Doc. No.: PCD 06 (23418) WC
February 2024

BUREAU OF INDIAN STANDARDS

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Draft Indian Standards

METHOD OF TEST FOR DETERMINATION OF SPECIFIC GRAVITY OF BITUMINOUS MIXTURES

(ICS No. 75.140)

Bitumen, Tar and Related Products Sectional Committee, PCD 06	Last date for comment is 14 April 2024

FOREWORD

(*Formal clauses will be added later*)

Specific gravity is an intrinsic property of bituminous mixtures which is influenced by the composition of the mixture. Values of bulk specific gravity and theoretical maximum specific gravity are used to calculate air voids in bituminous mixtures. This would also the indication of the compaction values of the mixture.

In reporting the results of a test analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2:2022 'Rules for rounding off numerical values (*second revision*).'

1 SCOPE

1.1 This standard prescribes methods for determination of bulk specific gravity of specimens of compacted bituminous mixtures and theoretical maximum specific gravity of uncompacted bituminous paving mixtures at 25 ºC.

1.2 This method shall not be used if the compacted specimen contains open or interconnected voids and/or absorbs more than 2 percent of water by volume.

2 SAMPLE PREPARATION

2.1 Bulk Specific Gravity of Compacted Test Specimens — Specimens shall be either prepared in the laboratory or taken out as cores from existing pavement. Specimens shall be separated from other pavement layers by sawing or other suitable means.

2.2 Theoretical Maximum Specific Gravity Test Specimens

2.2.1 A sample of loose paving mixture shall be used.

2.2.2 The minimum sample size shall be 1500 g for mixes with nominal maximum aggregate sizes of 12.5 mm or smaller and shall be 2500 g for mixes with nominal maximum aggregate sizes from 19 mm to 25 mm.

3 DETERMINATION OF BULK SPECIFIC GRAVITY OF COMPACTED SPECIMENS

3.1 APPARATUS

3.1.1 *Balance* — The balance shall have sufficient capacity and be readable to 0.1 percent of the sample mass (or better). It shall be capable of weighing the specimen in air as well as suspended in water. A suitable wire suspension (with little friction) arrangement shall be provided for the latter.

3.1.2 *Water Bath* — It shall be capable of maintaining a temperature of (25 ± 1) ºC and equipped with an overflow outlet for maintaining a constant water level.

3.2 PROCEDURE

3.2.1 Dry the compacted specimen to a constant mass. Cool it to room temperature and record the dry mass, *A*.

3.2.2 Immerse the specimen in water bath at (25 ± 1) ºC for (4 ± 1) min and record the immersed mass, *C*.

3.2.3 Remove the specimen from water bath, quickly damp dry it by blotting with a damp towel and determine its surface-dry mass, *B*. Any water that seeps from the specimen during weighing is considered part of the saturated specimen.

NOTES

1 Recently laboratory compacted specimens do not need to be dried to constant mass.

3.3 CALCULATION

3.3.1 Calculate the bulk specific gravity (G_{mb}) of the compacted specimen as follows:

$$G_{mb} = \frac{A}{(B-C)}$$

where

A = mass in grams of dry sample in air,
B = mass in grams of saturated-dry specimen in air; and
C = mass in grams of specimen in water.

3.3.2 Calculate the percent water absorbed by the specimen (on volume basis) as follows:

$$\text{Percent water absorbed by volume} = \frac{(B-A)}{(B-C)} \times 100$$

3.4 REPORT

3.4.1 Report the bulk specific gravity of each specimen up to 3 decimal places.

4 DETERMINATION OF THEORETICAL MAXIMUM SPECIFIC GRAVITY OF LOOSE PAVING MIXTURE

4.1 APPARATUS

4.1.1 Container shall be used either as specified in **4.1.1.1** or **4.1.1.2.**

4.1.1.1 *Vaccum bowls* — Either a metal or plastic bowl with a diameter ranging from 180 mm to 260 mm and a bowl height of at least 160 mm. The bowl shall be equipped with a stiff, transparent cover fitted with a rubber gasket and a connection for the vacuum line. The hose connection shall be covered with a small piece of fine wire mesh to minimize loss of any fine material from the mix.

4.1.1.2 *Vacuum flask for weighing in air* — A thick-walled volumetric glass flask with a capacity of approx. 4000 ml, fitted with a rubber stopper with a connection for the vacuum line. The hose connection shall be covered with a small piece of fine wire mesh to minimize loss of any fine material from the mix.

4.1.2 *Balance — See* **3.1.1**

4.1.3 *Vacuum pump* — Capable of evacuating air from the vacuum container to a residual pressure of 4.0 kPa (30 mm of Hg) or less. A suitable trap shall be provided between the pump and container to minimize water vapour entering the vacuum pump.

4.1.4 Residual pressure manometer or calibrated absolute pressure gauge with a bleed valve to adjust the vacuum level.

4.1.5 *Water bath — See* **3.1.2**

4.2 CALIBRATION OF CONTAINERS

4.2.1 *Bowls* — Determine the mass (*B*) of the container immersed in water at (25 ± 1) ºC. If the bowl is used for weighing in air, place the volumetric lid on the bowl while under water. Remove the water-filled bowl with the lid in place and dry prior to determining the combined mass of the bowl, lid, and water. Repeat 3 times and take average of the 3 masses and record.

4.2.2 *Flasks* — Calibrate the volumetric flask by accurately determining the mass of the flask filled with water at (25 ± 1) ºC. Use a glass cover plate to ensure the flask is completely full.

4.3 TEST PROCEDURE

4.3.1 Separate the particles of the loose paving mixture (while it is warm) by hand so that the particles are not larger than about 6 mm. Place the mix sample directly into the tared bowl or flask. Weigh the container with the sample and record the net mass of the sample as A.

NOTE — Don't fracture the aggregate.

4.3.2 Add sufficient water at 25 ºC to cover the sample completely. Place the cover or stopper on the containers.

4.3.3 Place the container with the sample and water on a mechanical agitation device or agitate manually at frequent intervals of 2 min to 3 min. Begin removing entrapped air by gradually applying vacuum and increasing the vacuum pressure until the residual manometer reads (3.7 ± 0.3) kPa (27.5 ± 2.5) mm of Hg. After achieving this vaccum level within 2 min, continue the vacuum and agitation for (15 ± 2) min. Gradually release the vacuum with the bleed valve.

4.3.4 *Weighing in water* — Suspend the bowl (without lid) and contents in water for (10 ± 1) min and then determine mass. Record the mass under water of the bowl and sample as C.

4.3.5 *Weighing in Air*

4.3.5.1 *Weighing in air using Bowl* — Submerge the bowl and sample slowly in the water bath at (25 ± 1) ºC. Keep it for (10 ± 1) min. Immerse the lid in water and slide it onto the bowl without removing water from the bowl so that no air is trapped inside the bowl. Remove the bowl with the lid in place from the water bath. Dry the bowl and lid with a dry cloth. Determine the mass of the bowl, sample, and lid and record as E.

4.3.5.2 *Weighing in air using Flask* — Fill the flask slowly with water ensuring not to introduce any air into the sample. Place the flask in water bath for (10 ± 1) min to stabilize the temperature at (25 ± 1) ºC without submerging the top of the flask. Completely fill the flask with water using a cover plate without entrapping air beneath the cover plate. Wipe the exterior of the flask and

cover plate. Determine the mass of the flask, plate and its contents completely filled with water. Record this mass as E.

4.4 CALCULATIONS

Calculate the theoretical maximum specific gravity of the sample of loose paving mixture as follows:

4.4.1 *Bowls Used Under Water Determination:*

$$G_{mm} = \frac{A}{[A-(C-B)]}$$

where

A = mass of the dry sample in air, g
B = mass of bowl under water, g; and
C = mass of bowl and sample under water, g

4.4.2 *Bowls in Air Determination:*

$$G_{mm} = \frac{A}{[A+(D-E)]}$$

where

A = mass of dry sample in air, g
D = mass of lid and bowl with water at 25 ºC, g; and
E = mass of lid, bowl, sample and water at 25 ºC, g

4.4.3 *Flask used for Determination:*

$$G_{mm} = \frac{A}{[A+(D-E)]}$$

where

A = mass of dry sample in air, g
D = mass of cover plate and flask filled with water at 25 ºC, g; and
E = mass of flask, cover plate, sample, and water at 25 ºC, g

4.5 REPORT

4.5.1 Report the value of the theoretical maximum specific gravity (G_{mm}) of the bituminous mix up to 3 decimal places.

4.6 PRECAUTIONS

4.6.1 Apply vacuum within the specified range (*see* **4.3.3**) and not more than 15 min. Too less vacuum will not eliminate air bubbles trapped within the loose mix particles. Too much vacuum in terms of amount and time may draw air from the voids inside the solid aggregate particles, which will then get saturated with water and thus give erroneous test results.

4.6.2 If the loose bituminous mix has some uncoated particles, heat the mix and remix it thoroughly so that all particles are coated with bitumen.