DTZS 706

DRAFT TANZANIA STANDARD

PRODUCTS USED FOR TREATMENT OF WATER INTENDED FOR HUMAN CONSUMPTION – SILICA SAND AND SILICA GRAVEL

TANZANIA BUREAU OF STANDARDS

First Edition 2021

0 National Foreword

0.1 The Tanzania Bureau of Standards is the statutory national standards body for Tanzania, established under standards Act No. 3 of 1975, amended by Act No. 1 of 1977 and then Act No. 3 was replaced by the Act No. 2 of 2009.

This draft Tanzania Standard is being prepared by BCDC 7 Sanitation structure and sanitary appliances Technical Committee under the supervision of the Building and Construction Divisional Committee (BCDC). The Committee is composed of Tanzania Bureau Standards secretariat, together with the representatives of key stakeholders including government, academia, consumer groups, private sector and other interested organization.

After passing through Divisional committee, the Draft Tanzania Standards is circulated to stakeholders for comments. The comments received are discussed and incorporated before finalization of standards, in accordance with the principles and procedures for development of Tanzania standards.

0.2 In the preparation of this Tanzania Standard, assistance was adopted from:
BS EN 12904:2005 *Products used for treatment of water intended for human consumption-Silica sand and silica gravel* published by British Standards Institution.

DRAFT TANZANIA STANDARD DTZS 706

Products used for treatment of water intended for human consumption- silica sand and silica gravel.

1 Scope

This draft Tanzania Standard is applicable to silica sand and silica gravel used for treatment of water intended for human consumption. It describes the characteristics of silica sand and silica gravel and specifies the requirements and the corresponding test methods for silica sand and silica gravel.

It gives information on their use in water treatment, labelling, transportation and storage.

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.

EN 12901:1999, *Products used for treatment of water intended for human consumption - Inorganic supporting and filtering materials - Definitions.*

EN 12902, *Products used for treatment of water intended for human consumption – Inorganic supporting and filtering materials - Methods of test.*

3 Terms, definitions and symbols

For the purpose of this standard the following definitions shall apply:

3.1

particle size

nominal width of the test sieve aperture which the particle passes under defined conditions

NOTE 1: particle size is expressed in millimeters.

3.2

particle size range (grading)

all particle sizes between two sieve apertures

NOTE 2: the particle size range is designed by these apertures (maximum particle size, minimum particle size)

3.3

maximum particle size

maximum sieve aperture when analyzing a particle size distribution

3.4

minimum particle size

minimum sieve aperture when analyzing a particle size distribution

3.5

oversize percentage
percentage by mass (% (m/m)) of a particulate mixture which does not pass the test sieve with the larger aperture used for the respective particle fraction.

3.6

undersize percentage
percentage by mass (%(m/m)) of a particulate mixture which pass the test sieve with the smaller aperture used for the respective particle fraction.

3.7

particle size fraction (size class)
subdivision of particle size range

> **NOTE 3:** each particular size fraction is determined by the apertures of two consecutive sieves of a mesh scale.

3.8

Particle size distribution
Percentage by mass(%(m/m)) of the individual size fractions

3.9

Particle size distribution curve
plotted curve of the percentage by mass (%(m/m)) of the individual size fraction passing each of a series of test sieves versus sieve aperture

3.10

effective particle size, d_{10}
theoretical aperture, obtained from the particle size distribution curve, that 10% (m/m) of particles would pass

3.11

uniformity coefficient, U
ratio of the aperture of sieve which would permit 60% (m/m) to pass through to the aperture of sieve which would permit 10% (m/m) to pass through

NOTE4: $U = {}^{d_{60}}/_{d_{10}}$
d_{60} and d_{10} are given by the particle size distribution curve.

3.12

minimum particle size
d_1
aperture of sieve which would permit 1%(m/m) particles to pass through

NOTE 5**:** d_1 should be determined to ensure a continuous particle size distribution in the lower range.

3.13

nominal particle size
particle size range which is declared by the producer

3.14

absolute density,ρ_A
mass of the substance divided by its volume, excluding the volume of pores and blisters

3.15
particle density dry, ρ_D
Mass of a particle divided by its volume including the pores and blisters

3.15

particle density wet, ρ_W
Mass of the water saturated particle divided by the particle volume including open pores and blisters

NOTE 6: open pores in the filter particle are filled with water in the course of time during submerged storage. The rate of the process depends on porosity, type of pores, pore size distribution and surface properties of the filter medium concerned. The wet particle density can be calculated approximately from the porosity and the dry particle density, assuming that the pores are filled with water in a known amount.

3.16

bulk density, loose
mass of a non-compacted powder or granular material divided by its total volume

3.17

bulk density, packed
mass of a granular material after compacting by a specified method divided by its total volume

4 Description

4.1 Identification

4.1.1 *Chemical name(s)*

Silica (Si), silicon dioxide (SiO_2)

4.1.2 *Synonym or common names*

Silica sand and silica gravel

4.2 Commercial forms

Silica sand and silica gravel according to this standard are available in different particle size ranges.

5 Physical Properties

5.1 Appearance

The product is a grey/white, yellow or multicolored granular material.

The structure is crystalline, with a smooth to rough texture. The particle shape is spherical or angular depending mainly on the origin and manufacturing procedure (quarrying or dredging, or crushing). The shape influences filtration performance, see A.3.

The product shall be generally homogeneous and shall be visibly free of extraneous matter.

5.2 Particle size distribution

The particle size distribution shall be described by either:

a) effective size: (d_{10}), with a maximum deviation of ± 5 %;

For Slow Sand Filter, the effective size ranges between 0.2 to 0.4 mm and the Rapid Sand Filter, the effective size ranges between 0.35 to 0.55.

- uniformity coefficient: (U), shall be less than 1.5;
- minimum size: (d_1), with a maximum deviation of ± 5 %;

or

b) particle size range and mass fraction of oversize and undersize particles according to application. The maximum permitted contents of oversize and undersize shall be a mass fraction of 5 % for the application of the product in multimedia filters and a mass fraction of 10 % for use in single media filters. For use as a support layer, maximum contents of oversize and undersize of mass fraction of 15 % are acceptable. See A.2.3 for examples of available particle sizes that are used.

NOTE7: The particle size can decrease during transportation and handling.

NOTE 8: Other values can be necessary for certain applications.

5.3 Density

5.3.1 Bulk density, loose

The bulk density loose shall be in the range of 1 400 kg/m^3 to 1 700 kg/m^3.

5.3.2 Bulk density, packed

The bulk density packed shall be in the range of 1 500 kg/m^{3}to 1 900 kg/m^3.

6 Chemical properties

6.1 This standard specifies the minimum purity requirements for silica sand and silica gravel used for the treatment of water intended for human consumption. Limits are given for impurities commonly present in the products. Depending on the raw material and the manufacturing process other impurities may be present and, if so, this shall be notified to the user and when necessary to relevant authorities.

> **NOTE 9:** Users of these products should check the national regulations in order to clarify whether it is of appropriate purity for treatment of water intended for human consumption, taking into account raw water quality, required dosage, contents of other impurities and additives used in the products not stated in this document.

6.2 Limits have been given for impurities and chemical parameters where these are likely to be present in significant quantities from the current production process and raw materials. If the production process or raw materials lead to significant quantities of impurities, by-products or additives being present, this shall be notified to the user.

6.3 Silica sand and silica gravel shall conform to Table 1.

Table 1- Composition of silica sand and silica gravel

		Limit in mass fraction in % of the product			
		Type 1	Type 2	Type 3	
				d_{10} < 2 mm	d_{10}≥ 2 mm
SiO_2	min.	96	80	80	80
Acid-soluble material	max.	2	2	5	10

> **NOTE 10:** The contents of SiO_2 and acid-soluble material give information about the source of silica sand and silica gravel.
>
> **NOTE 11:** Other potential components are given in A.2.1.
>
> **NOTE 12:** After filling, washing and commissioning of a filter system producing drinking water the silica sand or silica gravel should not increase the concentrations of chemical parameters (see [1]).
>
> **NOTE 13:** Water-extractable substances, determined in accordance with the method for granular materials given in EN 12902, can be used to estimate the leaching of the chemicals specified in EN 12902.

7 Mechanical properties

The filter material shall be hard and durable grains. See A2.2

8 Test methods

8.1 Sampling

Prepare the laboratory sample(s) required by the relevant procedures described in EN 12902.

8.2 Analysis

8.2.1 Particle size distribution

The particle size distribution shall be determined on samples taken at the point of manufacture using the method of test given in EN 12902.

8.2.2 Bulk density loose

The bulk density loose shall be determined in accordance with EN 12902

8.2.3 Bulk density packed

The bulk density packed shall be determined in accordance with EN 12902

8.2.4 Content of silica

The content of silica shall be determined in accordance with EN 12902

8.2.5 Acid-soluble material

The content of acid-soluble material shall be determined in accordance with EN 12902

9 Labelling- Transportation -Storage

9.1 Means of delivery

Silica sand and silica gravel shall be delivered in bags, semi-bulk containers, or bulk.

In order that the purity of the product is not affected, the means of delivery shall not have been used previously for any different product or it shall have been specially cleaned and prepared before use.

9.2 Risk and safety labelling

Existing national regulations on risk and safety labelling shall apply

9.3 Transportation regulations and labelling

Silica sand and silica gravel are not classified as dangerous goods.

9.4 Marking

The marking shall include the following:

i) name of the product "silica sand" or "silica gravel",

ii) trade name,

iii) grade and type;

iv) net mass;

v) name and the address of the supplier and/or manufacturer;

vi) reference to this standard

9.5 Storage

9.5.1 Long term chemical stability

Silica sand and silica gravel can be stored for an unlimited period of time and shall be adequately protected from outside contamination.

Annex A

(informative)

General information on silica sand and silica gravel

A.1 Origin

A.1.1 Raw material

Natural silica sand, silica gravel.

A.1.2 Manufacturing process

Silica sand and silica gravel are produced by quarrying, dredging or crushing, cleaning, drying, and sieving.

A.2 Typical properties

A.2.1 Chemical composition

The composition depends on the origin. Typical values (mass fraction) are given as an example in table A.1 (the main components are given in clause4.2.1).

Table A.1 - Chemical composition

		Mass fraction in %		
Parameter		Type 1	Type 2	Type 3
Al_2O_3	≤	3	13	13
Fe_2O_3	≤	2	10	2
Cao	≤	1.5	1	5
K_2O	≤	2	4	1
Na_2O	≤	1.5	2	1

Mineralogical and petrological analyses give additional information

A.2.2 Mechanical strength

The mechanical strength of silica sand and silica gravel is high.

Abrasion products consist of dust and small particles of material. They are formed during transportation, filling, and washing. Abrasion products are not completely removed by washing.

The existing methods for determination of abrasion do not lead to exact results regarding behaviour of filter media during operation. They can be used only for comparison of different filter media.

A.2.3 Examples of particle size distribution

Examples of particle size distribution described by different particle size ranges and a permissible mass fraction of oversize and undersized product are given in table A.2.

Table A.2 - Examples of particle size range

				Permissible mass fraction, % a)	
Particle size range mm				Undersize	Oversize
Silica sand	0.4	to	0.8	5	5
	0.5	to	1.0		
	0.6	to	1.18		
	0.63	to	1.0		
	0.71	to	1.25		
	0.85	to	1.7	10	10
	1.0	to	1.6		
	1.0	to	2.0		
	1.18	to	2.8		
	1.6	to	2.5		
Silica gravel	2.0	to	3.15		
	2.36	to	4.75		
	3.15	to	5.6		
	5.6	to	8.0	15	15
	6.7	to	13.2		
	8.0	lo	12.5		
	8.0	to	12.5		
	12.5	to	16.0		
	13.2	to	26.0		
a) Generally, the maximum permitted contents of undersize and oversize are a mass fraction of 5 % for application of the product as a filtration layer in multi media filters, a mass fraction of 10 % for use in single media filters and a mass fraction of 15 % for application as a support layer.					

Other particle size ranges can be specified

A.2.4 Density

A.2.4.1 Absolute density

The absolute density is generally in the range of 2.5 g/cm^3 to 2.8 g/cm^3.

A.2.4.2 Particle density dry

The particle density dry is generally in the range of 2.5 g/cm^3 to 2.8 g/cm^3,

A.2.4.3 Particle density wet

The particle density wet is generally in the range of 2.5 g/cm^3 to 2.8 g/cm^3.

A.3 Use

A.3.1 Function

Silica sand and silica gravel are used as filtering or supporting materials.

A.3.2 Specific amount

The amount of silica sand and silica gravel used depends on application. Filtration rate and filter media depth vary with the suspended matter content of the water to be filtered.

A.3.3 Means of application

Silica sand and silica gravel are used in open or closed, single or multi media, filters. Silica sand is also used in "slow sand filtration" systems.

A.3.4 Secondary effects

The products have no secondary effects.

A.4 Hydraulic characteristics

A.4.1 Interstitial volume

The interstitial volume is approximately 0.4 (V/V). If used for calculations the interstitial volume should be measured.

A.4.2 Head loss in filtration

Head loss depends on size, shape and roughness of particles, filtration rate, filter bed depth, and water temperature.

A.4.3 Expansion in up-flow washing

The expansion during washing depends on flow rate, effective size, density, shape and roughness of particles, and water temperature.

A.5 Rules for safe handling and use

Silica sand and silica gravel are not hazardous products:

- it is recommended to avoid dust formation;

-when handling dry product the use of a dust mask is recommended, especially when using air conveying.

A.6 Emergency procedures

A.6.1 First aid

In case of contact with skin, it is recommended to wash with water.

In case of contact with eyes, it is recommended to flush with plenty of water.

In case of inhalation. it is recommended to move to fresh air.

A.6.2 Spillage

It is recommended to sweep up and to discard in a refuse container or repackage.

A.6.3 Fire

No special requirements are necessary.

Bibliography

Design, construction supervision, operation and maintenance (DCOM) manual (2020), The United Republic of Tanzania, Ministry of water.