METHOD OF TEST FOR BULK RELATIVE DENSITY OF COMPACTED BITUMINOUS MIXTURES USING PARAFFIN COATED SPECIMENS

1. SCOPE

1.1 This method covers the procedure for the determination of the bulk relative density of compacted bituminous mixtures with air voids of approximately 10% and greater or for bituminous mixtures with absorptions greater than 2%.

2. RELEVANT DOCUMENTS

2.1 MTO LS-291 Test for Quantitative Extraction of Asphalt Cement and Mechanical Analysis of Extracted Aggregate from Bituminous Paving Mixtures - Ontario Procedure

2.2 ASTM D1188 Standard Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Coated Samples

3. DEFINITION

3.1 The bulk relative density of a compacted bituminous mixture is the ratio of the mass in g of the specimen in air to the mass in g of an equal volume of water at a specified temperature which is generally 25°C.

4. APPARATUS

4.1 BALANCE: Minimum of 2000 g capacity and accurate to 0.1 g.

4.2 WIRE BASKET: Made from copper or brass wire mesh, 20 cm dia. by 18 cm high to contain a sample when determining mass in water. For flat pavement samples, use a flat piece of copper or brass wire mesh approximately 20 cm square.

4.3 THIN COPPER WIRE: To suspend basket or platform from balance.

4.4 CONTAINER: 60 to 90 L capacity galvanized or plastic garbage can with an overflow spout to maintain a constant water level.

4.5 REFRIGERATING UNIT: Capable of maintaining a temperature of approximately 4°C.

4.6 WAX BATH: Thermostatically controlled electric pot.

4.7 PARAFFIN

4.8 POWDERED TALC: For dusting specimens.

4.9 CONSTANT TEMPERATURE OVEN: With a range of 110 to 170 ± 5°C.

5. TEST PROCEDURE

5.1 Allow the specimen to stand in air for at least 1 h. Carefully brush off any loose particles adhering to the sample. Determine the sample's mass in air and record as "A".

5.2 If further tests on the specimens will be required, the wax can be removed more easily by liberally dusting the specimen with powdered talc prior to coating with wax. Determine the mass of the talc-coated sample mass in air as "A_1".

5.3 Removal of the paraffin coating may be accomplished more easily by first chilling the specimen in a refrigerating unit to a temperature of approximately 4°C for 30 min. and then dipping the specimen in warm wax (5°C above the melting point).

5.4 Coat the test specimen on all surfaces with melted paraffin sufficiently thick to seal all surface voids. Small holes in the coating may be filled in by brushing on hot paraffin. Allow the sample to cool in air at room temperature for a minimum of 30 min. Again determine the mass and record the talc/paraffin coated sample mass in air as "A_2".

5.5 Determine the waxed sample mass in water and record as "B".

5.6 If air bubbles are noticed rising from the specimen during the weighing in water, quickly remove the specimen from the water and seal the pinhole(s) using a hot spatula. After attaining the mass of the specimen in water, surface-dry the specimen with a towel and record the new mass in air as "A_3". Note that rising air bubbles indicate that holes are present in the wax coating and water is being absorbed into the specimen.

5.6.1 When a Marshall briquette or pavement core is being weighed, rest the sample with the curved side on the bottom of the basket.

5.6.2 When a rectangular pavement sample is being weighed, place the sample on its side or end on the bottom of the basket.

5.7 Determine the mass of all samples to 0.1 g accuracy.

5.8 For cold in-place recycled and cold in-place with expanded asphalt mixtures, moisture correction shall be made using the moisture content obtained from the adjacent slab sample using LS-291. Moisture correction for other pavement materials, or other specimens that may contain absorbed moisture, is done in the following manner:

5.8.1 Remove the paraffin coating and brush off the talc.

5.8.2 Place the uncoated sample in an oven maintained at a temperature of approximately 110°C.

5.8.3 Dry the sample to a constant mass.

5.8.4 Record this corrected mass in "A" (dividend only).

6. CALCULATIONS

6.1 Calculate the bulk relative density of the sample as follows:

$$\text{Bulk Relative Density} = \frac{A}{A_3 - B - \left\{\frac{A_1 - A}{D_1} + \frac{A_2 - A_1}{D_2}\right\}}$$

Where: A = Mass of dry specimen in air, g.

A_1 = Mass of specimen plus talc coating in air, g.

A_2 = Mass of specimen including talc plus paraffin coating in air, g.

A_3 = Surface dry mass of specimen including talc plus paraffin after immersion in water, g.

B = Mass of specimen including talc and paraffin, in water, g.

D1 = Bulk relative density of talc.

D2 = Bulk relative density of paraffin.

7. REPORTING OF RESULTS

7.1 Report the sample number.

7.2 Report the bulk relative density to three decimal places with the third decimal place having been "rounded off".

7.3 Report the moisture content determined from LS-291.

8. GENERAL NOTES AND PRECAUTIONS

8.1 When determining the mass of samples in water both the basket and handle, where provided, must be completely immersed in water.

8.2 Be certain that no air bubbles adhere to the wire basket or waxed specimen when it is immersed in water.

8.3 Use as thin a wire as possible to suspend the basket from the balance.

8.4 For Marshall briquettes, all bulk relative density (B.R.D.) determinations should be done in triplicate. If the B.R.D. of any one briquette is more than 0.015 from the mean of the triplicate values, recheck the calculations and, if necessary, re-weigh.

8.5 If the percentage voids for any one briquette is less than 0.5% from the mean of the triplicate values, then the B.R.D., M.R.D., and percent void values of that briquette are acceptable.

8.6 Mass of pavement samples should be minimum of 1000 g.

8.7 Pavement samples must be free of cracks.

8.8 The water in the weigh bucket must be maintained as close to room temperature as possible (25°C).

8.9 B.R.D. for talc is 2.78.

8.10 B.R.D. for paraffin is 0.89.

8.11 The above-noted B.R.D.s are only for the products tested by the MTO Downsview Laboratory and may vary with the sources of material.