FLORIDA DEPARTMENT OF TRANSPORTATION
State Materials Office
5007 NE 39th Avenue
Gainesville, Florida 32609
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Florida Method of Test
For
Determining the Optimum Asphalt Binder Content of an Open-graded Friction Course Mixture Using the Pie Plate Method

Designation: FM 5-588

1. SCOPE

This method covers the determination of the optimum asphalt binder content of an open-graded friction course mixture using the pie plate method.

2. REFERENCED DOCUMENTS

Florida Department of Transportation Specifications:

Section 901
Section 902
Section 337
Section 916

AASHTO Specification:

M 231, Weighing Devices Used in the Testing of Materials

Florida Methods of Test:

FM 5-563, Quantitative Determination of Asphalt Content from Asphalt Paving Mixtures by the Ignition Method

3. APPARATUS

3.1 Oven – oven of sufficient size capable of maintaining the required temperature of 320 ±5°F (160 ±3°C).

3.2 Balance – balance conforming to the requirements of AASHTO M 231, Class G2. Balances with a greater degree of accuracy may be used.

3.3 No. 4 Sieve – 8 or 12 in. diameter sieve used to break up fiber conglomerates.

3.4 Mixing Bowl – clean metal bowl of sufficient capacity to allow hand mixing the aggregate, asphalt binder, and fibers.

3.5 Spatula – A clean spatula capable of hand mixing the aggregate, asphalt binder, and fibers.

3.6 Pie Plate – A clear, 9 in. diameter, flat-bottomed heat resistant pie plate, in which the mixture will be placed. Pyrex brand pie plates have been found to meet these requirements.

3.7 Digital Camera – A camera with suitable resolution to photograph the bottom of the pie plate after the mixture has cooled. The photographs will be used to record the appearance of the bottom of the pie plate at each asphalt binder content for documentation only. Binder content selection will be determined by direct observation of the pie plates, not by examination of the photographs.

4. MATERIALS

4.1 Aggregates, Hydrated Lime, and Fiber Stabilizing Additive – As defined in Sections 901, 902, and 337 of the Department's Specifications.

4.2 Asphalt Binder – Use PG 67-22 asphalt binder as defined in Section 916 of the Department's Specifications to determine the optimum asphalt binder content. Use the asphalt binder type specified on the mix design to determine the asphalt binder ignition oven calibration factor in accordance with FM 5-563.

5. DETERMINATION OF OPTIMUM ASPHALT BINDER CONTENT

5.1 Verify the aggregate blend meets the gradation and component requirements of Section 337 of the Department's Specifications.

5.2 Determine the amount of fiber material and hydrated lime (if required) using the following calculations:

$$\text{Weight of Mineral Fibers} = (A \div 0.996) - A$$

$$\text{Weight of Cellulose Fibers} = (A \div 0.997) - A$$

$$\text{Weight of hydrated lime} = B \times 0.01$$

Where:

A = Total weight of aggregates, mineral filler, hydrated lime, and binder

B = Total aggregate batch weight (aggregate, mineral filler, and hydrated lime, but not including fibers)

5.3 Break up any large conglomerates of fibers by passing the fibers through the No. 4 sieve.

5.4 Prepare three 1200 g aggregate batches. Add the hydrated lime additive (if required) and the fiber material into the aggregate batches. Ensure the fiber material (and hydrated lime, if required) is distributed evenly throughout the aggregate batch. Place each batch in a separate mixing bowl.

5.5 Heat the aggregate batches and the asphalt binder for a minimum of two hours in an oven at 320 ±5°F (160 ±3°C).

5.6 Using the spatula, gently mix the aggregate batches and asphalt binder in the mixing bowls at the following three prescribed asphalt binder contents (by weight of total mix): 5.5%, 6.0%, and 6.5% for mixtures containing granite aggregate or 6.8%, 7.3%, and 7.8% for mixtures containing limestone aggregate. Continue mixing until all the aggregate and fiber particles are thoroughly coated, ensuring that there are no large conglomerates of fine particles.

5.7 Immediately after mixing, carefully transfer the mixture from the mixing bowl into a pie plate using a method that will evenly distribute the mixture over the entire bottom surface of the pie plate without causing segregation or sliding/dragging of the mixture over the surface of the pie plate. Care should be taken to ensure that the mixture is not disturbed once it has contacted the pie plate. After placing the mixture in the pie plate, place the pie plate on a level surface in an oven and heat for one hour ±2 minutes at 320 ±5°F (160 ±3°C). Repeat this step for each of the remaining samples.

5.8 After the one-hour heating period, carefully remove each pie plate from the oven, place it on a heat resistant surface and allow it to cool undisturbed until it reaches room temperature.

5.9 After all the mixtures have cooled to room temperature, invert the pie plates, and inspect the bottom surfaces. Determine the optimum asphalt binder content based on the sample which displays sufficient bonding between the mixture and the bottom of the pie plate without evidence of excessive asphalt binder drainage (see Figures 1, 2, and 3). The optimum asphalt binder content should exhibit slight drainage of asphalt binder at points of contact between the coated aggregate particles and the glass pie plate. The size and quantity of asphalt binder contact points are the determining factors in selecting the optimum asphalt binder content and have been validated by research and field performance. The optimum asphalt binder content may be one of the three trial asphalt binder contents or may be estimated to be higher or lower than one of the three trial asphalt binder contents. For example, by examination of Figures 1-3 below, the optimum binder content would be selected at 6.3%. Additional samples may be prepared, at different asphalt binder contents, if necessary.

5.10 Photograph the bottom of each pie plate for documentation.

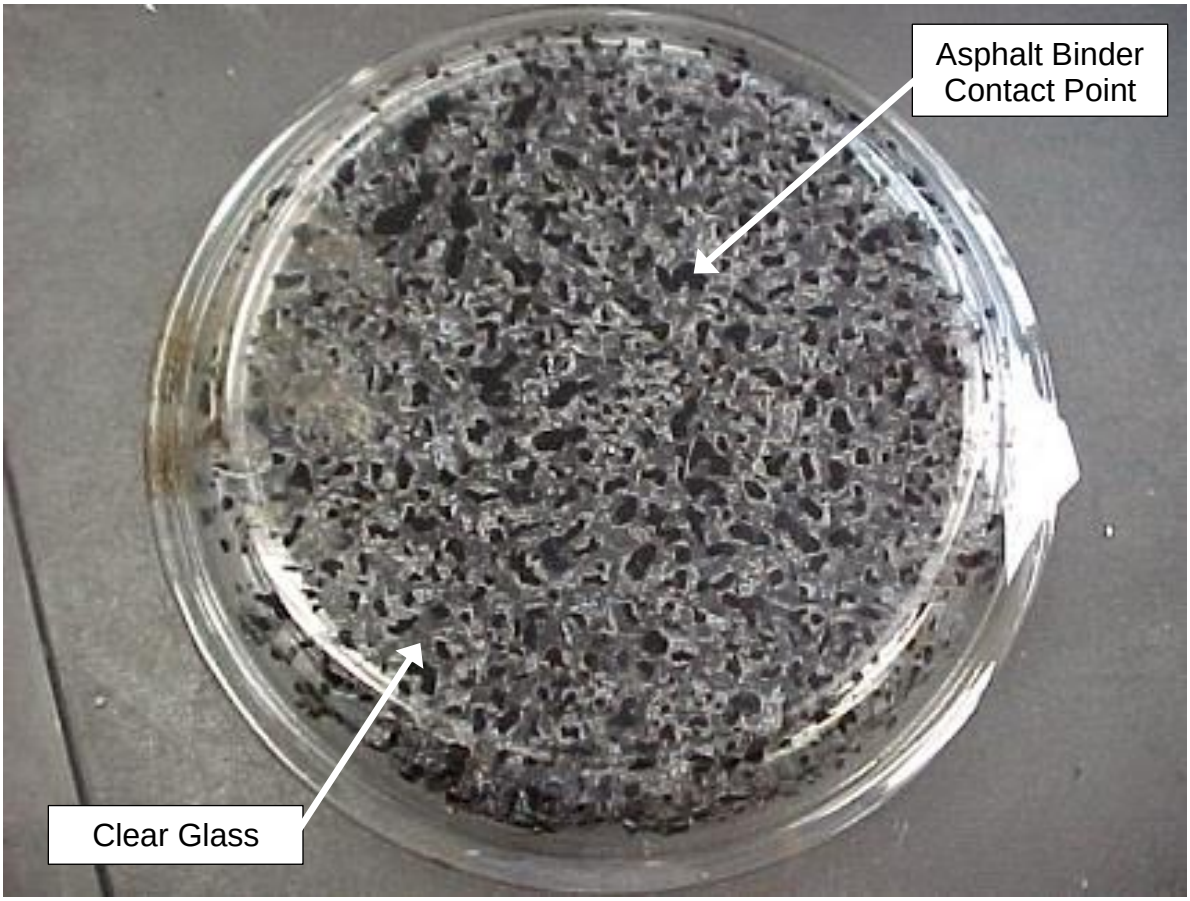

Figure 1
FC-5 @ 5.5% asphalt binder
Insufficient bonding/drainage – asphalt binder content too low

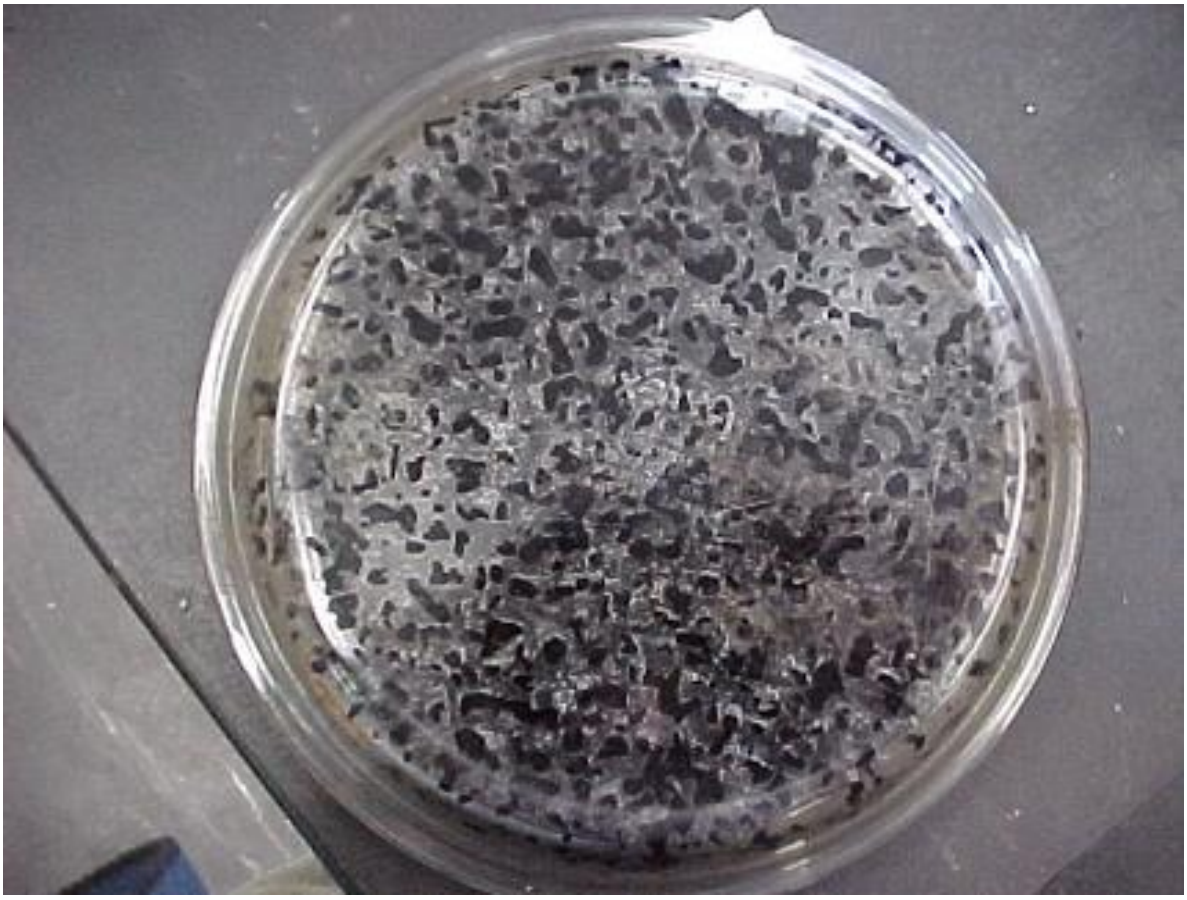

Figure 2
FC-5 @ 6.0% asphalt binder
Insufficient bonding/drainage – asphalt binder content slightly low

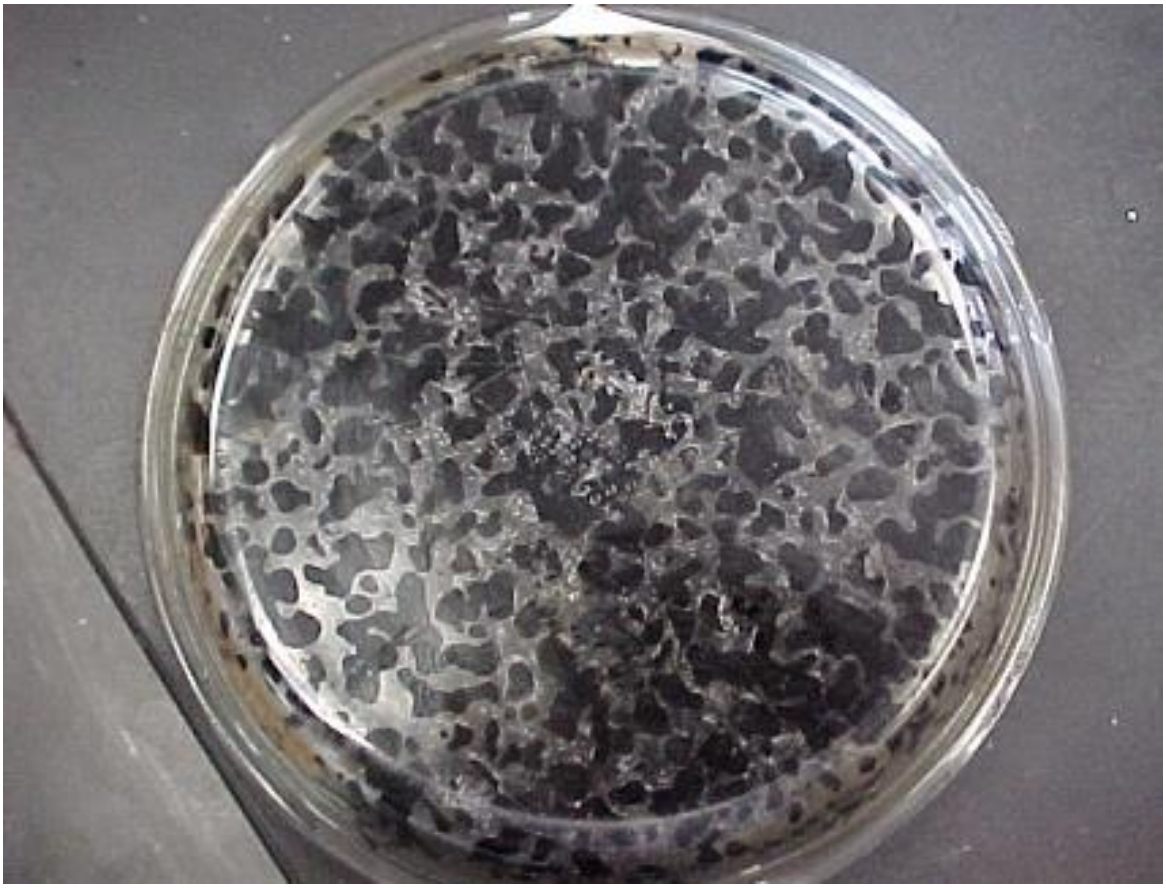

Figure 3
FC-5 @ 6.5% asphalt binder
Excessive bonding/drainage – asphalt binder content slightly high

NOTE 1: If PG 76-22 (PMA) or high polymer asphalt binder is required, the total asphalt binder content to be shown on the approved mix design will be the same as the original asphalt binder content determined using PG 67-22 asphalt binder. If PG 76-22 (ARB) asphalt rubber binder is required, the total asphalt binder content must be increased to include the percent of rubber by weight of optimum asphalt binder using the following calculation:

Total PG 76-22 (ARB) content = PG 67-22 optimum asphalt binder content x 1.07

6. DETERMINATION OF ASPHALT BINDER CALIBRATION FACTOR

6.1 Prepare two 1500 g aggregate batches. Include the hydrated lime additive (if required) and the fiber material into the aggregate batches. Place each batch in a separate mixing bowl.

6.2 Heat the aggregate batches and the required asphalt binder [PG 76-22 (PMA), PG 76-22 (ARB), or High Polymer] for a minimum of two hours ±5 minutes in an oven at 320 ±5°F (160 ±3°C).

6.3 Using a spatula, gently mix the aggregate batch and asphalt binder in the mixing bowl. Continue mixing until all the aggregate particles and fibers are thoroughly coated.

6.4 Determine the asphalt binder ignition oven calibration factor in accordance with FM 5-563.