General construction principles

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Foreword

Rwanda Standards are prepared by Technical Committees and approved by Rwanda Standards Board (RSB) Board of Directors in accordance with the procedures of RSB, in compliance with Annex 3 of the WTO/TBT agreement on the preparation, adoption and application of standards.

The main task of technical committees is to prepare national standards. Final Draft Rwanda Standards adopted by technical committees are ratified by members of RSB Board of Directors for publication and gazettement as Rwanda Standards.

DRS 126-2 was prepared by Technical Committee RSB/TC 009 on *Civil engineering and building materials*.

In the preparation of this standard, reference was made to the following standards:

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

2) BS EN 12255-10:2001, *Waste Water Treatment Plant — Safety Principles*

3) EN 752-6, *Drain and sewer systems outside buildings — Part 6: Pumping installations*

4) EN 809, *Pumps and pump units for liquids — Common safety requirements*

5) EN 1085, *Wastewater treatment — Vocabulary*

6) EN 12255-9, *Wastewater treatment plants — Part 9: Odour control and ventilation*

7) EN 12255-12, *Wastewater treatment plants — Part 12: Control and automation*

The assistance derived from the above source is hereby acknowledged with thanks.

This second edition cancels and replaces the first edition (RS 126-2: 2012), clause 4 of which has been technically revised.

DRS 126 consists of the following parts, under the general title *Waste water treatment plants*:

— *Part 1: Vocabulary*

— *Part 2: General construction principles*

— *Part 3: Safety requirements*

— *Part 4: General data required*

Committee membership

The following organizations were represented on the Technical Committee on *Civil engineering and building materialsnd Safety* (RSB/TC 13) in the preparation of this standard.

B. J Construction Ltd

Bridge to Prosperity

CIMERWA

Green Pact Africa

Mass Design

Rwanda Housing Authority

Rwanda Inspectorate, Competition and Consumer Protection Authority (RICA)

UR-CST

Rwanda Standards Board (RSB) – Secretariat

Waste water treatment plant — Part 2: General construction principles

1 Scope

This Draft Rwanda Standard specifies general requirements for structures and equipment as they relate to wastewater treatment plants for a total population of more than 50 PT.

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

Requirements for structures which are not specific for wastewater treatment plants are not within the scope of this Draft Rwanda Standard. Other Rwanda Standards can apply.

Equipment which is not solely used in wastewater treatment plants is subject to applicable product standards. However, specific requirements for such equipment when used in wastewater treatment plants are included in this part.

General principles of building construction, mechanical and electrical engineering are not subject of this standard. This Rwanda Standard does not cover the design of treatment processes.

This standard gives fundamental information about the systems; this standard has not attempted to specify all available systems.

2 Normative references

The following referenced documents are indispensable for the application 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.

RS 126-3, Waste water treatment plants — Part 3: Safety requirements

3 Terms and definitions

For the purposes of this standard, the following terms and definitions.

3.1

structure

any construction and its components built for the accommodation of equipment

3.2

equipment

any component which is installed in, mounted on, attached to, or operated on structures, in the performance of their intended function

3.3

units

any structure including any related equipment which is used as a process stage and which can be isolated from other parallel, upstream or downstream structures.

NOTE Examples for a units are a grit chamber, a clarifier, an aeration tank, a thickener, a digester.

3.4

assembly

mechanical equipment that can be removed and replaced as a whole

NOTE Examples for an assembly are a pump, a compressor, a gas engine, an aerator.

3.5

wastewater treatment plant

system for the purification of wastewater including structures and equipment

3.6

client

municipality, city or other organization or its representative which intends to build a wastewater treatment plant or parts thereof

3.7

bidder

company or other organization which offers to build a plant, or to build or supply parts thereof

3.8

contractors

company or organization which received a contract to build a plant, or to build or supply parts thereof

3.9

tracks

those parts of a structure on which wheels run

3.10

design loading Y_N

effective average loading in continuous operation under full load

NOTE It is greater than or equal to the value of the operating loading which, for example, fluctuates as a function of the given load.

3.11

continuous load bearing capacity YC

load bearing capacity in continuous operation under full load

3.12

maximum loading Ymax

peak loading which is taken as the switch-off value to which, for example, overload circuit breakers are adjusted

3.13

maximum load bearing capacity YB

highest possible load bearing capacity limited to short-term load peaks, such as occur on switching on and off

NOTE In addition, alarm loadings Y_S, lying between the design loading Y_N and the switch-off loading Y_{max}, can be agreed as required, Y_N and Y_{max} being stated by the equipment supplier.

3.14

utilization factor K_A

parameter for the effects on drive units etc., intrinsic to their operation

NOTE Usually KA includes either directly or indirectly information on the loading, running time and temperature and is an overall value of the relationship between load bearing capacity and loading.

3.15

design service life

operating time until break-down of a machinery element under design loading, which is reached by a certain percentage of the elements tested

NOTE As an example, the percentage for rolling bearings is 90 %; the design service life is different from both the warranty time and an average service life of use, as used for cost efficiency calculations.

3.16

mode of operation

characteristic value related to the effects on motors and other electrical components intrinsic to their operation (e.g. frequency of starts, temperatures)

3.17

degree of protection

characteristic value related to the effects on motors and other electrical components intrinsic to their environmental conditions (e.g. effects of water or dust)

4 Requirements

4.1 General requirements

Wastewater treatment plants shall meet the following requirements:

a) National regulations shall be observed;

b) The discharge limits shall be met;

c) be capable of satisfactory treatment of the full range of flows and loads;

d) personal safety;

e) nuisance, odour, noise and toxicity, aerosols and foam shall be considered and shall meet the relevant requirements of BS EN 12255-9 and RS 126-3;

f) danger to operating personnel shall be minimized;

g) the required service life and long term structural integrity shall be achieved, including water and gas;

h) tightness;

i) provisions shall be made for case of operation and maintenance;

j) provision for future extensions or modifications of the plant shall be considered;

k) the reliability of operation shall be high and risk of danger and the impact of malfunctions shall be limited;

l) be cost effective in respect of total costs (capital and operating costs);

m) the energy consumption during construction and operation shall be considered; and

n) the waste products shall be reduced in quantity and improved in quality as far as reasonably achievable to allow for reuse or safe disposal.

4.2 Design requirements

4.2.1 All assemblies that are subject to occasional failure (e.g. pumps and compressors) shall be installed with sufficient stand-by capacity so as to achieve full treatment capacity and efficiency with one assembly out of service. In the case where stand-by assemblies cannot be practically installed, provisions shall be made to replace rapidly by another one kept in stock.

4.2.2 Where practicable and necessary for maintenance work it shall be possible to bypass every unit or assembly, either by a parallel unit or assembly, channel or pipe.

4.2.3 Where necessary the inlet to the treatment plant shall include a facility which limits the flow. Such facilities may be balancing tanks and/or storm water overflows as required by the authorities.

4.2.4 Where power supply is subject to prolonged interruption, wastewater treatment plants shall have emergency power generation or an equivalent facility to provide a sufficient power supply during power failure of the network, e.g. a terminal for easy connection with a readily available mobile power generator. Connected to the emergency power supply shall as a minimum include the measuring and control system, the pumps for waste water and return sludge and any aeration equipment (at a designed minimum capacity).

4.2.5 When the power supply is restored after an interruption, the treatment plant shall be designed so that normal operating status is resumed automatically.

4.2.6 Provision shall be made for taking representative samples upstream and downstream of each unit and of any flow whose characteristics are important for operation and supervision.

4.2.7 The design shall ensure that all information (quantities and qualities) that is important for effective operation of the plant is readily obtainable (e.g. flows, levels, pressures, temperatures, dissolved oxygen concentrations, pH-values, other concentrations).

4.2.8 The design shall enable cleaning, maintenance and repairs to be carried out easily and safely (e.g. access, flushing connections to pipes, isolation means).

4.2.9 Appropriate provision shall be made for the case of malfunction or emergency.

4.3 Structural requirements

4.3.1 General

Structures shall be:

a) stable to bear all loads during construction, operation and maintenance periods

(e.g. water pressures, static and dynamic forces being induced by the equipment);

b) resistant against chemical and biological attack from wastewater, sludge, air and gas components and against temperatures and temperature changes as appropriate; and

c) protected against flotation.

4.3.2 Dimensional tolerances

The permissible dimensional tolerances for structures which are required for the function of the equipment are specified in Annex A. Other dimensional tolerances shall be agreed with the supplier of the equipment.

4.3.3 Concrete tracks

4.3.3.1 Tracks shall be identified in the drawings.

4.3.3.2 Tracks shall be level and free of ridges.

4.3.3.3 Particular requirements in regard of the quality and placing of the concrete shall be met in order to reinforce the tracks against the effects of compression and shear forces.

4.3.3.4 The strength of concrete shall not be less than 35 N/mm².

4.3.3.5 The maximum pressure on the wheels shall be limited to:

a) rubber wheels 2.5 MN/m²;

b) polyurethane wheels 5.0 MN/m²

In the latter case, protection of the track with steel plates or other suitable material may be necessary.

4.3.4 Fixings and connections between equipment and structures

4.3.4.1 The possibility of differential settlement between structures, and between structures and equipment (such as pipelines) shall be taken into account. Sufficient flexible joints and flexibility in the equipment itself or in its connections to the structures shall be provided.

4.3.4.2 Reinforcement in the structure shall not be used for securing equipment.

4.3.4.3 Where different metals are in contact, measures shall be incorporated to prevent corrosion by galvanic action.

4.3.4.4 Where metallic fixings might be in electrical contact with the reinforcement of the structure appropriate electrical insulation shall be provided, e.g. insulating, chemical anchor with threaded rod.

4.3.5 Access

4.3.5.1 Safe and sufficient access in the form of paths, gangways, bridges, stagesand the like shall be provided to allow supervision, operating, servicing, cleaning and maintenance. Openings shall be provided which allow easy replacement of equipment.

4.3.5.2 The location of operating and maintenance points shall allow for adverse weather conditions and other hazards (e.g. handling of gases, vapours, sludge, oil and grease) and possibility of collapse, squeeze and sheer points.

4.3.5.3 The buildings and access shall be sufficiently large to allow all erecting and dismantling, maintenance and repair operations and replacement of assemblies in an easy manner.

4.3.5.4 Appropriate means shall be provided to deter access by unauthorized persons.

4.3.6 Building ventilation

In enclosed rooms, the possible existence of damp atmospheres, foul air and the risk of explosions shall be considered according to RS 126-3. Adequate ventilation shall be provided according to BS EN 12255-9.

4.3.7 Water supply and drainage

4.3.7.1 Where occasional flushing is required, a water supply shall be installed. Process water shall preferably be used for this purpose. Appropriate means shall be provided to prevent process water from contaminating the drinking water network. Any national regulations for the quality of process water used for flushing shall be observed. This may be particularly important when water is pressurized.

4.3.7.2 Appropriate drainage shall be installed where water accumulation may occur due to overflow, leakage or flushing. In such locations, all floors shall be sealed and sloped towards a pit from where the water drains by gravity or is automatically pumped away. All tanks should be constructed to allow emptying.

4.3.8 Lifting equipment

Lifting equipment or adequate provisions for removal shall be provided where necessary in order to allow all maintenance work and replacement of all assemblies.

4.3.9 Storage for hazardous chemicals and fuels

4.3.9.1 Where hazardous liquid chemicals or fuels are stored or conveyed, provisions must be made to prevent environmental impact in case of leakage. National regulations and any requirements in RS 126-3 shall be observed. The required safety provisions (e.g. double tank walls, tanks in bunds, leak sensors) will depend on the volumes stored and potential risks..

4.3.9.2 Tanks containing chemicals that would interact to form a hazardous mixture or could attack the material of other tanks shall not share a single bund.

4.4 Requirements for equipment

4.4.1 Principles for mechanical design

4.4.1.1 The use and requirements of the equipment shall be specified.

4.4.1.2 A general description and the following information shall be provided:

a) loads (e.g. traffic loads, wind loads, operating loads and travelling single loads);

b) loadings (e.g. design loading, maximum loading, alarm loadings);

c) load bearing capacities (e.g. continuous load bearing capacity, maximum load bearing capacity);

d) utilization factor K_A;

e) mode of operation;

f) degree of protection provided by enclosures. All gears and drives which are located above water, but near a place where water jet flushing may take place, shall be protected against spray water; gears and drives which may be directly cleaned with water jets shall be protected.

g) safety measures and precautions.

4.4.2 General design requirements

4.4.2.1 Walkways, stairs, platforms and gratings

Irrespective of the design traffic load, the load-bearing capacity of walkways shall not be less than 3.5 kN/m^2. In addition, the maximum deflection of a walkway shall not exceed 10 mm or the span divided by 200.

4.4.2.2 Covers, assembly openings, cleaning openings

The design and arrangement of covers, assembly openings and cleaning openings shall be consistent with the operational requirements of the plant. Openings shall be fitted with secure covers which cannot shut accidentally. Where frequent access is required, the covers shall be easily opened and closed and shall be tight to control gas and odour.

4.4.2.3 Cable drums with spring motors

Spring motors used for cable drums may be employed only where the number of cycles does not exceed 1 000 per year and the path length does not exceed 30 m.

4.4.2.4 Pumps and pipelines

4.4.2.4.1 All pumps shall be appropriate to the conveyed medium and its condition.

4.4.2.4.2 The minimum nominal diameter of pipes and pumps shall be specified appropriately to the medium conveyed. Generally, the minimum nominal diameter shall be DN 80 if mixtures of water and grit or sludges are conveyed. Smaller minimum nominal diameters may be agreed if upstream comminution or sieving is incorporated or where there is no risk of blockage.

4.4.2.4.3 Pumps shall be provided with individual isolating valves and check valves, if not otherwise specified. Positive displacement pumps shall be equipped with a sensor and a pressure switch to detect lack of liquid inflow and prevent damage.

4.4.2.4.4 Isolating and check valves shall be tight when closed and be appropriate for the medium and its condition (e.g. pressure, temperature, composition). If not otherwise specified, there shall be no internal obstruction to the flow when opened.

4.4.2.4.5 The forces and vibrations arising in pipe systems shall be taken into account in the design.

4.4.2.4.6 For pipelines conveying wastewater, sludge or digester gas, the pipe arrangement, the profile and the velocity shall be such that sedimentation (and condensation accumulation in gas or air pipes) and gas accumulation are avoided. Where this is not possible, means for the removal of sediment, condensate and gas accumulation shall be provided. Branches shall not be made in such a way that obstructions are likely to be formed. If not otherwise specified, the radius of bends shall be minimum three times the nominal diameter.

4.4.2.4.7 Pipes shall be readily identifiable or marked to ease of identity.

4.4.2.4.8 Pipe systems shall be water and gas tight as necessary.

4.4.2.5 Blowers, compressors

4.4.2.5.1 Blowers and compressors shall be appropriate for the intended use and blowers for aeration shall deliver an air sufficiently free from oil.

4.4.2.5.2 Blowers and compressors shall be equipped with appropriate isolating and check valves and, where necessary, with temperature and pressure switches.

4.4.2.6 Measuring and control equipment

4.4.2.6.1 Measuring and control equipment serves to acquire process information which is necessary for the safe reliable and efficient operation of the wastewater treatment plant and its equipment.

4.4.2.6.2 The necessary measuring and control equipment shall be specified at an early planning stage, taking into account the installation conditions. This applies both to its location within the plant and to the layout and size of the structures as a function of the type of equipment.

4.4.2.7 Electrical equipment

4.4.2.7.1 The necessary electrical equipment shall be specified at an early planning stage, taking into account the installation conditions. This applies both to its location within the plant and to the layout and size of the structures depending on the type of equipment.

4.4.2.7.2 Additional information on specific structures and assemblies is given in the relevant specific standards.

4.4.2.8 Materials and corrosion protection

4.4.2.8.1 Materials used for the equipment shall be resistant to attack by the constituents of municipal wastewater and sludge, aerosols, sewage gases and atmospheric influences (e.g. micro-atmosphere) as appropriate and consistent with the relevant requirements. The client shall inform the equipment supplier of any special factors, such as the presence of septic sewage. If different materials are connected, detrimental galvanic corrosion shall be prevented. If load-bearing components are made of plastic material, detrimental effects of the environment (e.g. UV-radiation, temperature) shall be considered.

4.4.2.8.2 Unless otherwise specified, the supplier may assume that the wastewater concerned is municipal containing industrial effluents only in such portions that the characteristics lie within the limits given by the relevant consent standards for the discharge of wastewater into municipal sewers. On this basis, the equipment supplier shall select the materials.

4.4.2.8.3 Local conditions may require the use of particularly durable materials; this being subject to special agreement between contractor and client. Durability can be achieved by the use of materials inherently resistant to corrosion or by the application of a suitable coating. Where possible, anti-corrosion protection shall form part of the manufacturing process.

4.4.2.8.4 Jointing elements (e.g. nuts, bolts, washers and screws) which are in contact with water or corrosive atmosphere should be made of stainless steel, with the exception that use of high-strength material is necessary to bear strong forces.

4.4.2.9 Fabrication of welded equipment

4.4.2.9.1 Proof of qualification is required for the personnel fabricating welded structures and equipment (e.g. isolating gates, working platforms, conveyor systems, screening assemblies and sludge scrapers).

4.4.2.9.2 Special skills of the personnel in charge of welding work for systems which are to contain inflammable or explosive fluids, such as fuel or gas, are required.

4.4.2.9.3 These requirements do not invalidate other specifications for individual equipment, such as pressure vessels.

4.4.2.10 Scrapers

Since scrapers are used in several units, their design principles are specified in this general part.

Loads and dimensioning:

The traffic load on bridges shall be assumed to be 1.5 kN/m^2. Higher traffic loads may be agreed. The maximum deflection under combined action of its own weight and the main loads, with the exception of the traffic load, shall be the span divided by 500. The supporting structure shall be such that the main loads including operational loads do not cause any torsion liable to impair the scraper performance or resulting in its permanent deformation.

4.4.3 Environmental impact

4.4.3.1 All relevant requirements concerning emission control shall be observed. All wastewater treatment plants shall be located and designed with due regard for their effects on the environment.

4.4.3.2 Where significant emission to the environment is likely as a result of the operation of a wastewater treatment plant, such emission shall be abated by special measures relating to structures, equipment and methods of operation, due consideration being given to the distance of the area to be protected from the treatment plant. Emission of odour, noise and pollutants (e.g. oil and grease) shall be prevented by means of suitable structures, equipment and mode of operation.

4.4.3.3 Where additional measures to prevent or abate such emissions are required, these shall not impair the function, reliability, safety and maintenance of the plant and its components.

4.4.3.4 Soil and groundwater shall be protected from systems leakage.

4.4.4 Safety requirements

See RS 126-3.

4.4.5 Documentation

4.4.5.1 The basic documentation for wastewater treatment plants shall include "as completed" drawings for structures, parts of structures and equipment, means of corrosion protection, pipe work plans, wiring diagrams, operating instructions, lubrication plans and lists of spare parts and wearing parts, all these requiring regular updating. The documentation shall enable the client to undertake all service, maintenance and repair work and shall contain the essential information for future modification or extension works.

4.4.5.2 The client shall specify the language in which the basic documentation is to be supplied.

4.4.5.3 Operating instructions shall cover the general process and any specific local modifications or peculiarities. Frequency and scope of routine tasks as well as the necessary servicing measures for all parts of the plant, including checking its quality of operation, shall be described.

4.4.6 Spare parts, special tools

Spare parts shall be recommended by the supplier and be listed separately and satisfactory provision must be made for their availability.

Annex A
(informative)

Structural tolerances

A.1 Circular tank

A.1.1 Circular tank with scraper

a) Inner diameter of the tank: ± 0, 03 m;

b) Bottom contour: ± 0, 03 m.

A.1.2 Circular tank with a scraper bridge travelling on the side wall (track)

a) Inner diameter of the tank: ± 0, 03 m;

b) Bottom contour: ± 0, 03 m;

c) Inner and outer diameter of the track: ± 0, 03 m.

A.2 Rectangular tank

a) Distance of the side walls and tracks from the middle axis: ± 0, 02 m;

b) Distance of the tracks from each other: ± 0, 02 m;

c) Distance of the side walls from each other: ± 0, 02 m;

d) bottom surface laterally: ± 0, 01 m;

e) Level of tracks a distance of 4 m: ± 0, 02 m.

f) Only for suction type scraper and other non-swiveling scrapers:

g) Depth of tank (bottom to track): ± 0, 02 m.

Bibliography

[1] Regulation No 004/R/SAN/EWS/RURA/2016 of 10/11/2016, *Governing decentralized waste water treatment systems*

[2] RS 126-2:2012 *Waste water treatment plants – Part 2: Construction principles*

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