

# **STANDARD PRACTICE FOR MIXTURE CONDITIONING OF HOT MIX ASPHALT**

## **AASHTO R 30**

### **GLOSSARY**

Short term mixture conditioning - a laboratory procedure used to simulate the effects of HMA aging and binder absorption that occurs during the precompaction phase of the construction process.

Oxidation - a type of chemical reaction that occurs between binder and oxygen that changes the stiffness of the binder.

Long term mixture conditioning - a laboratory aging procedure used to simulate the effects of HMA aging that occurs over the service life of a pavement.

### **MIXTURE CONDITIONING OF HOT MIX ASPHALT (HMA)**

Samples of HMA prepared in the laboratory have different properties from mixtures produced in a HMA plant for a number of reasons. One of these reasons is that the HMA ages as it goes through the plant, and during storage and transportation, until it cools down. The binder reacts with oxygen in the air and becomes harder and more brittle. Some volatile fractions of the binder may also be driven off at the high temperatures encountered during construction. Absorption of some of the binder into the aggregate can also occur during construction while the binder is still fluid enough to migrate into the pores of the aggregate. Aging continues at a slower rate throughout the service life of the pavement. The aging (or oxidation) reaction proceeds at a higher rate in hot climates or during the summer months when the temperatures are higher.

It is important to account for these changes in the mixture properties when preparing mixtures in the lab. One way to account for these changes is to condition the laboratory mixtures in such a way as to simulate the aging that happens during construction and service. The short term mixture conditioning procedure is used to simulate the aging that occurs during construction (up to the point of compaction) and is used during the mix design procedure. Long term aging is used to simulate the aging that occurs over the many years that pavement is in service. Consequently, long term aging is used when performing tests to simulate mixture properties late in the life of the pavement, such as when analyzing the resistance of a mixture to low-temperature cracking using Superpave mixture analysis and the indirect tension tester. Long term mixture conditioning follows short term condition for laboratory prepared mixtures.

## **Apparatus**

Forced-Draft Oven, capable of maintaining temperatures from room temperature up to  $350 \pm 5^\circ\text{F}$  ( $176 \pm 3^\circ\text{C}$ ).

Loading device, capable of applying a static 12.5 kip (56 kN) load at a rate of  $16 \pm 0.01$  kip/min ( $72.00 \pm 0.05$  kN/min).

Thermometers, covering the range from  $122^\circ\text{F}$  to  $500^\circ\text{F}$  ( $50^\circ\text{C}$  to  $260$ ) readable to the nearest  $2^\circ\text{F}$  ( $1^\circ\text{C}$ ).

Miscellaneous equipment, shallow metal pan for aging loose mix, metal spatula or spoon for stirring, oven gloves.

## **Procedure**

### **Mixture Conditioning for Volumetric Mixture Design**

The mixture conditioning procedure for volumetric mix designs applies to laboratory-prepared, loose mixture only. No mixture conditioning is required when conducting QC/QA testing on plant-produced mixture.

1. Place the mixture in a pan, and spread it to an even thickness ranging between 1 to 2 in. (25 and 50 mm)
2. Place the mixture and pan in a forced-draft oven for  $2 \text{ h} \pm 5 \text{ min}$ . at a temperature equal to the mixture's compaction temperature  $\pm 5^\circ\text{F}$  ( $\pm 3^\circ\text{C}$ ).

(Note: The compaction temperature range of an HMA mixture is defined as the range of temperatures where the unaged binder has a kinematic viscosity of approximately  $0.28 \pm 0.03$  pa-s ( $280 \pm 30$  mm<sup>2</sup>/s) measured in accordance with ASTM D 4402. The target compaction temperature is generally the mid-point of this range. When using modified asphalts, the binder manufacturer's recommendation for compaction temperature should be considered.)

3. Stir the mixture after  $60 \pm 5$  minutes to maintain uniform conditioning.

### **Mixture Conditioning for Short-Term Aging**

The short-term conditioning for the mixture mechanical property testing procedure applies to laboratory-prepared, loose mix only.

1. Place the mixture in a pan, and spread it to an even thickness ranging between 1 to 2 in. (25 and 50 mm).
2. Place the mixture and pan in a forced-draft oven for  $4 \text{ h} \pm 5 \text{ min.}$  at a temperature of  $275 \pm 5^\circ\text{F}$  ( $135 \pm 3^\circ\text{C}$ ).
3. Stir the mixture every  $60 \pm 5$  minutes to maintain uniform conditioning.

### **Mixture Conditioning for Long-Term Aging**

The long term mixture conditioning procedure can be applied to laboratory-prepared samples following short term aging, to plant-mixed HMA, or to compact roadway samples when needed to simulate long term aging effects. This mixture conditioning step is used when samples will be tested for mechanical properties, such as indirect tensile creep or strength.

#### **Loose-Mix -- Gyrotory Compacted Specimen**

Laboratory-prepared mixture should be conditioned following the procedure described for short-term aging above. Plant-mixed material does not need to be short term aged.

1. Compact the HMA sample according to T 312 to the level of compaction required for the tests to be conducted. Do not extrude the specimen from the mold.
2. Condition the compacted sample by cooling in the mold to  $140^\circ \pm 5^\circ\text{F}$  ( $60^\circ \pm 3^\circ\text{C}$ ). This typically takes about 2 hours.
3. The ends of the specimen may not be parallel. The ends are squared up by applying a static load in a testing device. Increase the load from 0 kN at a rate of  $16 \pm 0.01 \text{ kip/min.}$  ( $72.00 \pm 0.05 \text{ kN/min}$ ). Release the load at the same rate when the ends of the specimen are level or when the load reaches a maximum of 12.5 kip (56 kN).
4. Remove the specimen from the testing machine and allow to cool  $16 \pm 1$  hours at room temperature. The sample should be extruded from the compaction mold after cooling for 2-3 hours.

### **Loose-Mix -- Rolling Wheel Compacted Specimens**

1. Compact the specimen in accordance with PP 3.
2. Cool the specimen at room temperature for  $16 \pm 1$  h.
3. Remove the slab from the mold, and saw or core the required specimen from the slab.

### **Compacted Roadway Specimens**

1. Cool the test specimen at room temperature for  $16 \pm 1$  h.
2. Place the specimen in the oven at  $185 \pm 5^\circ\text{F}$  ( $85 \pm 3^\circ\text{C}$ ) for  $120 \pm 0.5$  h.
3. After  $120 \pm 0.5$  h, turn the oven off, open the oven doors, and allow the test specimen to cool to room temperature. This typically takes about 16 hours. Do not touch or remove the specimen from the oven until the end of this cooling period.