DRAFT TANZANIA STANDARD

Test methods - Determination of the binder content of mixtures used in bituminous slurry seals.

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-AS22:2014 Determination of the binder content of mixtures used in bituminous slurry seals, published by SOUTH AFRICAN NATIONAL STANDARD**

1 Scope

This Tanzania Draft Standard applies to the bituminous slurry mixtures used in surfacing seals and describes a method for determining the binder content of the mixture.

2 Definitions

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

2.1 bituminous slurry mixture

mixture of graded aggregates, emulsified bituminous binder, and an active filler such as cement

2.2 bituminous slurry seal

slurry mixture produced in a mobile or static mixer and applied to the road surface to form a seal, either by mechanical or manual methods

2.3 constant mass

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

2.4 oven-dry

dried in an oven at a temperature of between 105 °C and 110 °C

3 Apparatus

3.1. Electronic balance Fine measurement which has a capacity of 10 kg and is accurate to 0.1 g

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

3.3. Filter flask, of capacity at least 3 l.

3.4. Glass cover plate, flat, and suitable for closing the mouth of the flask.

3.5. Thermometer, capable of measuring from 0 °C to 50 °C, and reading to 0,5 °C.

3.6. Spout stopper, of rubber and suitable tubing**.**

3.7. Vacuum pump, capable of reducing pressure to a maximum of 30 mm mercury, fitted with a manometer or a vacuum gauge fitted close to the pump to ensure that there is no difference in the reading between the pump and the actual mercury manometer reading.

3.8. Water bath, at least 150 mm deep so that the majority of the flask is covered, and thermostatically controlled with a circulation mechanism to maintain a temperature of 25 °C ± 1 °C.

3.9. Stainless steel basins or pans, of capacity at least 3 l.

3.10. Funnel, wide mouthed.

3.11. Scoop, of capacity 5 L.

3.12. Plastic containers, with sealable lids, and of capacity 5 l.

3.13. Steel spatula, with blade of length approximately 200 mm.

3.14. Ladle, of capacity approximately 200 ml.

3.15. Glass pipette, of capacity 50 ml.

4 Test sample preparation

4.1 Slurry mixture

4.1.1 Make up the test sample of slurry from a composite sample taken at the discharge point of the equipment used to produce the slurry.

4.1.2 Use the scoop to take eight samples at regular intervals from the batch. Transfer a 0.5l portion from each scoopful into the 5 l plastic container, then seal and label.

4.1.3 Dispatch the sample immediately to the laboratory for testing, as described in Annex-A

4.2 Aggregate

4.2.1 Take a sample of approximately 20 kg of aggregate from the stockpile of the aggregate used in the slurry mixture, and riffle it to produce a sample of approximately 5 kg, as described in Annex-B. Sample each stockpile and prepare separately when more than one aggregate fraction is used in the slurry mixture.

4.2.2 Oven-dry the aggregate sample or samples to constant mass**.**

4.2.3 When more than one aggregate is used in the mix, combine them in the same proportion as used in the slurry mix. At this stage, add the active filler, such as cement, in the required proportion. Mix the components together thoroughly.

4.2.4 Prepare the test sample by quartering out a sample of approximately 1 kg.

5 Procedure

5.1 Determining the relative density of the aggregate

5.1.1 Clean, dry, determine and record the mass of the flask with the cover plate, M1, to the nearest 0.1 g.

5.1.2 Using the wide mouthed funnel, transfer the test sample of aggregate into the flask, and determine the mass of the flask, cover plate, and test sample, M2, to the nearest 0.1g.

5.1.3 Add drinking water that complies TZS 574/EAS 153, so that the test sample is covered by 50 mm of water, without filling the flask.

5.1.4 Attach the vacuum pump to the flask, reduce the pressure to as close to, but not exceeding, a maximum of 30 mm mercury. At intervals of approximately 2 min agitate the flask by tapping the sides with the hand while holding it firmly and maintain the reduced pressure for a period of 15 min± 2 min.

5.1.5 Restore the flask gradually to atmospheric pressure, disconnect it from the vacuum pump, insert the spout stopper and add water to a level 5 mm below its rim. Place the flask in the water bath, for 30 min ± 5 min so that its contents stabilize at a temperature of 25 °C ± 1°C.

5.1.6 Use the pipette to completely fill the flask with water, slide the cover plate over the mouth of the flask ensuring that no air is trapped in the flask. Wipe off all excess water on the outside of the flask and cover plate and dry. Determine the mass of the flask with its contents and cover plate, M3, to the nearest 0.1 g.

5.1.7 Empty and rinse the flask. Refill it with drinking water at 25 °C ± 1 °C, and cover it with the cover plate, as described in 5.1.6. Determine the mass of the flask with water and cover plate, M4, to the nearest 0.1 g.

5.2 Determining the relative density of the slurry mixture

5.2.1 Unseal the container with the field sample of the slurry mixture and mix the slurry thoroughly, using the spatula. Place the funnel in the mouth of the filter flask and use the ladle to transfer approximately 1 kg of the slurry mixture into the flask.

5.2.2 Add sufficient drinking water that complies with TZS 574/EAS 153,, to cover the slurry sample, but do not fill the flask.

5.2.3 Attach the vacuum pump to the flask and follow the requirements given in 5.1.4 to 5.1.6. Determine the mass of the flask, its contents, and the cover glass, M5, to the nearest 0,5 g.

NOTE Should foaming occur in the flask, thus interfering with the filling, add two drops of amyl alcohol to disperse the foam.

5.2.4 Empty the contents of the flask into the stainless-steel basin or pan and oven-dry to constant mass. Determine the mass of the dry slurry mixture, M6, to the nearest 0,1 g.

6 Calculations

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

6.1 Calculate the density of the aggregate, using the following equation:

$$D_a = \frac{1000(M_2 - M_1)}{(M_4 + M_2) - (M_1 + M_3)}$$

Where;

D_a is the density of the aggregate, in kilograms per cubic metre (kg/m3);

M_1 is the mass of the empty flask and cover glass, in grams (g);

M_2 is the mass of the flask, cover glass, and aggregate sample, in grams (g);

M_3 is the mass of the flask, cover glass, aggregate sample and water, in grams (g);

M_4 is the mass of the flask, water, and cover plate, in grams (g).

6.2 Calculate the density of the dry slurry mixture, using the following equation:

$$D_m = \frac{1000M_6}{(M_6 + M_4) - M_5}$$

D_m is the density of the dry slurry mixture, in kilograms per cubic metre (kg/m3);

M_5 is the mass of the filter flask, wet slurry, water, and cover plate, in grams (g);

M_6 is the mass of the dry slurry mixture, in grams (g).

6.3 Calculate the binder content of the slurry mixture, using the following equation:

$$B = \frac{100 \times D_b \times (D_a - D_m)}{D_m \times (D_a - D_b)}$$

Where;

B is the binder content, expressed as a percentage of the mass of the dry slurry mixture;

D_b is the density of the binder, in kilograms per cubic metre (kg/m^3).

NOTE: For the purpose of the calculations the Db, of penetration grade binder, may be taken as 1 020 kg/m3. Where modified binders are used, obtain the Db of the binder from the supplier.

7 Test report

Report the binder content of the slurry mixture, expressed as a percentage by mass of the dry slurry mixture, to one decimal place.

Annex A

(informative)

Example of the calculation procedure

A.1 Use the following information to calculate A.2 to A.4:

M_1 = 1000 g (the mass of the empty flask and cover glass).

M_2 = 2000 g (the mass of the flask, cover glass, and aggregate sample).

M_3 = 4620 g (the mass of the flask, cover glass, aggregate sample and water).

M_4 = 4000 g (the mass of the flask, water, and cover plate).

M_5 = 4550 g (the mass of the filter flask, wet slurry, water, and cover plate).

M_6 = 950 g (the mass of the dry slurry mixture)

D_b = 1020 kg/m^2 (the density of the binder) (see note to 7.3).

A.2 Calculate the density of the density of the aggregate to two decimal places, using the following equation (see 6.1):

$$D_a = \frac{1000(M_2 - M_1)}{(M_4 + M_2) - (M_1 + M_3)}$$

$$= \frac{1000(2000 - 1000)}{(4000 + 2000) - (1000 + 4620)}$$

$$= 2632\ kg\ /\ m^3$$

A.3 Calculate the density of the dry slurry mixture, using the following equation (see 6.2):

$$D_m = \frac{1000M_6}{(M_6 + M_4) - M_5}$$

$$= \frac{1000(950)}{(950 + 4000) - 4550}$$

$$= 2375kg\ /\ m^3$$

A.4 Calculate the binder content of the slurry mixture, using the following equation (see 6.3):

$$B = \frac{100 \times D_b \times (D_a - D_m)}{D_m \times (D_a - D_b)}$$

$$B = \frac{100 \times 1020 \times (2632 - 2375)}{2375 \times (2632 - 1020)}$$

$$= 6.8\%$$

Annex B

(informative)

METHODS OF SAMPLING OF STOCKPILES

B.1 SCOPE

This method describes the procedure to be followed when stockpiles are sampled (see 6.1). The stockpiles may consist of: Natural gravel, soil or sand; Crushed rock for base or subbase Screened-out crusher dust for binder, fine aggregate for concrete or fine aggregate for bituminous mixes; Crushed single-sized aggregate for bituminous or concrete work**.**

B.2 APPARATUS

B.2.1 Shovels.

B.2.2 Picks.

B.2.3 A mechanical loader-digger (if available).

B.2.4 Suitable sample bags (or other containers).

B.2.5 Suitable canvas sheets.

B.2.6 A riffler with 25 mm openings and six matching pans.

B.2.7 A 19 mm sieve with a recommended diameter of 450 mm.

B.2.8 A basin with a diameter of approximately 500 mm.

B.3 SAMPLE SIZE

The sample size will depend on the proposed use of the material and the tests which have to be carried out on it. Proposed use Mass Pavement and formation layers (Gravels, soils and crushed stone) Gradings and constants: 10 kg California Bearing Ratio: 60 kg Fine aggregate for concrete and bituminous mixes Single-sized coarse aggregate for concrete mixes and bituminous surfacing 25 kg.

B.4 METHODS

B.4.1 Sampling while stockpile is being formed by the off-loading of material

Select one or two positions on the consolidated surface of every layer of the stockpile at random while the pile is being formed. Make a vertical test hole through the layer (or as deep as is practically possible) with the pick and shovel. Place a canvas sheet in the bottom of the hole and cut a groove in the side of the hole from top to bottom, letting this material fall onto the canvas sheet. Gather a sufficient quantity of material by cutting successive grooves, frequently raising the canvas sheet from the hole and tipping its contents onto another canvas sheet on the surface. Mix the material on the canvas sheet and divide it, by means of the riffler and the quartering method **(refer Laboratory Testing Manual (2000),** into the required size so that each sample bag or container contains a representative sample of the material taken from the test hole.

B.4.2 Sampling from an already completed stockpile

Select at least twelve sampling positions in a random manner. Approximately half the positions may be on top of the stockpile if its surface is fairly large.

B.4.2.1 Sampling with a mechanical loader digger

B.4.2.1.1 From the sides of a stockpile

Scooping from the sides of the stockpile from the bottom towards the top, fill the bucket of the loader-digger and deposit the material on a clean hard surface –the flat steel back of a truck or a hard clean ground surface are suitable. Mix the material thoroughly with the spade and quarter it out into smaller equal parts using the quartering method until a quantity approximately twice the size is obtained. (See note B.7).
Deposit this material on a canvas sheet, mix it thoroughly again and further divide it with the aid of the riffler until the desired sample, consisting of one or more bags (or containers), each representative of the sample, has been obtained.

B.4.2.1.2 From the top of the stockpile

Use the load-digger to make a hole approximately 2 m deep. (See note B.7) Now scoop a load of material from the side of the hole, working from the bottom to the top, and deposit it in the back of a truck. Mix and divide the sample as described in paragraph B.4.2.1.1 above.

B.4.2.2 Sampling with pick and shovel

B.4.2.2.1 From the sides of a stockpile

Using shovels, dig a groove from the top to the bottom of the stockpile. (See note B.7) Remove all the material that has collected at the bottom of the groove as a result of the digging. Place a canvas sheet of suitable size at the bottom of the groove and using picks and shovels loosen a uniform thickness of material down the full length of the groove. Throw this material onto a canvas sheet, mix it thoroughly and quarter it as described in paragraph B.4.2.1.1 above.

B.4.2.2.2 From the top of the stockpile

Dig a vertical test hole with a pick and shovel, preferably 2m deep (or as deep as practically possible). (See note B.7) Place a canvas sheet in the bottom of the hole and cut a uniform groove into the hole from the top to the bottom so that the material falls onto the sheet, or throw it onto the sheet. Continue with this method until you have enough material, raising the canvas sheet as often as necessary and depositing the material on another canvas sheet on the surface of the stockpile.. Now mix thoroughly all the

material deposited on the canvas sheet on the surface and quarter it as described in B.4.2.1.1 above.

B.5 REPORTING

Samples taken from stockpile are often tested in field laboratories. In such cases a proper record must be kept of the sample number, date of sampling, position in the stockpile, description of the material, depth of test hole, etc. When samples from a stockpile are sent to a central laboratory, they must be send under cover of a properly composed report in which full details of the stockpile and samples are given. Important particulars about the sample are the sample number, the position at which sampled, depths between which the sample was taken (right of the side from which it was taken), description of the material of which the sample consists, number and type of bags (or containers) in which the samples are contained and the proposed use of the material. A sketch of the stockpile showing the positions of the sampling points at which the various samples were taken must be included with the report.

NOTE:

B.6 Sampling from a stockpile should, if at all possible, be done while the stockpile. is being formed. Whenever a layer has been completed sampling points should be taken by making test holes in the

layer and taking samples from them. However, stockpiles are often scraped together in natural material with bulldozers, in which case it is better to wait until the stockpile has been completed before taking samples.

B.7 The number of samples will depend on the size of the stockpile. At least four samples must be taken from ach stockpile, but if the pile is greater than 4000 m, one sample must be taken for every 1 000m, i. e. for 0-4 000m- 4 samples, for 5000m – 5 samples for 7000m – 7 samples.

The primary sample should consist of at least 300 kg for coarse and 50 kg for fine material. However, since it is impractical to transport such large quantities, the material is immediately divided up into the secondary sample size as shown in paragraph 3. The tertiary sample size is determined by the test method.

Annex C

(informative)

C.1 SAMPLING OF SLURRY MIXES

This method describes the procedures which should be followed when a sample of ready mixed slurry is taken.

C.2 APPARATUS

C.2.1 Clean, dry sample containers capable of forming an air-tight seal

C.2.2 A suitable scoop.

C.3 MATERIAL

Cleaning material such as toluene, cloths for wiping and water.

C.4 SAMPLE SIZE

A compound sample of at least 4l each must be taken as follows:
Place a clean scoop under the machine's outlet chute and let about 5 l flow into the scoop. Be sure to catch the full width of the stream of slurry. Take a 0.5 l sample from these 5 l and pour it into the sample container. Place the lid on the sample container.

Eight samples must be taken at regular intervals, as described above, from each batch of slurry while it is being spread. The eight single samples must be placed in one container to form one compound sample of at least 4l. (See note C.6.2). Seal the sample container properly and mark or label it with the sample number, then place at which the batch was laid and the time and date of sampling. Dispatch the sample to the laboratory immediately so that tests can be done without delay.

C.5 REPORTING

A full report containing the details of the sample and the slurry mix (mix proportions and mix composition) must accompany the sample to the laboratory.

C.6 NOTES

C.6.1 Since the slurry seal is a suspension with a fairly low viscosity, it is quite easy to sample. However, the sample can only be taken at one stage and that is while the machine is engaged in spreading the mix onto the road. On no account may the modern slurry machine (which uses a continuous mixing method) be stopped so that a sample can be taken (for example to get a wheelbarrow on top of the trailer under the outlet chute.) As soon as the mixing process stops the mix changes composition. On no account may a sample of slurry be scraped off the road either, because: The material is in intimate contact with the underlying layers and a pure and representative sample cannot be taken; and the underlying layers usually absorb some of the binder form the slurry seal.

C.6.2 After each sample has been taken, the equipment must be thoroughly washed with clean water and thereafter dried with clean cloths. If the batch is discharged quickly, it may be necessary to have four sets of equipment ready to avoid the possibility of the equipment still being wet when the next single sample has to be taken.

Bibliography.

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- **SANS 3001-AS20**, Civil engineering test methods – Part AS20: Determination of the soluble. binder content and particle size analysis of an asphalt mix.
- **SANS 1649,** Non-automatic self-indicating, semi-self-indicating and non-self-indicating weighing instruments with denominated verification scale intervals.
- **TMH1,** Standard methods of testing road construction materials.
- **TZS 574/EAS 153**, Packaged drinking water — Specification.