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METHOD OF TEST FOR CRUMB RUBBER MODIFIER

A. SCOPE

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

B. REFERENCES

ASTM D 2240	Standard Test Method for Rubber Property—Durometer Hardness
ASTM E 11	Standard Specification for Woven Wire Test Sieve Cloth and Test Sieves
AASHTO M 231	Standard Specification for Weighing Devices Used in the Testing of Materials
AASHTO R 76	Standard Practice for Reducing Samples of Aggregate to Testing Size
AASHTO T 27	Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates

C. APPARATUS

The sampling apparatus must consist of the following:

1. Sampling device (see Figure 1): A rust-resistant thief sampler with an inner tube and an outer tube such as a cereal or grain probe. The device must be approximately 3 ft long, have an outside diameter of approximately 7⁄8 in.

and an inside diameter of approximately 5⁄8 in, and have a pointed end to aid insertion. The hollow inner tube should be 1 to 1½ in. 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 must have 3 matching longitudinal openings, each approximately 8 in. long. Longitudinal openings in the outer tube should be approximately ¾ in. wide; the width of longitudinal openings in the inner tube is limited by its diameter. The handle is used to turn the inner tube to open the sampling device by aligning the inner tube's longitudinal openings with the outer tube's openings so that CRM particles can enter the inner tube, and to close the sampling device.

2. Metal Rod: A metal rod at least 48 in. long with an approximate maximum diameter of 1⁄8 in. so that it can easily fit inside the inner tube of the probe.

3. Sample retainer (see Figure 2): The sample retainer is a 4 in. diameter PVC pipe, 37 in. long with a cap on the bottom. The cap has a 4 in. rubber disk glued to the inside to prevent damage to the probe.

4. Box cutter or utility knife

5. Plastic sample bags and ties

6. Duct tape

7. Indelible marking pen

8. Gloves

The testing apparatus must consist of the following:

1. Balance or scale shall have sufficient capacity, be readable to 0.01 g or better, and be in accordance with AASHTO M 231.

2. Metal pan with a minimum 40 sq. in. bottom surface area and sufficient depth to prevent any loss of material.

3. Sample splitter: Sample splitters shall have an even number of at least twelve equal-width chutes. The minimum width of the individual chutes shall

be 50% larger than the largest particle of CRM, and the maximum width of the individual chutes shall be ¾ in. (19 mm).

4. Magnet

5. Container: 1 pint jar

6. Spatula

7. Sieves: Woven-wire cloth sieves of No. 8, No. 10, No. 16, No. 30, No. 50, No. 100, and No. 200 size designations with square openings in accordance with ASTM E11.

8. Sieve shaker: A mechanical sieve shaking device that provides adequate motion of the sieves in accordance with AASHTO T 27.

9. Oven: An oven capable of maintaining a temperature of 140 ± 5°F.

10. Rubber balls: Rubber balls for each sieve, each must weigh 9.5 ± 0.5 g, measure 1" ± .05" in diameter, and have a shore durometer "A" hardness of 45 ± 5 in accordance with ASTM D2240.

11. Laboratory-grade talc

12. Tweezers

13. Soft bristle brush

D. SAMPLING PROCEDURE

CRM is usually packaged and delivered to the job site in bulk bags (4 ft × 4 ft × 6 ft tall) weighing approximately 2000 lb.

Sample CRM as follows:

1. Randomly select a bulk bag of CRM from the bulk 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.

2. Locate and mark where to cut 12 sampling holes on the bulk bag. For each of the four sides, one sampling hole must be located in the bottom third, one in the middle third, and one in the upper third of the bulk bag.

3. Cut a horizontal hole in the bulk bag about 3 in. in length at one of the locations marked on the bulk bag.

4. With the sampling device in the closed position such that the longitudinal openings are not aligned, insert the device into the sampling hole in the bulk bag. Turn the inner tube to open the sampling device and slightly move the device back and forth into the bulk bag to allow the CRM to fall into the inner tube.

5. Twist the inner tube to close the sampling device and remove it from the sampling hole.

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

7. If the CRM does not come out of the sampling device's inner tube, insert a metal rod into the sampling device's inner tube and move it back and forth to transfer the CRM to the sample retainer.

8. Obtain 2 more samples from the remaining hole locations on the same side of the CRM bag and add the material to the sample retainer.

9. Pour the combined samples from the sample retainer into a plastic sample bag and seal the bag with a tie.

10. Place duct tape over the sample holes in the CRM bulk bag to prevent leakage.

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

12. Move to another side of the bulk bag and repeat steps 3 to 11. Continue sampling until all 12 CRM samples are collected into four plastic sample bags (one bag per side) for each bulk bag selected.

13. Combine the 12 CRM samples from the four plastic sample bags in step 9 into a single CRM sample from which test specimens will be split.

E. TESTING PROCEDURE

PART 1. DETERMINING PERCENT OF WIRE IN CRM

Determine the percent of wire in CRM as follows:

1. In accordance with AASHTO R 76-16 (Method A), split out no less than 300 g and no more than 350 g of the combined CRM sample and place the sample in a metal pan. Record this value to the nearest 0.01 g.

2. Pass a magnet over and through the CRM sample for sixty seconds ensuring all metal fragments are removed.

3. Using a soft bristle brush, carefully brush the magnet to transfer all metal fragments into a separate metal pan.

4. Record the weight of the recovered metal to the nearest 0.01 g.

5. Calculate the percentage of wire by total CRM weight. Record the percentage of wire to the nearest 0.01%.

Alternate method for determining the percent of wire in CRM:

1. In accordance with AASHTO R 76-16 (Method A), split out no less than 300 g and no more than 350 g of the combined CRM sample and place the sample in a metal pan. Record this value to the nearest 0.01 g.

2. Obtain a tare weight for the magnet by placing it on a scale. Record this value to the nearest 0.01 g.

3. Pass the magnet over and through the CRM sample for sixty seconds ensuring all metal fragments are removed.

4. Place the magnet along with the metal fragments into a separate metal pan.

5. Subtract the tare weight of the magnet and record the weight of the recovered metal fragments to the nearest 0.01 g.

6. Calculate the percentage of wire by total CRM weight. Record the percentage of wire to the nearest 0.01%.

PART 2. DETERMINING GRADATION

Determine the gradation of CRM as follows:

1. In accordance with AASHTO R 76-16 (Method A), split out no less than 100 g and no more than 150 g of the combined CRM sample and place the sample in a metal pan. Dry the sample initially for 90 ± 5 min at 140 ± 5°F and determine its mass. Then continue to dry the sample to constant mass, checking at 30 ± 5 min intervals until further drying does not alter the mass by more than 0.05 percent. Record the original and dry sample masses to allow calculation of moisture content if desired.

2. Weigh 100 g ± 5 g of the oven-dried CRM and record the weight ("CRM") to the nearest 0.01 g.

3. Weigh 5.0 g ± 0.5 g of talc and record the weight ("T") to the nearest 0.01 g. Mix the dry 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 dry CRM and talc ("CRM" + "T").

   NOTE: To facilitate the sieve analysis and calculations, sieve the talc by hand shaking through a No. 200 sieve before adding it to the dry CRM.

4. Place one rubber ball on each sieve and pour the combined CRM and talc sample into the top of the sieve nest (No. 8 through No. 200 and pan). Brush remaining particles from the mixing container into the sieve nest.

5. Sieve the combined CRM and talc material in accordance with AASHTO T 27 for 10 min ± 1 min and disassemble the sieves. Material adhering to the bottom of a sieve must be brushed into the next finer sieve.

6. During the weighing of retained CRM on each sieve, place observed fabric balls 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 3 of this procedure.

7. Weigh and record the weight of the material retained on the No. 8 sieve in Column A of the worksheet form in Appendix A and leave this material (do not discard) on the balance. Add the material retained on the next finer sieve (No. 10) to the balance. Weigh and record the combined weight as the accumulated weight retained on that sieve in accordance with AASHTO T 27. Repeat this step for each of the remaining sieve sizes and pan and record the results in Column A of the worksheet.

NOTE: Each weight measurement must be recorded to the nearest 0.01 g.

PART 3. DETERMINING PERCENT OF FABRIC IN CRM

Determine the percent by weight of fabric in CRM as follows:

1. Perform the sieve analysis to determine CRM gradation in accordance with Part 2.

2. When dissembling the test sieves, look for free fabric on each sieve. The fabric in CRM is typically light in color, may be thread-like or may form clumps. As the fabric is found, collect it using tweezers. Do not discard the collected fabric.

3. Place the collected fabric on the scale and record its weight. Calculate the percentage of fabric in CRM to the nearest 0.01% by dividing the weight of collected fabric by the total dry CRM and talc sample weight. Record this data on the worksheet form in Appendix A.

F. CALCULATIONS

Use the spreadsheet shown in Appendix A for performing calculations. Appendix A includes an example calculation worksheet with instructions using the example's test values.

Determine the gradation of CRM as follows:

1. From the accumulated weights retained on each sieve and in the pan (the "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 the Column B weights equals the "TOTAL" in Column A.

   NOTE: The sum of the weights retained for each sieve fraction must 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. The "Total" from either column A or column B may be used.

   "CRM" + 0.75"T" ≤ "TOTAL" ≤ "CRM" + "T"

2. From the total weight calculated in Part 2, subtract the original weight of the CRM sample obtained. The remainder, R, is considered to be talc.

   R = "TOTAL" - "CRM"

3. If R is greater than the amount of talc in the pan, assume the difference is due to retention of talc by the CRM above the No. 200 sieve and below the No. 10 sieve. The amount of talc retained by the CRM particles is the difference between R and the weight of the pan contents, which is considered to be talc.

   Retained Talc = R - Pan Weight

4. Evenly distribute the weight of the retained talc among the No. 16, No. 30, and No. 50 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 zero the pan weight for column C. Accumulate these weights in Column D.

5. 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.

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

G. PRECAUTIONS

During CRM sampling, take care not to dent the inner tube of the sampling device during the sample transfer process, as it will not fit back into the outer tube if damaged.

The longitudinal openings in the sampling device have very sharp edges and can easily cut a finger severely. Exercise caution and wear gloves when using the sampling device.

H. REPORTING OF RESULTS

When required by the contract documents, submit test results electronically in accordance with the DIMEXML format and guidance documents found at the following link:

https://dime.dot.ca.gov/index.php?r=help/submittestresult

I. HEALTH AND SAFETY

It is the responsibility of the user of this test method to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Prior to handling, testing, or disposing of any materials, testers must be knowledgeable about safe laboratory practices, hazards and exposure, chemical procurement and storage, and personal protective apparel and equipment.

Refer to the Safety Manual for your Laboratory.

End of Text
(California Test 385 contains 15 pages)

FIGURE 1. Sampling Device

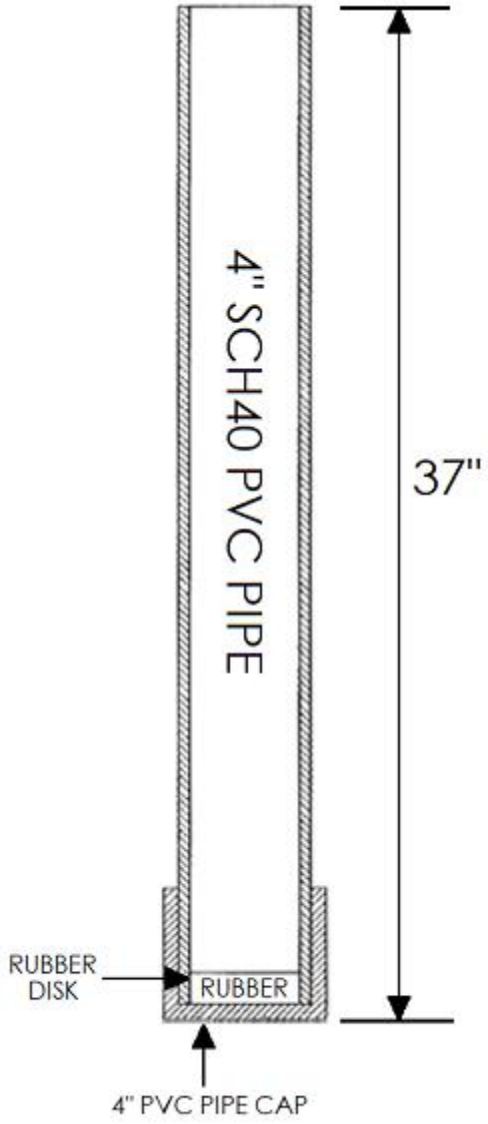

FIGURE 2. Sample Retainer

Appendix A

INSTRUCTIONS FOR CALCULATION WORKSHEET

(with Example Data)

Original weight of CRM, "CRM" = 102.34 g
Weight of Talc added, "T" = 5.07 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 the sum of Column B = Column A Total.

2. Total weight retained "TOTAL"= 107.01 g

3. Check: ("CRM" + 0.75 "T") ≤ "TOTAL" ≤ "CRM" + "T")

   (102.34 g + 0.75(5.07 g) = 106.14 g) ≤ 107.01 g ≤ (102.34 g + 5.07 g = 107.41 g) →OK

4. Determine R: R = "TOTAL" -"CRM" = 107.01 g - 102.34 g = 4.67 g

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

6. Retained Talc = R - Column B Pan Weight = 4.67 g - 3.04 g = 1.63 g

7. Retained Talc / 3 = 1.63 g / 3 = 0.54 g < 0.8 g → Use 0.54 g

8. Subtract Retained Talc/3 from the individual weights retained on each of the No.16, No. 30, and 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 No.8, No. 10, No. 100, and 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: The 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 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.

California Test 385 Calculation Worksheet (EXAMPLE)

Project Information:

Sample Date: <MM/DD/YYY>
Test Date: <MM/DD/YYYY>

CRM Information

CRM Manufacturer: <Enter Manufacturer Name>
CRM Source: <Enter Source Name>
CRM Type: <Enter CRM Type>

CRM sample original weight (g) = 102.34 (CRM)
CRM sample weight for % wire (g) = 304.32 (CRM-W)
Weight of talc added (g) = 5.07 (T)

Sieves	**A**	**B**	**C**	**D**	**E**	**F**
Size	Accumulated weight retained (g)	Individual weight retained (g)	Adjusted individual weight retained (g)	Adjusted accumulated weight retained (g)	CRM % Retained	CRM % Passing
No. 8	0.00	0.00	0.00	0.00	0.0	100.0
No. 10	0.34	0.34	0.34	0.34	0.3	99.7
No. 16	4.16	3.82	3.28	3.62	3.5	96.5
No. 30	30.06	28.90	28.36	28.98	28.3	71.7
No. 50	82.83	52.77	52.23	81.21	79.3	20.7
No. 100	93.17	10.34	10.34	91.55	89.4	10.6
No. 200	103.97	10.80	10.80	102.35	100.0	0.0
Pan	107.01	3.04	0.00	102.35		
Total =	107.01	107.01	102.35	102.35		

Accuracy Check: "CRM" + 0.75"T" ≤ "TOTAL" ≤ "CRM" + "T"
106.14 g ≤ 107.01 g ≤ 107.41 g

R = TOTAL – CRM = 107.01 g – 102.34 g = 4.67 g

Retained Talc = R – (Weight Retained in Pan under Column B) = 4.67 g – 3.04 g = 1.63 g

Retained Talc / 3 = 1.63 g / 3 = 0.54 g

Weight of Fabric / Weight of CRM * 100 = % Fabric (Nearest 0.01%)

0.00 g / 102.34 g * 100 = 0.00%

Weight of Wire / Weight of CRM-W * 100 = % Wire (Nearest 0.01%)

0.04 g / 304.32 g * 100 = 0.01%

California Test 385 Calculation Worksheet

Project Information:

Sample Date: _____
Test Date: _____

CRM Information

CRM Manufacturer: _____
CRM Source: _____
CRM Type: _____

CRM sample original weight (g) = _____ (CRM)
CRM sample weight for % wire (g) = _____ (CRM-W)
Weight of talc added (g) = _____ (T)

Sieves	**A**	**B**	**C**	**D**	**E**	**F**
Size	Accumulated weight retained (g)	Individual weight retained (g)	Adjusted individual weight retained (g)	Adjusted accumulated weight retained (g)	CRM % Retained	CRM % Passing
No. 8						
No. 10						
No. 16						
No. 30						
No. 50						
No. 100						
No. 200						
Pan						
Total =						

Accuracy Check: "CRM" + 0.75"T" ≤ "TOTAL" ≤ "CRM" + "T"
_____ ≤ _____ ≤ _____

R = TOTAL – CRM = _____ + _____ = _____

Retained Talc = R – (Weight Retained in Pan under Column B) = _____ - _____ = _____

Retained Talc / 3 = _____

Weight of Fabric / Weight of CRM * 100 = % Fabric (Nearest 0.01%)

_____ / _____ * 100 = _____

Weight of Wire / Weight of CRM-W * 100 = % Wire (Nearest 0.01%)

_____ / _____ * 100 = _____