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SAMPLING AND TESTING CRUMB RUBBER MODIFIER

CAUTION: Prior to handling test materials, performing equipment setups, and/or conducting this method, testers are required to read "**SAFETY AND HEALTH**" in Section I of this method. It is the responsibility of the user of this method to consult and use departmental safety and health practices and determine the applicability of regulatory limitations before any testing is performed.

OVERVIEW

This method presents procedures for sampling and physical testing of crumb rubber modifier (CRM) to be used in the production of asphalt rubber binder. CRM includes scrap tire CRM and high natural CRM. Scrap tire CRM consists of ground or granulated rubber derived from a combination of automobile tires, truck tires or tire buffings. High natural CRM consists of ground or granulated rubber derived from materials that utilize high natural rubber sources, which may include tires.

These procedures are presented in 2 parts.

Part 1. Method of Sampling CRM

Part 2. Test Methods for CRM for Determining Gradation and Percent by Weight of Wire and Fabric

PART 1: METHOD OF SAMPLING CRUMB RUBBER MODIFIER

1. SCOPE

This method describes the procedure for sampling crumb rubber modifier (CRM) from bulk bags. CRM is usually packaged and delivered to the project site in bulk bags, four feet (1.2 m) by four feet (1.2 m) by six feet tall (1.8 m) bags weighing approximately 2000 pounds (907 kg). A grain or cereal thief sampling device (probe) is used to obtain representative samples. A series of small holes are cut into the sides of the bag, the probe is inserted through each hole, a sample is extracted from the bag, and the hole is taped closed. Multiple CRM samples are obtained in this manner which are combined for testing.

2. APPARATUS

2.1 Sampling Device: A thief sampler that is a rust-resistant open-handled double-tube (inner and outer) cereal or grain probe approximately 3 ft (0.9 m) long. The outer tube should have an outside diameter of approximately 7/8-inch (22 mm), inside diameter of approximately 5/8-inch (16 mm), and a point on one end to aid insertion. The hollow inner tube should be 1 to 1-1/2 inches (25 to 37.5 mm) shorter than the outer tube and have a handle or knob on one end. The inner tube must fit easily into the outer tube with the handle opposite the pointed end and be capable of being locked into place. Both tubes shall have 3 matching longitudinal openings, each approximately 8 inches (200 mm) long. Openings in the outer tube should be approximately ¾-inch (19 mm) wide; width of openings in the inner tube

is limited by its diameter. The handle is used to turn the inner tube to align with the holes in the outer tube so that CRM particles can enter the inner tube, and to close the sampler.

2.2 Metal Rod: A metal rod at least 48 inches (1.2 m) long with an approximate maximum diameter of 1/8-inch (3 mm) so that it can easily fit inside the inner tube of the probe.

2.3 Sample Retainer (Figure 1): The sample retainer is a 4-inch (100 mm) diameter PVC pipe, 37 inches (0.94 m) long with a cap on the bottom. The cap has a 4-inch rubber disk glued to the inside to prevent damage to the probe.

2.4 Box cutter

2.5 Plastic sample bags and ties

2.6 Duct tape

2.7 Indelible marking pen

2.8 Gloves

3. SAMPLING PROCEDURE

3.1 Randomly select a bag of CRM from the bags at the job site. The bag to be sampled should be placed in a safe location and must be accessible from all four sides.

3.2 Locate where to cut the 12 sampling holes in the bag. On each of the four sides, one hole shall be located in the bottom third, one in the middle third, and one in the upper third of the bag.

3.3 Cut a small horizontal hole about 3 inches (76.2 mm) in length at one of the locations marked on the bag.

3.4 Make sure the sampling device is closed (holes are not aligned) and insert it into the hole. Turn the inner tube to open the sampling device and slightly move the device back and forth to allow the CRM to fall into the inner tube.

3.5 Twist the inner tube to close the sampling device and remove it from the bag.

3.6 Tilt the sampling device and insert it into the sample retainer. Turn the inner tube until the holes are aligned and the CRM sample falls into the retainer. The sampling device can be tapped against the bottom of the retainer to assist in removal of the CRM material.

3.7 If the CRM does not come out of the inner tube, insert a metal rod into the tube and move it back and forth to transfer the CRM from the tube to the sample retainer

3.8 After placing the three samples obtained from one side of the CRM bag into the sample retainer, pour the combined samples into a plastic bag.

3.9 Tape over the holes in the CRM bulk bag to prevent leakage.

3.10 Label the sample bag to identify the source of the sample. The sample label should include CRM source, lot number, date sampled, sample location, whether the CRM is scrap tire or high natural, and any other pertinent information. Seal the bag.

3.11 Repeat Steps 3.3-3.10 until 12 samples (4 sample bags) of CRM are obtained from each bulk bag selected.

3.12 Combine the 12 samples from each bulk bag into a single CRM sample from which test specimens will be split.

4. PRECAUTIONS

4.1 Take care not to dent the inner tube of the probe during the cleaning process, as it will not fit back into the outer tube if damaged.

4.2 The holes in the probe have very sharp edges and can easily cut a finger severely. Exercise caution and wear gloves when using the probe.

PART 2 TEST METHODS FOR CRM

1. DETERMINING PERCENT BY MASS OF WIRE

1.1 SCOPE

This test method describes the procedure for determining the percent by mass of wire in CRM.

1.2 APPARATUS

A. Balance: a balance or scale reading to 0.1 g

B. Aluminum pan with minimum 40 sq. in. bottom surface area

C. Magnet

1.3 PROCEDURE

A. Split out no less than 100 grams and no more than 150 grams of CRM and place the sample in an aluminum pan.

B. Pass a magnet over and through the sample for sixty seconds. After completing this action remove all metal fragments from the magnet.

C. Weigh and record the weight of the recovered metal in grams and calculate the percentage of wire by total CRM weight.

2. DETERMINING CRM GRADATION

2.1 SCOPE

This test method describes the procedure for determining the gradation of CRM. Each weight measurement shall be recorded to the nearest 0.1 g

2.2 APPARATUS

A. Balance: a balance or scale reading to 0.1 g

B. Sieves: Woven-wire cloth sieves of No. 8 (2.36 mm), No. 10 (2.0 mm), No. 16 (1.18 mm), No. 30 (600 μm), No. 50 (300 μm), No. 100 (150 μm), and No. 200 (75 μm) size designations with square openings that conform to AASHTO M92.

C. Sieve shaker: A mechanical sieve shaking device that provides both vertical and horizontal motion, such as a RoTap, RotoSift, Maryann, or equivalent that conforms to the requirements of CT 202.

D. Oven: An oven capable of maintaining a temperature of 140 ± 5°F (60 ± 3°C).

E. Rubber Balls: Rubber balls for each sieve, each weighing 9.3 g ± 0.5 g

F. Talc: Laboratory Grade.

2.3 PROCEDURE.

A. Split out or quarter no less than 100 and no more than 150 grams from the combined CRM sample obtained in Part 1, Section 3.12 and dry to a constant mass at a temperature of 140 ± 5°F (60 ± 3°C) (See Note 1). Record the original and dry sample masses to allow calculation of moisture content if desired.

NOTE 1: Four hours of drying time is typically sufficient.

B. Weigh 100 g ± 5 g of the oven-dried CRM and record the weight ("CRM") to the nearest 0.1 g.

C. Weigh 5.0 g ± 0.5 g of talc and record the weight ("T") to the nearest 0.1 g. Mix the CRM and talc in a container, shaking by hand or stirring if needed, until particle agglomerations and clumps are broken up and the talc is uniformly mixed. Record the combined weight of the CRM and talc ("CRM" + "T").

NOTE 2: To facilitate the sieve analysis and calculations, dry sieve the talc through a No. 200 (75 μm) sieve before adding it to the CRM.

D. Place one rubber ball on each sieve and pour the CRM sample into the top of the sieve nest. Brush remaining particles from the mixing container into the sieve nest.

E. Sieve the combined CRM and talc material for 10 minutes ± 1 minute and disassemble the sieves. Material adhering to the bottom of a sieve shall be brushed into the next finer sieve.

F. During the weighing of retained CRM on each sieve, observed fabric balls shall be placed together on the side of the balance to prevent the fabric balls from being covered or disturbed when placing the material from finer sieves onto the balance. Prior to discarding the CRM sample, separately weigh and record the total weight of fabric balls in the sample according to Part 2 Section 3 of this procedure.

G. Weigh and record the weight of the material retained on the No. 8 (2.36 mm) sieve in Column A and leave this material (do not discard) on the balance. Add the material retained on the next finer sieve (No. 10, 2.00 mm) to the balance. Weigh and record the combined weight as the accumulated weight retained on that sieve (No. 10, 2.00 mm) according to the procedure in California Test 202. Repeat this step for each of the remaining sieve sizes and the pan and record the results in Column A.

2.4 CALCULATIONS

Use the accompanying spreadsheet for performing calculations. Appendix A includes an example CRM gradation calculation sheet with detailed instructions.

A. From the accumulated weights retained on each sieve and in the pan ("TOTAL") in Column A, calculate the individual weights retained on each sieve as the difference between adjacent accumulated weights and record the results in Column B. Check by verifying that the sum of Column B weights equals the Total in Column A.

NOTE 3: The sum of the weights retained for each sieve fraction shall not be less than the original weight of the CRM plus 75% of the talc added nor greater than the original weight of the CRM sample plus 100% of the weight of the added talc. Repeat the test if either of these conditions occurs.

$$\text{“CRM”} + .75\text{“T”} \leq \text{“TOTAL”} \leq \text{“CRM”} + \text{“T”}$$

B. From the total weight calculated in Part 2, 2.4A, subtract the original weight of the CRM sample obtained in 2.3B. The remainder, R, is considered to be talc and shall be subtracted from the weight of material in the bottom pan.

$$R = \text{“TOTAL”} - \text{“CRM”}$$

C. If R is greater than the amount of talc in the pan, assume the difference is due to retention of talc along with the CRM above the No. 200 (75 μm) sieve. The amount of talc retained by the CRM particles is the difference between the weight of the pan contents, which are considered to be talc, and R.

$$\text{Retained Talc} = R - \text{Pan Weight}$$

D. Evenly distribute the weight of the retained talc among the No. 16 (1.18 mm), No. 30 (600 μm), and No. 50 (300 μm) sieve fractions, by subtracting the weight of Retained Talc/3 from the respective weights retained on each of these fractions. Record the individual adjusted retained weights in Column C and accumulate these weights in Column D.

E. Calculate the percentage retained on each sieve to the nearest 0.1% based on the individual adjusted retained weights in Column D and report in Column E.

F. Subtract each entry in Column E from 100% to determine the percentage passing each sieve size and record results in Column F.

3. DETERMINING PERCENT BY MASS OF FABRIC

3.1 SCOPE

This test method describes the procedure for determining the percent by weight of fabric in CRM. The fabric is typically light in color, may be wispy and thread-like or may form clumps or agglomerations.

3.2 APPARATUS

A. Same as for determining CRM gradation.

B. Tweezers

3.3 PROCEDURE

A. Perform sieve analysis to determine CRM gradation according to Part 2, Section 2.

B. When disassembling the test sieves, look for free fabric on each sieve. As it is found, the fabric is to be removed and collected using tweezers.

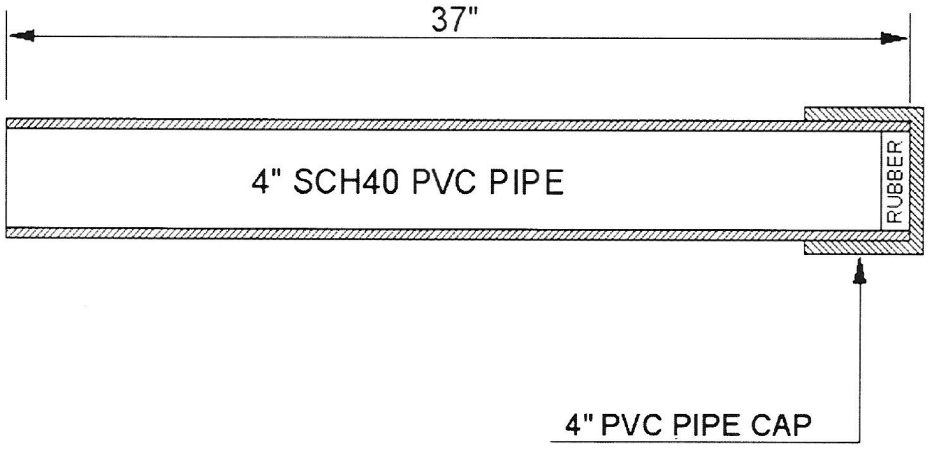
C. The free fabric may agglomerate into balls which may be easily removed from the sample using tweezers.

D. The total accumulation of fabric is then weighed and calculated as a percentage of the total CRM sample weight ("CRM").

4. DETERMINING SPECIFIC GRAVITY OF CRM

Perform according to California Test 208, Method of Test for Apparent Specific Gravity of Fine Aggregates, using the apparatus specified therein.

Figure 1 Sample Retainer



APPENDIX A
SAMPLE GRADATION CALCULATIONS FOR CRUMB RUBBER MODIFIER

"CRM" = Original weight of CRM = 101.5 g
"T" = Weight of Talc added = 5.1 g

1. Calculate individual weights retained on each sieve and in the pan by determining the differences between successive accumulated weights retained in Column A and record results in Column B. Check by verifying sum of Column B = Column A Total.

2. Total weight retained "TOTAL" = 105.9 g

3. Check: "CRM" + .75 "T" < "TOTAL" = 105.9 < "CRM" + "T"?
   101.5 g + .75(5.1 g) = 105.3 g < 105.9 g < 101.5 g + 5.1 g =106.6 g OK

4. Determine remainder R: R = "TOTAL" –"CRM" = 105.9 g – 101.5 g = 4.4 g

5. To determine how much talc has been retained by the CRM particles, calculate the difference between the weight of the pan contents in Column B which are considered to be talc, and R.

6. Retained Talc = R - Column B Pan Weight = 4.4 g -1.9 g = 2.5 g

7. Retained Talc/3 = 2.5 g/3 = 0.83 g ≈ 0.8 g → Use 0.8 g

8. Subtract Retained Talc/3 from the individual weight retained on each of the 1.18 mm (No. 16),
   600 µm (No. 30), and 300 µm (No. 50) sieve sizes in Column B. Record the adjusted values in Column C along with 0 for the pan weight. For the other entries in Column C, use the values in column B for the individual weights retained on 2.36 mm (No. 8), 2.00 mm (No. 10), 150 µm (No. 100), and 75 µm (No. 200) sieve sizes.

9. Sum the values in Column C to calculate the corresponding adjusted accumulated weights retained for the respective sieve sizes in Column D.

NOTE: Round-off of Retained Talc /3 may result in a slight difference between pan weight in Column D and original CRM weight ("CRM"). If difference is 0.2 g or more, check measured weights and calculations. If the difference cannot be reconciled to within 0.1 g, repeat the test.

10. Use the values in Column D (including pan weight as the total) to calculate CRM Percent Retained on each sieve size listed. Record the results in Column E.

11. To calculate CRM Percent Passing each sieve size, subtract the CRM Percent Retained values in Column E from 100%. Record the results in Column F.

LP-10 **CRM Gradation Calculations - Example** **10/5/2006**

Project Information

CRM Information

CRM Source
CRM Manufacturer
CRM Type

Sample Date

Original Wt. Of CRM Sample = 101.5 (CRM)
Original Wt. Of Talc Added = 5.1 (T)

	A	B	C	D	E	F
Sieve Size	Accum Wt Ret	Individ Wt Ret	Adj Individ Wt.Ret	Adj Accum Wt. Ret	CRM % Retained	CRM % Passing
2.36 mm (No. 8)	0.0	0.0	0.0	0.0	0.0	100.0
2.00 mm (No. 10)	2.2	2.2	2.2	2.2	2.2	97.8
1.18 mm (No. 16)	54.8	52.6	51.8	54.0	53.1	46.9
600 µm (No. 30)	90.9	36.1	35.3	89.3	87.9	12.1
300 µm (No. 50)	98.1	7.2	6.4	95.7	94.2	5.8
150 µm (No. 100)	103.4	5.3	5.3	101.0	99.4	0.6
75 µm (No. 200)	104.0	0.6	0.6	101.6	100.0	0.0
PAN	105.9	1.9	0.0	101.6		
Total =	105.9	105.9	101.6	101.6		

Accuracy Check:

CRM + 0.75T	<	Total	<	CRM + T
105.3		105.9		106.6

Retained Talc Calculation:

R = Total - CRM 4.4
Retained Talc = R - (Pan Column B)
2.5

Retained Talc/3 = 0.8

Fabric Calcs

Weight of CRM	101.5
Weight of Fabric	0.2
% Fabric	0.20

Wire calcs

Weight of CRM	123.5
Weight of Wire	0.1
% Wire	0.08

LP-10 **CRM Gradation Calculations Worksheet** **Date:**

Project Information

CRM Information
CRM Source
CRM Manufacturer
CRM Type

Sample Date

Original Wt. Of CRM Sample = _____ (CRM)
Original Wt. Of Talc Added = (T)

	A	B	C	D	E	F
Sieve Size	Accum Wt Ret	Individ Wt Ret	Adj Individ Wt.Ret	Adj Accum Wt. Ret	CRM % Retained	CRM % Passing
2.36 mm (No. 8)						
2.00 mm (No. 10)						
1.18 mm (No. 16)						
600 µm (No. 30)						
300 µm (No. 50)						
150 µm (Non. 100)						
75 µm (No. 200)						
PAN						
Total =						

Accuracy Check: CRM + 0.75T < Total < CRM + T

_____

Retained Talc Calculation: R = Total - CRM _____

Retained Talc = R - (Pan Column B)
_____

Retained Talc/3 = _____

Fabric Calcs
Weight of CRM
Weight of Fabric
% Fabric

Wire calcs
Weight of CRM
Weight of Wire
% Wire