METHOD OF SAMPLING AND TESTING
MT-324-04
METHOD OF TEST FOR
EFFECT OF WATER ON COHESION OF COMPACTED BITUMINOUS MIXTURES
(Modified AASHTO T 165)

1 Scope:

1.1 This method covers measurement of the loss of cohesion resulting from the action of water on compacted bituminous mixtures containing penetration grade asphalts. A numerical indeed of reduced cohesion is obtained by comparing the compressive strength of freshly molded and cured specimens with the compressive strength of duplicate specimens that have been immersed in water under prescribed conditions.

2 Referenced Documents:

2.1 ***AASHTO:***

T 67 Force Verification of Testing Machines
T 165 Effect of Water on Compressive Strength of Compacted Bituminous Mixtures

MT Manual:

MT-314 Method of Test for Bulk Specific Gravity of Compacted Bituminous Mixtures
MT-323 Fabricating Specimens for Compressive Strength of Bituminous Mixtures

3 Apparatus:

3.1 *High Temperature Water Bath* – One or more automatically controlled water baths shall be provided for immersing the specimens. The baths shall be of sufficient size to permit total immersion of the test specimens. They shall be so designed and equipped as to permit accurate and uniform control of the immersion temperature of 140 ± 2 ºF (60 ± 1ºC). They shall be constructed of or lined with copper, stainless steel, or other nonreactive material. The water used for the wet storage of the specimens shall be either distilled or otherwise treated to eliminate electrolytes and the bath shall be emptied, cleaned, and refilled with fresh water for each series of tests. Tap water can be used for wet storage if it can be shown that it does not affect the test results of the immersed specimens.

3.2 *Low temperature Water Bath* – A manually or automatically controlled water bath also shall be provided for bringing the immersed specimens to the temperature of 77±2 ºF (25±1 ºC) for the compression test. Any convenient pan or tank may be used provided it is of sufficient size to permit total immersion of the specimens.

3.3 *Balance* – A balance and a water bath with suitable accessory equipment will be required for weighing the test specimens in air and in water in order to determine their densities, the amount of absorption, and any changes in specimen volume resulting from the immersion test. The balance will have a capacity of 5 kilograms or more and be sensitive to 0.1 grams or less.

3.4 *Flat plate* – For very fragile specimens a supply of flat transfer plates of glass or metal will be required. One of these plates shall be kept under each of the specimens during the immersion period and during subsequent handling. Except when weighing and testing, in order to prevent breakage or distortion of the specimens.

3.5 *Testing machine* – The testing machine may be of any type of sufficient capacity that will provide a range of accurately controllable rates of vertical deformation. The rate of vertical deformation for the compression test is specified as 0.05 in (1.3 mm) per min. per 1 in. (25 mm) of height of specimen. A controllable rate of 0.2 in. (5.1 mm) per minute is required for a 4 in. (200 mm) nominal height specimen. For central control laboratory installations the testing machine shall

3 Apparatus: (continued)

conform to the requirements of Methods of Verification of Testing Machines (AASHTO T 67). The testing machine shall be equipped with two steel bearing blocks with hardened faces, one of which is spherically seated and the other plane. The spherically seated block shall be mounted to bear on the upper surface of the test specimen and the plane block shall rest on the platen of the testing machine to form a seat for the specimen. The bearing faces of the plates shall have a diameter slightly greater than that of the largest specimens to be tested. The bearing faces, when new, shall not depart from a true plane by more than 0.0005 in (0.013 mm) at any point and shall be maintained within a permissible variation limit of 0.001 in (0.025 mm). In the spherically seated block, the center of the sphere shall coincide with the center of the bearing face. The movable portion of this block shall be held closely in the spherical seat but the design shall be such that the bearing face can be rotated freely and tilted through small angles in any direction.

4 Test Sample:

4.1 At least four 4 x 4 inch (100 x 100 mm) cylindrical specimens (nominal dimension) shall be made for each test. The procedure described in Fabricating Specimens for Compressive Strength of Bituminous Mixture, MT-323, shall be followed in preparing the loose mixtures and in molding and curing the test specimens.

5 Procedure:

5.1 Allow each set of test specimens to cool for at least two hours after removal from the curing oven described in MT-323. Determine the Bulk Specific Gravity of random specimen from Group 2 in accordance with the procedures and calculation for Bulk Specific Gravity of Compacted Bituminous Mixture in Section 5.

5.2 Sort each set of four specimens into two groups of specimens. Prepare the specimens in group 1 as described in 5.2.1 and prepare the specimens in group 2 as described in 5.2.2.

5.2.1 Group 1 – Bring the test specimens to the test temperature, 77 ± 2 ºF (25 ± 1 ºC), by storing them in an air bath maintained at the test temperature for not less than 4 hours then determine their compressive strengths.

5.2.2 Group 2 – Immerse the test specimens in water for 24 hr. at 140 ± 2 ºF (60 ± 1 ºC). Transfer them to a second water bath maintained at 77 ± 2 ºF (25 ± 1 ºC) for 2 hr. and then immediately determine their compressive strengths.

5.3 To determine the compressive strength of the specimens place the specimens in axial compression without lateral support loading the specimens at a rate of 0.2 inches (5.1 mm) per minute. The specimen is loaded at the above rate until failure occurs. The point of failure is defined as the maximum load obtained.

6 Calculation:

6.1 Calculate the bulk specific gravity of a random test specimen from Group 2 as follows:

$$\text{Bulk specific gravity} = \frac{A}{B - C}$$

where:

A = mass of oven-dry specimen in air, g.

B = mass of surface-dry specimen in air, g.

C = mass of specimen in water, g

6 Calculation: (continued)

6.2 Calculate the maximum compressive strength of each specimen in pounds per square inch (psi) for a 4 inch (100 mm) diameter specimen as follows:

Maximum compressive strength, psi = $\frac{A}{B}$

Where:

A = the maximum load obtained for specimen in pounds.

B = area of surface loaded in inches squared. For a 4-inch (100 mm) nominal diameter specimen, it is 12.5664 inches squared.

6.3 Calculate the numerical index of resistance of bituminous mixtures to the detrimental effect of water as the percentage of the original strength that is retained after the immersion period. It shall be calculated as follows:

Index of retained strength, $\% = \frac{S_2}{S_1} x100$

Where:

S_1 = average compressive strength of dry specimens (group 1), and

S_2 = average compressive strength of immersed specimens (group 2).

7 Report:

7.1 The report shall include a random bulk specific gravity, the maximum compressive strengths for each specimen, and the percent of retained compressive strength as calculated in Sec 6.3. The report will also include the penetration range of the asphalt cement, the refinery where the asphalt was made, the percent of asphalt used and the mixing temperature of the test specimens.

8 Precision:

8.1 Single-Operator Precision – The single-operator standard deviation has been found to be 6 percent (see Note 1). Therefore, results of two properly conducted tests by the same operator on the same material should not differ by more than 18 percent (see Note 1).

Note 1 - These numbers represent, respectively the (1S) and D2S) limits as described in AASHTO Recommended Practice R4, for preparing Precision Statements for Test Methods for Construction Materials.

8.2 Multilaboratory Precision – The multilaboratory standard deviation has been found to be 18 percent (see Note 1). Therefore, results of two properly conducted tests from two different laboratories on identical samples of the same material should not differ by more than 50 percent (see Note 1).