DRAFT TANZANIA STANDARD

Test method - Determination of the wet-dry durability of compacted and cured specimens of cementitiously stabilized materials by mechanical brushing

TANZANIA BUREAU OF STANDARDS

1ST Edition

0 National foreword

The Tanzania Bureau of Standards is the statutory national standards body for Tanzania, established under the Act.No.3 of 1975, amended by Act.No.2 of 2009.
This draft Tanzania Standard is being prepared by BCDC 5 Roads Technical Committee under the supervision of the Building and Construction Standards Divisional Committee (BCDC).

In the preparation of this Tanzania Standard, reference was made to **SANS 3001-GR56:2015 Determination of the wet-dry durability of compacted and cured specimens of cementitiously stabilized materials by mechanical brushing, published by SOUTH AFRICAN NATIONAL STANDARD**

1 Scope

This Tanzania Standard applies to cementitiously stabilized materials (fine grained and coarse-grained soils,), and describes a method to determine, by mechanical brushing, the wet-dry durability of test specimens that have been compacted and cured.

2 Definitions

For the purposes of this Tanzania Standard, the following definitions shall apply:

2.1 Cementitious stabilizing agent

chemical materials, such as cement, hydrated lime, blends of cement or lime and cementitious extenders that are used to develop compressive and tensile strength when mixed with road construction materials

2.2 Constant mass

less than 0.1 % change in mass after two successive (more than 1 h) periods of drying

2.3 **Stabilization**

adding and mixing of cementitious stabilizing agents, normally less than 5 % (mass fraction), with materials to develop compressive and tensile strength

2.4 Wet-dry durability

total mass of material lost from a cylindrical specimen 127 mm in height and 152 mm in diameter after 12 wetting, drying and brushing cycles, using a mechanical brushing apparatus, expressed as a percentage of the mass of the specimen before commencement of this process

2.5 Fine grained Soil

fine natural particles of silt and clay size.

2.6 Coarse grained soil

Coarse particles of crushed stone, gravel and sand.

3 Apparatus

3.1. Water bath, of depth at least 150 mm, thermostatically controlled, containing drinking water which comply TZS 574/EAS, and maintained at a temperature range of 22 °C to 25 °C.

3.2. Electronic balance, fine measurement type, with a capacity of 10 kg, and reading to 1 g.

3.3. Drying oven, that is capable of maintaining a temperature range of 69 °C to 73 °C and 105 °C to 110 °C, with continuous draft.

3.4. Brushing apparatus, of the type shown in figure 1, capable of holding rigidly either a 102 mm or 152 mm diameter specimen and rotating it under a brush loaded to 2.25 kg at the rate of 60 rpm ± 5 rpm around its longitudinal axis. The apparatus incorporates an electronic device for setting and controlling the number of revolutions.

NOTE: The brush loading equates to a friction applied force along the surface of the specimen of 13.5 N, assuming a friction angle, Φ, of 31,5°.

3.5. Wire brush, consisting of a wooden block of 200 mm × 60 mm, mounted with spring steel bristles 40 mm long × 1,8 mm wide, of 0,5 mm gauge, arranged at random in 180 groups of six wires each. The 1.8 mm widths are parallel to the longitudinal axis of the brush and at right angles to the direction of brushing.

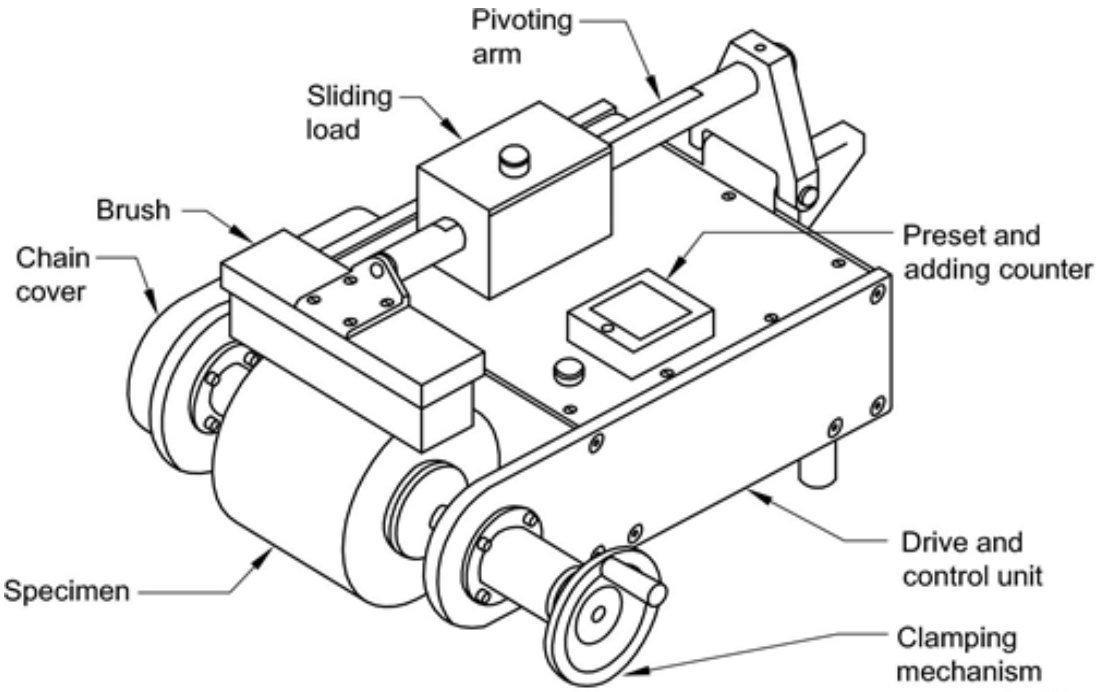

Figure 1 — Brushing apparatus

4 Principles

While this method is similar to the hand brushing method, and uses the same method for preparing specimens, there are certain basic differences which affect the outcome of the test. The mechanical brushing test generates smaller losses and appears to be more repeatable.
The major differences between the two methods are:

a). the number of brush coverages,

b). the direction of brushing (axial versus circumferential),

c). the number, grouping and spacing of bristles,

d). the surface brushed – whole specimen (end and circumference) versus partial specimen (Circumference only), and

e). the load application (mechanical versus hand).

5 Test sample preparation

Prepare and cure the test specimen at near-ambient temperature, as described in **The United Republic of Tanzania Ministry of works, Laboratory Testing Manual (2000).** Report the curing method used.

6 Procedure

6.1. Wetting, drying and brushing.

Lime contents are usually selected in increments of two percentage points, for example, 1 %, 3 %, and 5 % of lime.

6.1.1. *Submerge the cured specimen in water at 23.5 °C ± 1.5 °C for a period of 5 h ± 10 min.*

6.1.2. *Remove the specimen from the water and place it in an oven at 71 °C ± 2 °C for 42 h ± 0,5 h.*

6.1.3. *After the drying period, remove the specimen from the oven and allow it to cool to room temperature.*

6.1.4. *Transfer the specimen to the balance, weigh and record the mass, M_{S1}, to the nearest 1 g.*

6.1.5. *Clamp the specimen securely between the pads of the specimen holder on the brushing apparatus.*

6.1.6. *Lower the brush onto the specimen and switch on the machine, set the loading device to apply a load of 2.25 kg ± 0.05 kg, and the machine to run 50 revolutions at 60 rpm.*

6.2. Determining loss in mass of cemented material.

6.2.1. *Repeat the wetting, drying and brushing cycle (each cycle takes approximately 48h) until a total of 12 cycles has been completed. When it is not possible to run the cycle continuously because of Sundays or holidays, or for any other reason, the specimens should be held in the oven at 69 °C to 73 °C, during the layover period.*

6.2.2. *After the last cycle, oven-dry the specimen to constant mass at 105 °C to 110 °C.*

6.2.3. *Transfer the specimen to the balance, weigh and record the mass, M_{S12}, to the nearest 1 g.*

6.2.4. *Inspect the specimen for "pluck out" of pieces of aggregate during brushing and record where "pluck out" has occurred.*

For coarse materials "pluck out" could result in very high losses of material being recorded, which may not be truly indicative of the material's potential erosion resistance.

7 Calculation

NOTE: An example of the calculation procedure is given in annex A.

Calculate the loss in mass of the specimen after each cycle as a percentage of the original mass of the specimen to the nearest 0.1 % (see 6.1.4 and 6.2.3).

$$L_{Sn} = \frac{M_{S1} - M_{Sn}}{M_{S1}} \times 100$$

where

L_{Sn} is the loss in mass of the specimen after n cycles, expressed as a percentage of the original specimen mass;

NOTE: The percentage loss in mass after 12 cycles is known as the wet-dry durability.

M_{S1} is the original mass of the specimen, in grams (g);

M_{Sn} is the mass of the oven dry specimen after n cycles, in grams (g).

NOTE: n is any wet-dry cycle between one and twelve.

8 Test report

Clearly state that the mechanical brushing test method has been used and report the following:

a) the percentage mass loss after each cycle to the first decimal place;

b) the percentage mass loss after 12 cycles as the wet-dry durability;

c) the type and percentage of stabilizing agent;

d) the optimum moisture content and maximum dry density;

e) the date the test commenced;

f) the dates of each testing cycle; and

g) the curing method used.

For stabilization design purposes sets of results should be reported graphically, plotting wet-dry durability versus cement content.

Annex A

(informative)

Example of the calculation procedure

A.1 Use the following information to calculate A.2 and A.3:

M_{S1} = 6 984 g

M_{S2} = 5 984 g

M_{S12} = 5 001 g

A.2 Calculate the percentage mass loss after two cycles to the nearest 0.1 %, using the following equation (see clause 7):

$$L_{S2} = \frac{6984 - 5984}{6984} \times 100$$

= 14.3 %

A.3 Calculate the wet-dry durability the percentage mass loss after 12 cycles to the nearest 0.1 %, using the following equation (see clause 7):

$$L_{S12} = \frac{6984 - 5001}{6984} \times 100$$

= 28.4 %

Bibliography

- **The United Republic of Tanzania-Ministry of Work,** Laboratory Testing Manual (2000).
- **TMH1,** Standard methods of testing road construction materials**.**
- **TMH5,** Sampling methods for road construction materials.
- **TZS 574/EAS 153** Packaged drinking water — Specification.
- **SANS 241-2,** Drinking water – Part 2: Application of SANS 241-1.
- **SANS 1649,** Non-automatic self-indicating, semi-self-indicating and non-self-indicating weighing instruments with denominated verification scale intervals.
- **SANS 3001-GR50,** Civil engineering test methods – Part GR50: Preparation, compaction and curing of specimens of laboratory mixed stabilized graded materials.
- **SANS 3001-GR31,** Civil engineering test methods – Part GR31: Determination of the maximum dry density and optimum moisture content of laboratory mixed cementitiously stabilized materials.

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