

**1815 DETERMINATION of RAP AGGREGATE BULK SPECIFIC GRAVITY****1815.1 GENERAL**

This procedure is intended for use in determining the bulk specific gravity of the aggregates in a recycled asphalt pavement (RAP). This procedure is being used as an alternate to AASHTO T84 (Lab Manual 1205) and AASHTO T85 (Lab Manual 1204).

**1815.2 SUMMARY of METHOD**

The RAP sample is thoroughly prepared prior to testing by reheating and remixing the bituminous. A chemical extraction and two "Rice" tests are performed so that an effective specific gravity ( $G_{se}$ ) can be achieved. The  $G_{se}$  value is then used as a predictor variable to determine the bulk specific gravity ( $G_{sb}$ ) of the RAP.

**NOTE 1:** Mn/Dot has established a direct relationship between the  $G_{se}$  and  $G_{sb}$  of RAP.

**1815.3 EQUIPMENT**

Equipment shall consist of the following:

- A. Oven - Capable of maintaining a temperature of  $110 \pm 5^{\circ}$  C. ( $230 \pm 9^{\circ}$  F.).
- B. Balances - Meeting or exceeding the requirements in Table 2 of AASHTO M231 that are appropriate for the specific use.
- C. Sample pans - Large, flat and capable of holding 15000 - 20000 grams of RAP material.
- D. Sample "riffle" splitter with openings of 1" - 2".
- E. Chopping utensil - Used to separate the large clumps of a RAP sample into a loose-flowing condition.
- F. Vacuum setup - associated with the "Rice Test" (Refer to Section 1807).
- G. Centrifuge Extractor and equipment associated with the chemical extraction process (Refer to Section 1852).

**1815.4** RAP SAMPLE PREPARATIONS

- A. Reduce large amounts (greater than 20,000 grams) of RAP material by following one of the approved methods in Section 1002.
- B. Split out a representative 15000 to 20000 gram sample.
- C. Transfer this entire sample into a large flat pan(s).
- D. Place sample into a preheated oven at  $110 \pm 5^{\circ}$  C. ( $230 \pm 9^{\circ}$  F.) and heat for 30 to 45 minutes.
- E. Remove the sample from the oven and begin breaking up the larger conglomerations of RAP by chopping with a blade, trowel, or other utensil.
- F. As the old asphalt cement is being reactivated, blend the softened RAP by mixing the freshly chopped material with the fines in the pan.
- G. Return the RAP into the oven and continue heating for another 15 - 20 minutes.
- H. Remove the RAP from the oven and repeat the chopping of the asphalt clumps and blending of the fines.
- I. Continue this heating and re-mixing process until the RAP sample is homogeneous.  
  
**NOTE 2:** It's important that the clumps of fine aggregate are no larger than 19.0mm (3/4").
- J. Once the sample reaches a homogeneous state, allow the sample to cool. As it cools continue the process of chopping and re-mixing. Prevent the RAP from hardening back into a solid mass. The idea is to bring the RAP to a loose condition.
- K. Place the loose RAP into a hopper or pan and uniformly pour it through a mechanical sample splitter. Take each of the halves and re-pour through the splitter. Thoroughly blend the sample by repeating this process a 2 - 3 times.

**Note 3:** These steps are essential to the process of achieving a representative test sample for RAP.

**1815.5** PREPARED RAP SAMPLE TEST SIZES

- A. Once the RAP is initially prepared, split out the following representative test samples using a riffle splitter:

One (1) 2000 - 2500 gram sample for a chemical extraction.

**and**

Two (2) 2000 - 2050 gram samples for "Rice Tests"

**1815.6** TESTING

Before actual testing begins any moisture present within the RAP must be removed. Dry each test sample in an oven at  $110 \pm 5^{\circ}$  C. ( $230 \pm 9^{\circ}$  F.) for a minimum of 2 hours and then check at 30 min intervals until a constant weight is achieved.

A. Percent AC determination by Centrifuge Extraction

1. Dry the RAP sample to a constant weight in an oven at  $110 \pm 5^{\circ}$  C. ( $230 \pm 9^{\circ}$  F.).
2. Follow the chemical extraction procedure outlined in Section 1852. Calculate the % AC.

**NOTE 4:** For this RAP testing, 50 grams of celite shall be used.

B. Maximum Specific Gravity determination (Rice Test)

1. Dry each test sample to a constant weight in an oven at  $110 \pm 5^{\circ}$  C. ( $230 \pm 9^{\circ}$  F.) While drying, chop and break up the sample as you would with a standard "Rice" sample. Mix the "dirty" fines with the reactivated oil.
2. Follow the "Rice" procedure outlined in Section 1807.
3. Calculate the individual Max gravity values. The average result will be used in the calculation provided the individual results do not vary by more than 0.010.

## 1815.7 CALCULATIONS

Initially the average "Rice" value and %AC are used to calculate the effective specific gravity of the RAP. The following equation is used:

$$G_{se (RAP)} = \frac{100 - \% AC}{\frac{100}{\text{Rice}} - \frac{\% AC}{1.035}}$$

To determine the corresponding bulk specific gravity (Gsb) of the RAP the Gse value is now substituted as the "n" or predictor variable in the following regression equation.

$$G_{sb (RAP)} = (0.9246 \times \text{"n"}) + 0.1336$$

or

$$G_{sb (RAP)} = (0.9246 \times \text{"Gse (RAP)"}) + 0.1336$$

## EXAMPLE

Given: % AC in RAP = 5.1

Rice Test = 2.513

$$G_{se (RAP)} = \frac{100 - 5.1}{\frac{100}{2.513} - \frac{5.1}{1.035}} = \frac{94.9}{39.793 - 4.927} = 2.722$$

$$G_{sb (RAP)} = (0.9246 \times 2.722) + 0.1336 = 2.650$$