

RWANDA STANDARD

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Wastewater treatment plants

Part 4:

General data required

In order to match with technological development and to keep continuous progress in industries, standards are subject to periodic review. Users shall ascertain that they are in possession of the latest edition

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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 gazettment as Rwanda Standards.

RS 126-4 was prepared by Technical Committee RSB/TC 013, *Water and Sanitation*

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

BS 12255-11:2001 Waste Water Treatment Plant—Safety Principles

The first. edition (RS 126-4: 2012 has been reaffirmed by the Board on dd-mm-2019.

RS 126 consists of the following parts, under the general title Wastewater treatment plants:

- *Part 1: Vocabulary*
- *Part 2: General construction principles*
- *Part 3: Safety principles*
- *Part 4: General data required*

Committee membership

The following organizations were represented on the Technical Committee on Water and Sanitation (RSB/TC 013) in the preparation of this standard.)

Ministry of Environment (MoE)

Ministry of Disaster Management and Refugee Affairs (MIDIMAR)

Ruliba Clays Limited

Shine Engineers Multisectoral Company Limited (SEMC Ltd)

Sulfo Rwanda Industries (SULFO)

University of Rwanda/College of Science and Technology (UR/CST)

Water and Sanitation Corporation Ltd (WASAC Ltd)

Rwanda Standards Board (RSB) – Secretariat

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Waste Water Treatment Plant — Part 4: General Data Required

1 Scope

This Draft Rwanda Standard specifies data which is necessary for the planning, design, bidding, performance Guarantees, construction, start-up and compliance testing of a wastewater treatment plant or parts of it. This standard gives fundamental information about the practices; this standard has not attempted to specify all available practices.

This standard provides general requirements and processes for wastewater treatment plants for more than 50 PT.

2 Normative references

RS 548-1:2012: *Wastewater treatment –part1– Vocabulary*

RS 548-2:2012: *Wastewater treatment plants – Part 2: General construction principles*

3 Terms and definitions

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

3.1 plants

a new wastewater treatment plant; an upgrading or extension of an existing wastewater treatment plant or a part of a new or extended wastewater treatment plant (e. g. sludge handling facilities)

3.2 clients

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

3.3 functional tender

tender document that contains the design loads, a description of the site where the plant is to be built, the relevant discharge limits and any additional requirements

NOTE Turn-key contractors design the plant on the basis of the requirements and plans specified by the client (possibly with the assistance of a consulting engineer) and give bids on the plant as a whole in accordance with an overall guarantee. The turn-key contractor who secures the contract is responsible for the construction and the start-up of the plant as well as for the compliance with requirements demanded in the tender documents (turn-key project).

3.4

sectional tender

tender documents prepared for different sections of work for a plant

Note: e. g. earth work, concrete work, mechanical equipment, electrical installations, buildings etc. A plant is normally designed by a consulting engineer. Different companies may get the commissioning for the different sections. A consulting engineer may be commissioned to coordinate and to supervise the work.

3.5

consulting engineer

an independent engineer commissioned by the client designing a plant or parts of it and/or supervising the construction

NOTE He may assist the client with any work preparing all or part of the tender documents. He supervises the construction and checks the time schedule and costs. The consulting engineer has knowledge and experience in planning, design and operational aspects of wastewater treatment plants.

3.6

turn-key contractors

a contractor building a plant or parts of it as a whole

NOTE the turn-key contractor is a company which has knowledge and experience in planning, design, construction and operational aspects of wastewater treatment plants.

4 Client options

The client decides whether a functional tender or a sectional tender shall be prepared.

The client may commission a consulting engineer to carry out one or more of the following:

- a) establish the design loads and data;
- b) prepare the tender documents for a functional tender;
- c) design the plant and estimate the costs and prepare the tender documents for the sectional tender;
- d) inspect the construction in case of functional tendering;
- e) supervise and coordinate the construction in case of sectional tendering;
- f) evaluate the bids on the tenders and to propose which contractor or contractors (in case of sectional
- g) Tendering should be commissioned.

5 Basic design data required

Where applicable the following basic data either measured or estimated shall be provided by the client or his Representative e. g. consulting engineer.

5.1 Loading data

5.1.1 Sewerage system

The data on the sewerage system should include:

- a) Areas served by combined and/or separate sewers;
- b) Proportions of flows and loads from separate and/or combined sewer systems in dry weather
- c) Conditions;
- d) Storage capacity for storm water within the sewerage system;
- e) Potential to control and balance flows and loads within the sewerage system;
- f) Infiltration flows in dry weather conditions and their seasonal fluctuations (where appropriate);
- g) Septic and corrosive components of the wastewater.

5.1.2 Population served

The data on the population served shall include:

- a) Current population connected to the sewerage system;
- b) Population connected at start-up of the plant;
- c) Population connected at design horizon;
- d) Seasonal variations of population (e. g. holiday periods);
- e) Weekly variations of population (e. g. movement of commuting population).

5.1.3 Significant trades and industries

A list of trades and industries which discharge significant loads to the sewerage system should include the following flows and loads e. g.:

- a) COD, BOD₅, KN, NH₄-N, NO₃-N, total phosphorus, total suspended solids, organic suspended solids,
 - b) Salinity and alkalinity; shown as current, start-up, and design target data for:
-

- c) Hourly peak (m^3/h , kg/h);
- d) Weekly peak day (m^3/d , kg/d);
- e) Maximum weekly average (m^3/week , kg/week);
- f) Annual average (m^3/a , kg/a)
- g) In addition, for trades and industries with seasonal fluctuations the periods of high and low loads shall be included preferably as an annual diagram.
- h) The client shall specify dischargers who handle hazardous, toxic or inhibitory material and identify
- i) Which precautions are necessary to prevent that hazardous, toxic or inhibitory materials being discharged. Organic discharges with low biodegradability should be specified.

5.1.4 Data from existing wastewater treatment plants

The loading data and the operational results of the existing wastewater treatment plants contain valuable information.

As a minimum the following data for at least the previous year shall be provided:

- a) Annual wastewater flow (m^3/a), proportions treated physically, chemically and biologically;
- b) Average quantity (m^3/d) and composition of sludge with % solids, and % volatile solids content and
- c) Heavy metals;
- d) Annual quantity of screenings, grit and floatables;
- e) Average volume of liquor from sludge treatment (m^3/d) and organic and nutrient content;
- f) Average quantity of digester gas (m^3/d);
- g) – Electrical energy produced from digester gas (kWh/a);
- h) Electrical energy consumed (kWh/a);
- i) Probability plots and diagrams showing the following over a year wastewater flows (m^3/d) and the daily
- j) Loads of COD, BOD_5 , KN, $\text{NH}_4\text{-N}$, $\text{NO}_3\text{-N}$, total phosphorus, total suspended solids, organic
- k) Suspended solids, salinity and alkalinity;

- l) Seasonal temperature of the wastewater or biological reactor temperatures over a year;
- m) Diurnal fluctuation of the wastewater flow at dry weather conditions;
- n) Peak flow at storm water conditions (m^3/h);
- o) Amount and loads of other wastes than wastewater being delivered to the plant and
- p) Performance of the treatment plant.

5.1.5 Design flows and loads

The design flows and loads shall be based on the present flows and loads considering growth or decrease of the population, the trades and the industries and future connections of other communities, trades and industries. If there are no means to measure the present flows and loads the design data may be based on the projected population. In addition to the population the specific dry weather flow, $\text{l}/(\text{population } \square\square\text{d})$????, a peak factor considering storm water and infiltration water and the specific loads in $\text{g}/(\text{population } \square\square\text{d})$???? of COD, BOD₅, KN, NH₄-N, NO₃-N, total phosphorus, total suspended solids and organic suspended solids have to be provided. Flows and loads of trades and industries should be determined by measurements at the sites.

The following design data should be provided:

- a) Maximum hourly wastewater flow Q_{max} (l/s) reaching the plant and the probable duration;
- b) Details of discharge limits for storm water e. g. after screening, grit chamber, primary sedimentation or
- c) Other treatment to receiving water or a retention basin;
- d) design peak flow as remaining maximum flow after storm water discharge (l/s);
- e) – Diurnal (Daily) variation of the flow at a typical dry weather working day (l/s);
- f) design loads as appropriate for the process in kg/h , kg/d , kg/week of COD, BOD₅, KN, NH₄-N, NO₃-N,
- g) Total phosphorus, total suspended solids and organic suspended solids as well as the corresponding
- h) Volume of wastewater;
- i) – Minimum daily and weekly ratios of COD/N and COD/P;
- j) In case of seasonal flow and load fluctuations, day-to-day variation of flow (m^3/d) and loads (kg/d) of
- k) The main parameters over a year;
- l) Seasonal temperature of the wastewater over a year;
- m) Annual volume of wastewater (m^3/a) and annual loads (kg/a) of COD, BOD₅, KN, NH₄-N, total

- n) Phosphorus, total suspended solids and organic suspended solids.

5.2 Effluent quality, requirements for the disposal of residues and sludge

5.2.1 Effluent quality

The requirements of the discharge consent shall be provided. The mode of inspection (e. g. grab samples, 2-hour composite samples, 24-hour composite samples) and the requirements to meet the consent standard (e.g. permitted annual frequency of exceeding consent standard) shall be provided.

5.2.2 Requirements for storm water overflow discharge

If there are special requirements for storm water to be discharged from the wastewater treatment plant these shall be stated.

5.2.3 Requirements for the residues from preliminary treatment

The requirements for the disposal of the residues shall be stated,

e. g. water content of screenings, organic content of grit, and whether separate or co-disposal of grit, screenings and floatable material are permitted.

5.2.4 Requirements for sludge disposal

The mode of sludge disposal which is preferred by the client,

e. g. at agricultural utilization, landfill, incineration, coincineration at power stations or other industries, shall be stated as well as the appropriate requirements,

e.g. stabilization, water content. If certain chemicals, (e. g. for mechanical dewatering), are prohibited these shall be identified.

5.3 Site description

The site description shall include:

5.3.1 Plans (maps) of the site

Plans (maps) of the site shall be provided indicating:

- a) Elevation of site;
- b) Contour lines and topography;
- c) Site boundary;
- d) Existing buildings and structures including existing wastewater treatment plant;
- e) all services including sewers, rising mains, water mains, electrical cables, telephone cables, gas mains

- f) Including information on the capacity (e. g. pressure, voltage, flow);
- g) Service roads (including permissible truck weight) and walkways;
- h) Access from public road;
- i) Final effluent discharge point with maximum, minimum and average water level of receiving water.

5.3.2 Existing wastewater treatment plants

The details of any existing treatment plant shall be described. Plans of layout and structures shall be provided. The condition of the concrete, service roads and the mechanical and electrical equipment shall be described.

5.3.3 Ground geology, groundwater and climate

Borehole information should be provided as follows:

- a) Special characteristics of soil and ground water including information on possible contamination;
- b) Location of the boreholes;
- c) Ground conditions (e. g. clay, rock, sand);
- d) Maximum, minimum and average groundwater levels.
- e) Climatic information including temperature, humidity, winds etc. should be provided.

5.3.4 Special site constraints

Any special site constraints shall be stated and may include the following:

- a) Permissible maximum height of any building or structure;
- b) Limits on odour or noise emissions;
- c) Preservation of groundwater levels;
- d) Preservation of environment and natural habitat;
- e) Distances of any buildings from site boundary;
- f) Any limits or restrictions on building, transport and operation;
- g) Any special construction material requirements.

5.4 Additional data required

The following data required for design should be stated by the client or his representative:

- a) The minimum number of parallel units;
- b) Bypasses;
- c) stand-by equipment;
- d) Requirement for stand-by power supply (kVA);
- e) Any operational parameter (e. g. sludge age, retention time, surface loading, sludge loading) specifically requested by the client;
- f) Control and automation requirements;
- g) Design service life of equipment;
- h) Truck weight for service roads;
- i) requirements (space and equipment/furniture) for workshops, laboratories, store rooms and offices;
- j) Performance guarantees for:
 - 1) The plant performance at design load; the testing period in length and time of the year shall be stated;
 - 2) The projected consumption of power and chemicals; testing may be performed together with the before
 - 3) Mentioned testing; these tests may be requested for a lower load and/or for another period;
 - 4) Single units, e. g. screen, mixer, aeration equipment, digester.

5.5 Time schedule

- a) For a sectional tender all relevant contractual mile stones shall be stated and should include:
 - 1) starting date of contractual delivering time;
 - 2) anticipated time scale of the start-up and of the commissioning of the plant;
 - 3) The latest time scale for the contractor to report the construction and/or installations ready for inspection and for take over.

b) For a functional tender all relevant contractual mile stones shall be stated and should include:

- 1) anticipated starting date of contractual delivering time (notice to proceed);
- 2) Time scale for delivering the documents (drawings approval, approval certificate);
- 3) Time scale for over all functional test (commissioning; commissioning certificate);
- 4) Time scale for provisional take-over and final take-over.

NOTE Depending on the specific national regulations the client with the help of the contractor should obtain the permission for the planned treatment process and construction work from the authorities prior to the notice to proceed. This permission should be obtained before the final contract.

5.6 Start-up and guarantee testing

5.6.1 Start-up

The client may ask for:

- a) Vocational training of personnel;
- b) Advice on the technology.

5.6.2 Guarantee testing

If performance guarantees are requested, it shall be specified how the guarantees are to be tested and who will bear the costs. The client may ask for:

- a) Client and contractor perform testing in cooperation;
- b) testing performed by a qualified third party in co-operation with the client;
- c) testing performed by a qualified third party in co-operation with the contractor.

The time frame and the methods for process and plant testing and chemical analysis shall be specified.

5.7 Operational cost information

The client should provide unit costs where appropriate. Examples include:

- a) Personnel costs with indication of trade and skill level;
- b) Electrical energy;
- c) Fuel oil;

- d) Natural gas;
- e) Chemicals (e. g. for phosphate precipitation, sludge dewatering and gentrification);
- f) Disposal of residues (screenings and grit) depending on the mode of disposal;
- g) Disposal of sludge depending on the mode of disposal

6 Documents to be provided by a turn-key contractor or the consulting engineer

6.1 Complete documents

If the information and data provided by the client are not sufficient for the design and the calculation of the costs additional information shall be requested:

- a) By contractors immediately after receiving the tender documents or
- b) By a consulting engineer immediately when needed.

6.2 Design options

Normally the consulting engineer has to submit several options for which the costs are estimated. A turn-key contractor may also submit variants of the same treatment process.

6.3 Proposed solution

The offer of a turn-key contractor or the proposed solution of the consulting engineer shall be presented by text and drawings in detail in an agreed language. An abstract written for decision makers with no technical background should be provided. A list of abbreviations and symbols shall be attached. The process description shall be provided. It shall be explained how process objectives will be achieved.

The technological and hydraulic calculations including references shall be provided. The relevant design parameter for each offered treatment process has to be adequately documented to allow the client to assess the proposed process.

The procedures to ensure how normal operation is maintained during periods of malfunction, break-down of equipment and units out of operation for maintenance shall be described.

Within an agreed time scale the following general items (if applicable) shall be presented by text and drawings in detail:

- a) Process control system (may be regarded as part of the treatment process), e. g. control panel,
- b) Computer control, sub control stations, instrumentation for process control;

- c) Electrical power system including digester gas engines, transformers, cable arrangement, sub power
- d) Meters, control station, peak power demand (kVA);
- e) Lighting including types and luminous intensity, cables, switches;
- f) Taps and hydrants for service water including the water distribution system as well as the water
- g) Treatment plant if required;
- h) Service roads according to the load;
- i) Walkways;
- j) Workshop, office and storehouse buildings including equipment and furniture as stated in 5.4;
- k) Operating and maintenance manuals.

The properties of the material for construction and of the equipment installed shall be specified. If not specified by the client the procedures for start-up and testing shall be stated.

6.4 Calculation and presentation of costs

6.4.1 Construction costs

Considering the particular conditions of the area and the site, the costs for the complete plant shall be calculated.

Differentiation shall be made between the costs for civil works (e. g. concrete tanks, houses, and roads), the costs for mechanical equipment and the costs for electrical installations including monitoring and process control. In addition the costs arising for start-up and guarantee testing shall be stated.

6.4.2 Operational costs

Considering the particular conditions of the process and the site the annual operational costs shall be presented in accordance with flow and load based on the costs and prices as follows:

- a) Personnel costs: based on number and skilled level required, working in shifts and/or regular working time;
- b) Energy costs: to be separately calculated for (where appropriate):
 - 1) Raw wastewater pumping,
 - 2) Main treatment process (e. g. aeration, mixers, internal pumping, scrapers),

- 3) Tertiary treatment,
 - 4) Sludge treatment including pumping, mixing, mechanical dewatering,
 - 5) Miscellaneous (e. g. lighting, heating of buildings); based on the estimated consumption of (where appropriate):
 - 6) Electrical energy,
 - 7) Natural gas,
 - 8) Digester gas,
 - 9) Fuel oil;
- c) Costs for chemicals: to be separately calculated based on the estimated consumption where appropriate for:
- 1) Primary sedimentation for pre-precipitation and/or flocculation,
 - 2) Biological reactors for phosphate precipitation,
 - 3) Biological reactors for denitrification,
 - 4) Final clarifiers or filters for phosphate precipitation,
 - 5) Final clarifiers or filters to improve solids removal,
 - 6) Sludge to improve thickening,
 - 7) Sludge dewatering;
- d) Costs for disposal of residues and sludge: to be separately calculated based on the estimated volume or mass where appropriate for:
- 1) Screenings,
 - 2) Grit,
 - 3) Grease and floatables and
 - 4) Sludge;
- e) Costs for maintenance of civil works and equipment shall be separately calculated where appropriate for:

- 1) Office buildings, workshops, store houses, laboratories and other non-process buildings,
- 2) Tanks and channels exposed to wastewater or sludge,
- 3) Pipes exposed to wastewater, sludge or gas,
- 4) Plastic tanks and pipes exposed to wastewater, sludge or gas,
- 5) Mechanical equipment including spare parts and lubricants,
- 6) Electrical equipment including instrumentation and monitoring.

6.4.3 Presentation of costs

The client may commission a consulting engineer to estimate the costs. The consulting engineer shall estimate the total annual costs for alternatives including capital costs. At sectional tendering the contractors shall give bids on the costs for all items listed in the tender documents. They may offer and state the costs of special solutions which are adequate to that described in the tender documents. A turn-key contractor shall give a bid on the costs and as requested in the tender documents. Based on the bids the client shall be able to calculate the total annual costs of the plant including capital costs using cost benefit analysis.

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