

# **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 in open-graded friction course mixtures using the pie plate method.

## **2. REFERENCED DOCUMENTS**

Florida Department of Transportation Specifications:

Section 901

Section 902

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 up to  $320 \pm 5^{\circ}\text{F}$  ( $160 \pm 3^{\circ}\text{C}$ ).
- 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 –“buttered” 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., flat-bottomed heat resistant pie plate, in which the mixture will be placed, to determine optimum asphalt binder content. 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.

#### 4. MATERIALS

- 4.1 Aggregates, Hydrated Lime, and Fiber Stabilizing Additive – As defined in Section 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 calibration factor in accordance with FM 5-563.

#### 5. DETERMINATION OF OPTIMUM ASPHALT BINDER CONTENT

- 5.1 Develop an aggregate blend meeting the gradation and component requirements of Section 337 of the Department's Specifications.
- 5.2 Determine the amount of fiber material using the following calculations:

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

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

Where:

$$A = \text{Total weight of aggregate and binder}$$

- 5.3 Break up any large conglomerates of fibers using 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 that the fiber material is distributed evenly throughout the aggregate batch. Place each batch in a mixing bowl.
- 5.5 Heat the aggregate batches and the asphalt binder for a minimum of two hours in an oven at  $320 \pm 5^{\circ}\text{F}$  ( $160 \pm 3^{\circ}\text{C}$ ).
- 5.6 Using the spatula, gently mix the aggregate batch and asphalt binder in the

- mixing bowl at the following three prescribed asphalt binder contents (by weight of total mix): 5.3%, 5.8%, and 6.3% for granite aggregate or 5.8%, 6.3%, and 6.8% for limestone aggregate. Continue mixing until all of the aggregate 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. 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 at  $320 \pm 5^{\circ}\text{F}$  ( $160 \pm 3^{\circ}\text{C}$ ). Repeat this step for each of the remaining samples.
- 5.8 After the one hour heating period, carefully remove the 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 of 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 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. Additional samples may be prepared, at different asphalt binder contents, if necessary.
- NOTE 1:** The optimum asphalt binder content should exhibit slight drainage of asphalt binder at points of contact between the coated aggregate particles and the glass plate.

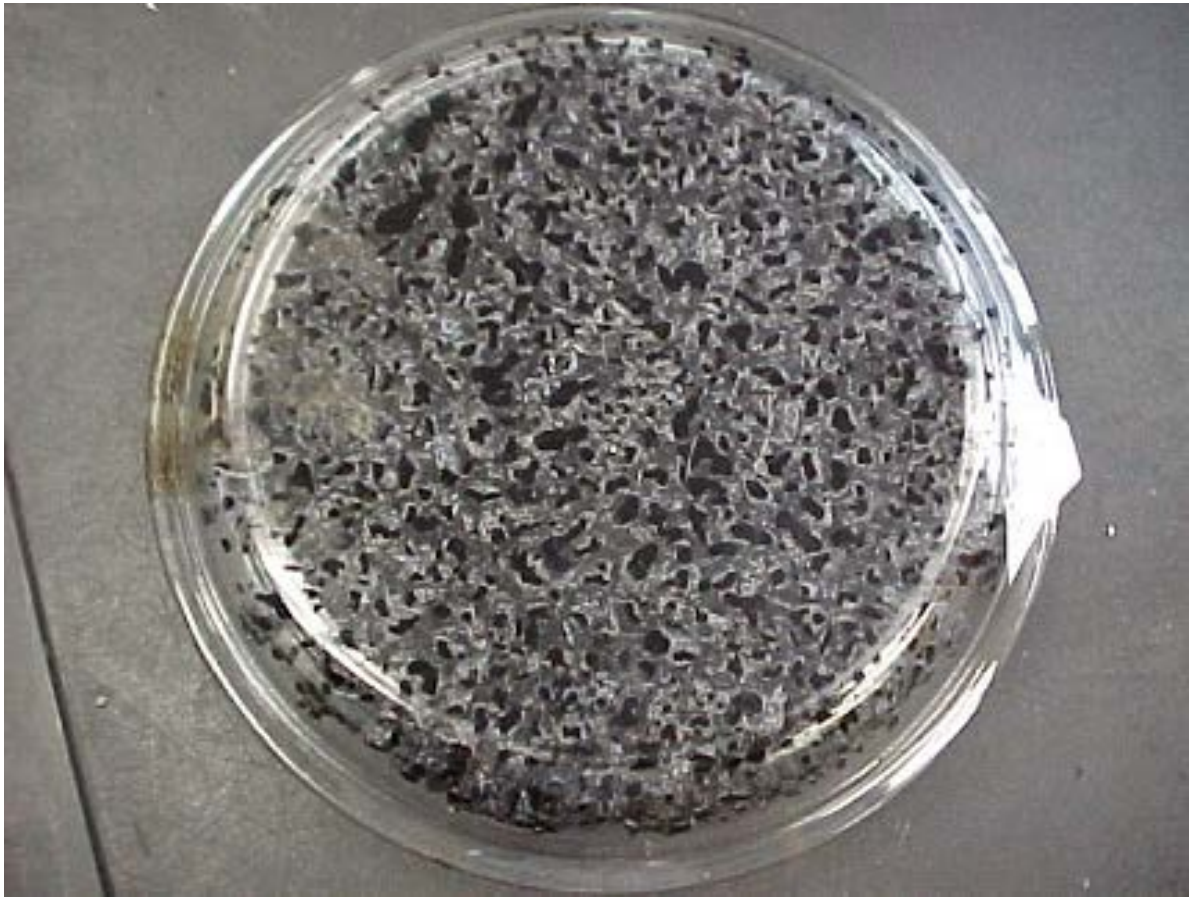


FIGURE 1  
FC-5 @ 5.3% asphalt binder  
Insufficient bonding/drainage – asphalt binder content too low

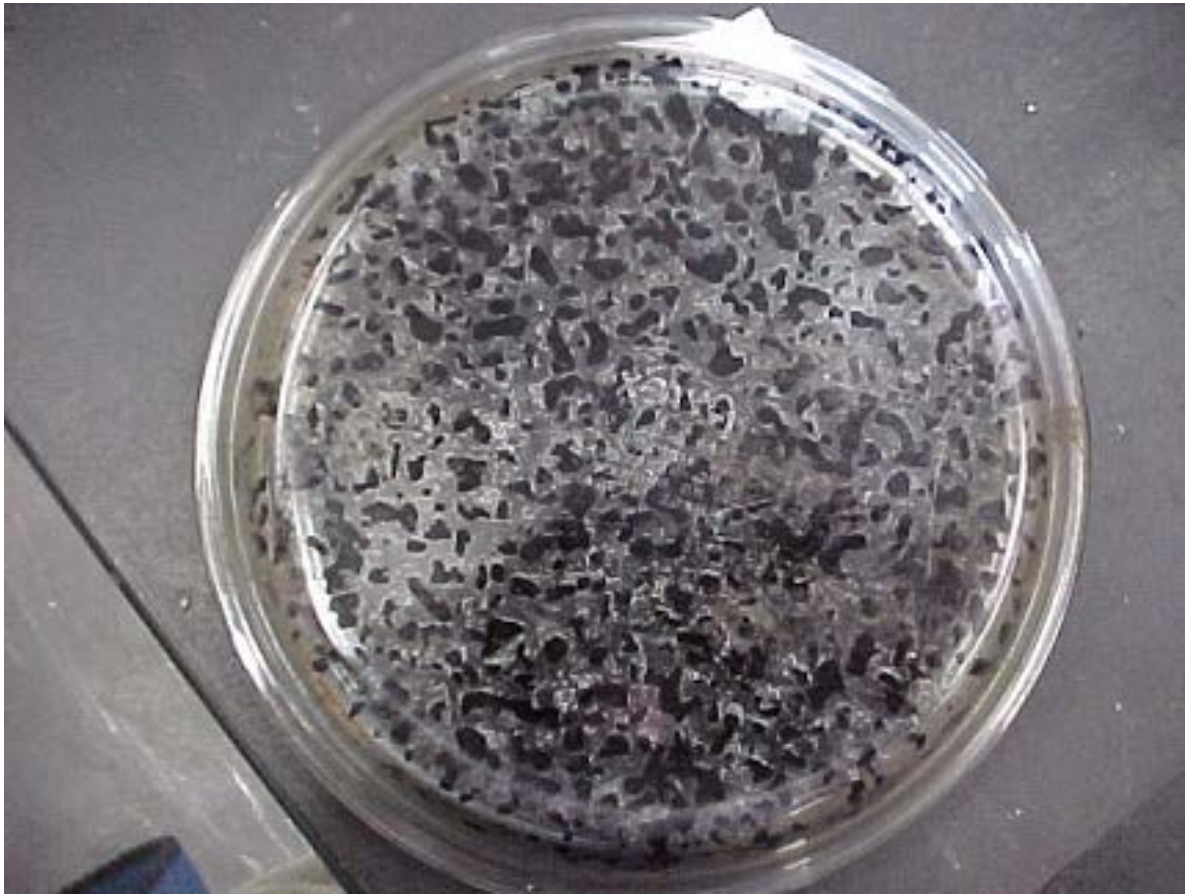


FIGURE 2  
FC-5 @ 5.8% asphalt binder  
Sufficient bonding/drainage – optimum asphalt binder content



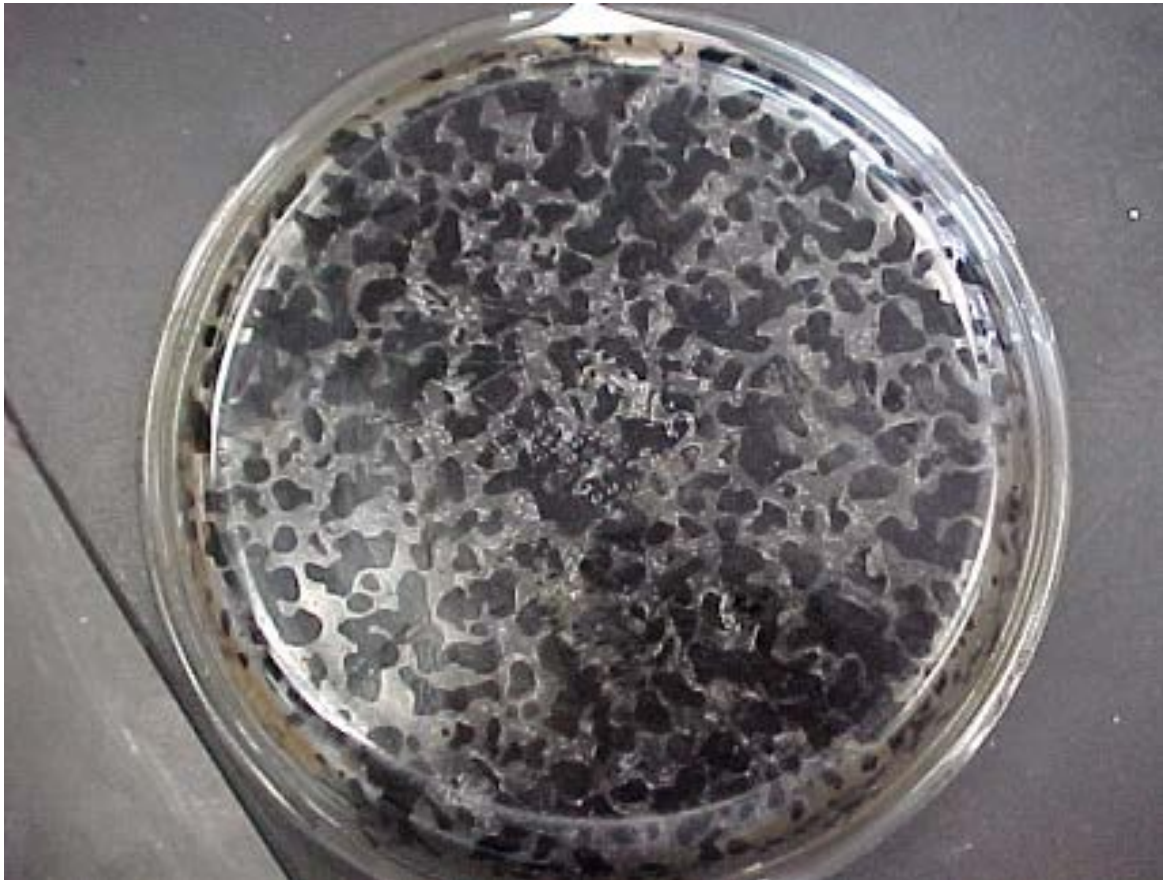


FIGURE 3  
FC-5 @ 6.3% asphalt binder  
Excessive bonding/drainage – asphalt binder content too high

5.10 Photograph the bottom of each pie plate for documentation.

**NOTE 2:** If PG 76-22 asphalt binder is required, the total asphalt binder content will be the same as the original asphalt binder content determined using PG 67-22 asphalt binder. If ARB-12 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:

$$\text{Total ARB-12 content} = \text{PG 67-22 optimum asphalt binder content} \times 1.12$$

## 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 mixing bowl.



- 6.2 Heat the aggregate batches and the required asphalt binder (PG 76-22 or ARB-12) for a minimum of two hours in an oven at  $320 \pm 5^{\circ}\text{F}$  ( $160 \pm 3^{\circ}\text{C}$ ).
- 6.3 Using a spatula, gently mix the aggregate batch and asphalt binder in the mixing bowl. Continue mixing until all of the aggregate particles are thoroughly coated.
- 6.4 Determine the asphalt binder calibration factor in accordance with FM 5-563.