

## **COMMENTARY TO AG:PT/T143 – PARTICLE SIZE AND PROPERTIES OF CRUMB RUBBER**

### **PREFACE**

This crumb rubber test method was developed by ARRB Group on behalf of Austroads, based on the test methods published by Roads and Traffic Authority of New South Wales. Representatives of Austroads, ARRB Group and the Australian Asphalt Pavement Association have been involved in the review of this test method.

### **SCOPE**

This method describes a procedure for determining the particle size, shape and contaminants of crumb rubber.

### **FURTHER DEVELOPMENT**

None.

## PARTICLE SIZE AND PROPERTIES OF CRUMB RUBBER

### 1 REFERENCES

The following documents are referred to in this method:

Austroroads

AG:PT/T101            Method of sampling polymer modified binders, polymers and crumb rubber

AG:PT/T144           Morphology of Crumb Rubber – Bulk Density Test

Australian  
Standards

AS 1152                Specification for test sieves

### 2 EQUIPMENT

The following equipment is required:

- (a) Sieves with the following apertures as required: 2.36 mm, 1.18 mm, 600  $\mu\text{m}$ , 300  $\mu\text{m}$ , 150  $\mu\text{m}$  and conforming to the requirements of AS1152 – test sieves.
- (b) Sieve brush, approx. 25 mm size.
- (c) Mechanical sieve shaker.
- (d) Mixing apparatus such as a trowel and quartering apparatus such as metal plates 400 mm by 125 mm and 200 mm by 125 mm.
- (e) Sample dividers (riffle boxes) of appropriate sizes.
- (f) Balance of not less than 200 g capacity, accurate to 0.01 g.
- (g) Metal dishes.
- (h) Two Petri dishes with lids, approximate diameter 140 - 160 mm.
- (i) Thermostatically controlled oven maintained at  $105 \pm 3^\circ\text{C}$ .
- (j) Desiccator with silica gel desiccant.
- (k) Magnet (bar or horse-shoe) capable of lifting 100g of soft steel (e.g. an empty 1L steel paint-type can).
- (l) Sheet of A3 paper.
- (m) Sheet of writing paper.
- (n) Small watercolour type brush
- (o) Hand lens or low powered microscope
- (p) Small spatula

### 3 SAMPLE PREPARATION

The whole sample shall be emptied onto a quartering tray. A trowel shall be used to heap material at the edges into a cone which is then flattened while pushing outward and continuing to heap and flatten until the whole amount has been turned over. The contents of the tray are quartered and the mass of one quarter determined.

For sieving, two sub-samples in the range 40 - 60 g are required. Riffing shall be used to ensure sub-samples remain representative. No attempt shall be made to secure an exact pre-determined mass.

Sub-samples required for the other tests are:

- (a) Moisture Content – one sample of 40 - 60 g
- (b) Metallic Iron Content - one sample of 80 - 120 g
- (c) Bulk Density – obtained from sieve analysis (refer to Section 5.1(f))
- (d) Particle Shape - one sample of 2.5 to 4 g (retained 300 µm material only obtained using Steps 5.1(a) and 5.1(b)).

During the mixing, quartering and riffing process, any obvious foreign bodies should be noted, reported and removed.

Any gross particles such as steel tyre wire or oversized rubber pieces observed during the quartering and riffing process should be reported.

### 4 MOISTURE CONTENT TEST

Moisture content determination is to be commenced within an hour of sample preparation (see Note 1).

#### 4.1 Procedure

- (a) Determine the mass of two Petri dishes (with lids) to 0.01 g (M1).
- (b) Divide the entire 40-60 g between the two Petri dishes, fit their lids and determine the mass of each dish and its contents (M2).
- (c) Agitate each dish gently to spread the crumbs evenly. Place the Petri dishes in the oven, remove the lids and place them beside their respective dish (see Note 2).
- (d) After 4 hours in the oven replace the lids, transfer the Petri dishes to a desiccator and allow them to cool to room temperature.
- (e) Determine the mass of the Petri dishes (with lids) containing the dried scrap rubber (M3).

#### 4.2 Calculation and Reporting

For each dish, calculate the moisture content:

$$\text{Moisture content (\%)} = \frac{M2 - M3}{M2 - M1} \times 100$$

The two determinations should agree within 0.2%. If they do, calculate the mean to the nearest 0.1%.

If the determinations differ by 0.2% or greater, repeat the determination with a freshly riffled sample. Report the mean of the two highest determinations.

### **4.3 Notes**

1. Prompt execution of preparation and weighing is necessary because the samples may be losing moisture to the air without heating.
2. The oven must not be used for any other purpose during this test.

## **5 PARTICLE SIZE TEST**

### **5.1 Procedure**

- (a) Nest the sieves in order (largest opening on top, dish on bottom). Determine the mass of one of the sub-samples to 0.1 g and place all of it in the upper sieve.
- (b) Place a lid on the stack and agitate in sieve shaker for 20 minutes.
- (c) Dismantle sieves and gently brush collected fractions into preweighed metal dishes. Do not force material through sieve openings. Brushes with stiff or worn-down bristles shall not be used. Sieves may be lightly brushed on the underside to clean away uncollected material from the apertures, but care must be taken not to apply pressure to the surface of the sieve. Weigh the material retained on each sieve and record the masses.
- (d) Repeat steps (a), (b) and (c) for the other sub-sample.
- (e) For each sub-sample, express the mass of each fraction as a percentage of the total. Compare the results of the two runs. All fraction percentages greater than 10% should agree within 20% of their mean. If this is so, calculate the mean of the % passing on each sieve. If not, repeat steps (a) - (e) with freshly riffled sub-samples.
- (f) If the total amount of material retained on the 300  $\mu\text{m}$  sieve for both sievings is greater than 6 g, keep this for the bulk density test (AG:PT/T144); if it is less than 6 g use the material retained on the 600 $\mu\text{m}$  sieves; if the sieved sample is in the range 6 - 8.5 g it may be used directly in the bulk density method; if it is above 8.5 g it must be riffled down to get a sample in the range 6 - 8.5 g.

### **5.2 Reporting**

Report the cumulative percentage passing each specified sieve to the nearest 0.1% by subtracting the cumulative mass retained on the sieves from 100%. If any foreign matter has been found (refer Section 3), record the total number of particles and give an estimate of the total proportion of sample size.

## **6 METALLIC IRON CONTENT TEST**

### **6.1 Procedure**

- (a) Weigh the sub-sample to 0.1 g (M4).
- (b) Spread the sub-sample roughly over the A3 paper on a clean non-magnetic surface.

- (c) Weigh the piece of writing paper to 0.2 mg (M5). Then wrap the end of the magnet to be used in the paper.
- (d) Drag the magnet back and forth through the crumb rubber in a ploughing pattern and then across to make a lattice. Continue until the crumbs are only one or two high on the A3 paper.
- (e) Carefully unwrap the magnet from the paper in such a way that all the magnetic particles are retained on the paper.
- (f) Weigh the paper with the magnetic particles (M6).

## 6.2 Calculations and Reporting

Calculate the metallic iron content as follows:

$$\text{Metallic iron content (\%)} = \frac{M6 - M5}{M4} \times 100$$

Report the metallic iron content to two significant figures. Report any gross magnetic particles which may have been in the original sample.

## 7 PARTICLE SHAPE TEST

### 7.1 Procedure

- (a) Mix the sub-sample well. With a small spatula distribute small piles (say, five) of the material on to a piece of paper.
- (b) With the brush or spatula count out three groups of 100 particles; once one of the original small piles has been started continue counting from it until it is exhausted.
- (c) From each of the three groups of 100 pick out the 11 longest particles. Then identify the three smallest in each of the groups of 11.
- (d) Record the general shape of the nine particles (three groups of three). Measure each of the nine particles to the nearest 0.5 mm. If the particles are compact (e.g. roughly spherical or cubical) they will have only one popular dimension which will correspond with the sieve sizing. However, the particles may have other shapes, such as brick shape, book, pencil, strap; these shapes have one longest dimension and a short dimension. Average the greatest length observed for the 9 particles. Do not attempt to straighten out curly particles or to measure along the length of the curve.
- (e) With the highest powered lens, note the surface shape of the particles. (Does it have fairly well defined corners and edges; is the surface fluffy or spongy?)

### 7.2 Calculation and Reporting

Calculate the "10th percentile maximum dimension" as the mean of the results of 7.1 (d) (to the nearest 0.5 mm) and report.

Report whether the particles are - fluffy or spongy, smooth faced.

