

DETERMINATION OF MOISTURE SUSCEPTIBILITY OF BITUMEN STABILISED MATERIALS (BSMs), USING MIST DEVICE

1. SCOPE

This method covers the procedure for determining the moisture-related damage on cured or cored triaxial test specimen made of Bituminous Stabilised Materials (BSMs). The method employs cyclic pulsing of water pressure into specimen to simulate moisture induction of dynamic traffic in the field condition.

2 APPARATUS

- 2.1 MIST (Moisture Induction Simulation Test) Device, the device consist of; 20litre pressure tank of max 600kPa, water pump, ON-OFF timer ranging from 0-60min, Pressure regulator and pressure gauge max of 400kPa, ON-OFF solenoid valves set by the timer, and hose pipe, see Figure 1.
- 2.4 Three phase electrical supply for the water pump
- 2.2 Triaxial cell, capable to accommodate specimen of 300mm high and 150mm Diameter, and top access to water pressure connection
- 2.3 Cylindrical container, (e.g. 150mm dia and 300mm high) with bottom outlet to drain water outflow
- 2.4 Water bath to accommodate overflow from triaxial cell
- 2.5 Steady water tape supply connected to the 20-litre pressure tank
- 2.6 A balance to weigh up to 15 Kg with accuracy of 0.5g
- 2.7 A drying oven capable of maintaining temperature of $110^{\circ}\text{C} \pm 5^{\circ}\text{C}$

3 METHOD

3.1 Preparation of triaxial specimens

Prepare triaxial specimens in accordance with the procedure described in the Appendix to BOSCH® compaction procedure, Task 12. Enough material should be mixed to produce at least twelve specimens on recommended binder.

3.2 Curing of Specimens

Cure the specimens in accordance with the procedure described in the Appendix to Curing procedure, Task 7 & 8.

3.3 Evaluation and grouping of specimens

3.3.1 After curing, remove the wet bag and let the specimens cool at ambient temperature (25°C) for about one hour. Cover the specimens immediately if delay occurs for conditioning.

After cooling, the following physical tests and measurements of each specimen carried-out:

- The average height (t) and average Diameter (D)
- Rice's density (G_{mm}) in accordance with THM1 Method C4
- Bulk relative density (G_{mb}) in accordance with THM1 Method C3
- The specimen volume (E) as a difference in specimen weighed in water and specimen saturated surface-dry weight.
- Percentage air void (P_a) in accordance with THM1 Method C3.

3.3.2 Group the specimens into a set of two, with approximately equal void content (P_a). Separate these sets with six (6) specimens for wet conditioning and static (monotonic) test, and other six (6) for un-conditioning or dry static (monotonic) test.

3.4 Conditioning of specimens

3.4.1 Set-up the test variables on MIST device i.e. ON-OFF timer at 0.54sec load time, and 1.40sec rest period, and regulate pressure gauge at 140kPa cyclic pulsing water pressure. (Cyclic pressure might require adjustment to accommodate for the water momentum).

3.4.2 Place specimen in a triaxial cell base and assemble the cell firmly. Then connect the top of the cell to the water pressure outlet, see Figure 1.

3.4.3 Start the MIST device and count 100 cycles, or time the haversine cyclic pulsing for 3.2 minutes then stop.

3.4.4 De-assemble the triaxial cell, and remove the specimen carefully. Take weight of saturated surface-dry specimen and transfer the specimen to the triaxial static (monotonic) test set-up.

3.5 Calculation

Volume of air voids (V_a) in specimen [cm^3], $V_a = \frac{P_a \times E}{100}$

Volume of water absorbed (V_w) in specimen [cm^3], $V_w = B - A$

Degree of saturation (S_r) in specimen [%], $S_r = \frac{V_w}{V_a} \times 100$

Where:

B = Weight of saturated-surface dry specimen [g]

A = weight of dry specimen in air [g]

P_a = air void content in specimen [%]

E = volume of specimen [cm^3]

3.5.1 The degree of saturation should be at least 80% for accurate screening of the BSMs.

3.6 Determination of retained cohesion ratio

- 3.6.1 After conditioning, place the specimen into simple triaxial device set-up. Triaxial test is performed in accordance with the procedure described in the Appendix to Simple triaxial test protocol, Task 5.
- 3.6.2 Two set of six (6) specimens with predetermined height and approximately equal void content, after conditioning are tested for static (monotonic) test at 50kPa, 100kPa, and 200kPa. Another two set of six (6) specimens tested unconditioned at 50kPa, 100kPa, and 200kPa, with the applied rate of loading of 2.1mm/minutes.
- 3.6.3 Repeat test is done on the second set of six (6) specimens are done for statistical evaluation and repeatability.
- 3.6.4 Shear properties (C and ϕ) of the conditioned and unconditioned sets of specimens are determined in accordance with the procedure described in the Appendix to simple triaxial test protocol, Task 5.
- 3.6.5 Retained cohesion ratio is calculated as follows:

$$\text{Retained cohesion, (RC)} = \frac{\text{Cohesion of wet mix, (CoW)}}{\text{Cohesion of dry mix, (CoD)}} \times 100$$

Where, cohesion of wet and dry mix calculated from Mohr Coulomb cycle as per Equation.

$$\sigma_{1,f} = \frac{1 + \sin \phi}{1 - \sin \phi} \sigma_3 + \frac{2.C \cdot \cos \phi}{1 - \sin \phi}$$

Where,

- σ_{1f} = Maximum principal stress at failure [kPa]
 σ_3 = confining pressure [kPa]
 ϕ = internal angle of friction of the mix [deg]
C = cohesion of the mix [kPa]

4 REFERENCES

- 4.1 Appendix to Bosch® vibratory compaction procedure Task 12
4.2 Appendix to Curing of BSMs procedure Task 7 & 8
4.3 Appendix to Simple triaxial testing procedure Task 5
4.5 THM1 Method C3, and C4

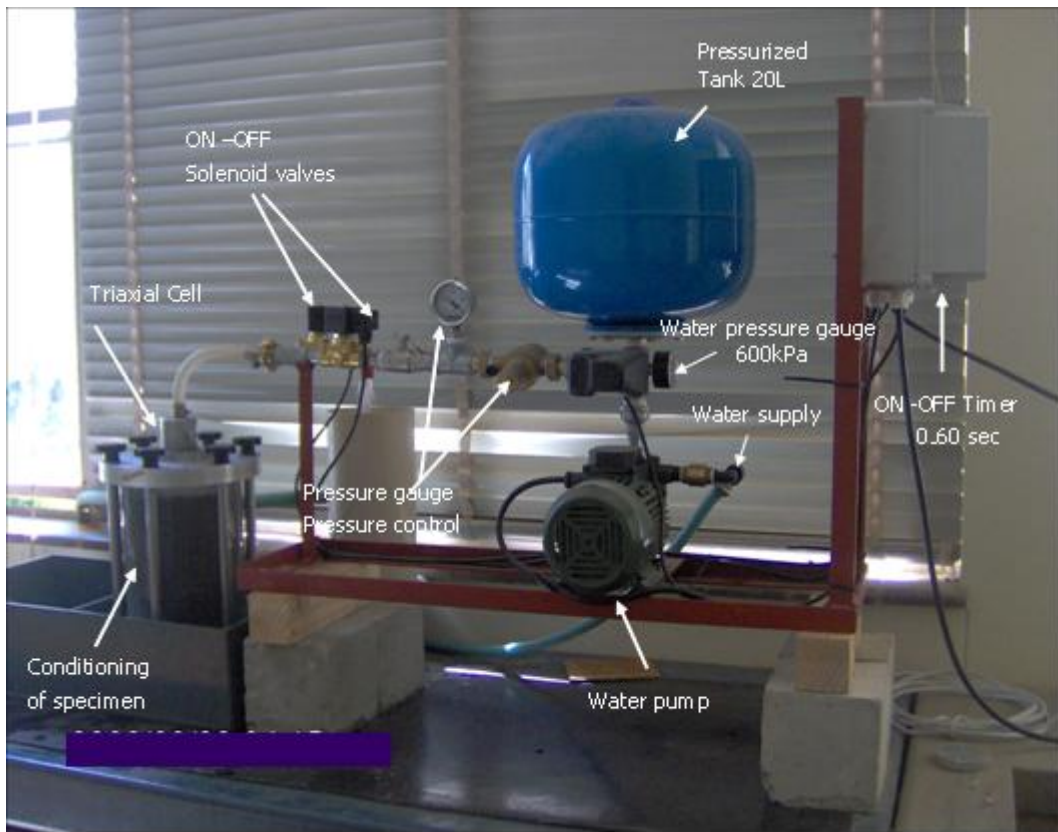


Figure 1: MIST device features, set-up and connections