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Test Procedure for

**DETERMINING ASPHALT CONTENT OF  
BITUMINOUS MIXTURES BY EXTRACTION**



TxDOT Designation: Tex-210-F

Effective Date: January 2019

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**1. SCOPE**

- 1.1 Use this test method to determine the percentage of asphalt in a paving mixture based on the weight of an asphalt and aggregate mixture. This method has four cold solvent extraction procedures. The aggregate and fines recovered can be used for sieve analysis (Tex-200-F).
- 1.2 Use Table 1 to achieve sample size requirements.

**Table 1—Sample Size**

Nominal Maximum Aggregate Size (in.) <sup>1</sup>	Minimum Size of Sample (g)
No. 4	500
3/8	1000
1/2	1500
3/4	2000
1	3000
1-1/2	4000

1. Nominal maximum aggregate size is one sieve size larger than the first sieve that retains more than 10% of the total aggregate.

- 1.3 The values given in parentheses (if provided) are not standard and may not be exact mathematical conversions. Use each system of units separately. Combining values from the two systems may result in nonconformance with the standard.

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**PART I—CENTRIFUGE EXTRACTION METHOD USING CHLORINATED SOLVENT**

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**2. SCOPE**

- 2.1 This part describes the extraction method using chlorinated solvent.

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### 3. APPARATUS

- 3.1 *Extractor*, motorized, with explosion-proof features of the centrifuge type, consisting of a bowl mounted in an assembly so the bowl revolves at a controlled speed. The apparatus should have a container or outer shell for catching solvent thrown from the bowl and a drain for collecting the solvent.
- 3.2 *Ventilation*, as required by current specifications for asphalt mix control laboratories. System requirements for non-chlorinated solvents apply unless tests show that the alternate system lowers the solvent vapor to safe levels throughout the testing process.
- 3.3 *Filter paper*, to fit the rim of the bowl and having a 20–25  $\mu\text{m}$  retention factor.
- 3.4 *Scoop, spatula, trowel, and small brush.*
- 3.5 *Graduate*, with a minimum capacity of 2000 mL.
- 3.6 *Filtrate containers.*
- 3.7 *Silica evaporating dish*, with a minimum capacity of 200 mL.
- 3.8 *Balance*, Class G2 in accordance with Tex-901-K, with a minimum capacity of 4000 g.
- 3.9 *Balance*, Class G1 in accordance with Tex-901-K, with a minimum capacity of 4000 g.
- 3.10 *Drying oven*, capable of attaining a temperature of at least  $200 \pm 9^\circ\text{F}$  ( $93 \pm 5^\circ\text{C}$ ).
- 3.11 *Muffle furnace or burner and hot plate.*
- 3.12 *Large, flat pan or microwave dish, solvent pouring container, beakers.*
- 3.13 *Desiccator* (optional).
- 3.14 *Sealed magnetic stirring device* (optional).
- 3.15 *Pipette*, 100 mL capacity.

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### 4. MATERIALS

- 4.1 *Extraction solvent*—1,1,1 trichlorethylene or methylene chloride.
- 4.2 *Ammonium carbonate solution*—saturated solution of ACS Grade  $(\text{NH}_4)_2\text{CO}_3$ .

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### 5. SAFETY CONSIDERATIONS

- 5.1 Follow the safety considerations detailed in Section 41 to perform this procedure safely.

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## 6. PREPARING MATERIAL SAMPLE

- 6.1 Prepare a representative sample of loose or compacted bituminous mixture for the extraction test.
- 6.2 For roadway cores, trim the bottom or top of the core only when necessary to remove any foreign matter. Foreign matter is another paving layer, such as hot mix, surface treatment, subgrade, or base material.
- 6.3 If the asphaltic mixture is not workable and cannot be separated and reduced to laboratory test-size, place several thousand grams in a large, flat pan and warm in an oven until it becomes workable.  
**Note 1**—Mix temperature should not exceed 200°F (93°C) due to flammability when used with non-chlorinated solvents.
- 6.3.1 Use a trowel to separate the particles of the sample using care not to fracture the aggregate particles.
- 6.4 Mix, blend, and quarter the mixture continuously until two combined opposite quarters weigh a minimum amount corresponding to Table 1. For mixtures not subject to segregation, thoroughly blend the material and take small portions from several places covering the entire area of the pan.
- 6.5 Dry the sample to constant weight at a minimum temperature of  $200 \pm 9^\circ\text{F}$  ( $93 \pm 5^\circ\text{C}$ ), if the sample consists of hot-mix, cold-laid material, pre-coated aggregate, pavement, or any fresh mixture that may contain moisture. If the sample consists of rock asphalt, dry to constant weight at a minimum temperature of  $140 \pm 9^\circ\text{F}$  ( $60 \pm 5^\circ\text{C}$ ).  
**Note 2**—Constant weight is the weight at which further oven drying does not alter the weight by more than 0.05% in a 2-hour or longer drying interval in accordance with Section 6.7.
- 6.6 If running the extraction on material containing moisture or hydrocarbon volatiles before drying, select representative portions of the mixture as received, and determine the moisture content in accordance with Tex-212-F and the hydrocarbon volatile content in accordance with Tex-213-F. Prepare and weigh the samples for these tests at the same time.
- 6.7 Calculate the percent difference in weight in accordance with Section 43.1.

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## 7. PROCEDURE

- 7.1 Weigh and record the laboratory size sample for extraction to the nearest 0.1 g.
- 7.2 Transfer the weighed sample into the extractor bowl, taking care not to lose any of the material.
- 7.3 Place the extractor bowl next to the ventilation system airflow.

- 7.4 Carefully cover the sample with solvent. If necessary, use a small amount of solvent to wash any material remaining in the pan into the bowl. Allow sufficient time for the solvent to dissolve the asphalt in the sample.  
**Note 3**—Exercise caution during the initial addition of solvent to the hot extraction sample, since the mix will shortly heat the solvent to temperatures above the solvent flash point and could present a flammability hazard. With stirring, the temperature should cool below the flash point within 2–5 min.
- 7.5 Dry a filter paper in an oven at a maximum temperature of 280°F (138°C).
- 7.6 Weigh the clean, dry, filter paper to the nearest 0.1 g and record as *B* under Section 43.3.
- 7.7 Place the filter paper and top on the extractor bowl and, screw on the funnel-clamp until tight.
- 7.8 Place the bowl containing the sample and solvent into the machine, tighten the lock nut, and secure the extractor lid.
- 7.9 Place a container under the drain to catch liquid extracted from the sample and start the machine.
- 7.10 When the solvent ceases to flow, stop the centrifuge and collect the discharged liquid in a 2000-mL graduated cylinder.
- 7.11 Add approximately 300 mL of solvent to the bowl through the funnel, and start the centrifuge.
- 7.12 Collect the discharged liquid, stop the centrifuge, pour the discharged liquid back into the bowl, and restart the centrifuge.
- 7.13 Stop the centrifuge and add the discharged liquid to that liquid already in the graduate.
- 7.14 Continue this procedure, centrifuging each addition of solvent several times until the extract has a faint brown appearance or is reasonably clear. Stop the motor each time before pouring solvent into the funnel.  
**Note 4**—Due to the nature of the extraction process, it is impossible to secure a clear extract without disintegrating some of the aggregate or using an excessive quantity of solvent.
- 7.15 Collect, measure, and record the total amount of discharged liquid.
- 7.16 Carefully remove the top and filter paper from the extractor bowl, and brush all clinging aggregate particles back into the bowl.
- 7.17 Dry the filter paper to constant weight and record its dry weight to the nearest 0.1 g as *C* under Section 43.3.  
**Note 5**—Constant weight is the weight at which further oven drying does not alter the weight by more than 0.05% in a 2-hour or longer drying interval when calculated in accordance with Section 43.

- 7.18 Subtract the original weight of filter paper (recorded in Section 7.6) from the final weight recorded in Section 7.17 to obtain the weight of the fine mineral matter (assumed to be particles passing the No. 200 [75µm] sieve) retained.
- 7.19 Transfer the aggregate in the extraction bowl to a tared pan and dry to constant weight at a minimum temperature of 200°F (93°C). Weigh and record the net weight of aggregate to the nearest 0.1 g as *G* under Section 43.3.
- 7.20 Weigh a 200-mL silica evaporating dish to the nearest 0.01 g and record as *J* under Section 43.3.  
**Note 6**—An Ash Factor may be used in lieu of ash determination. Follow the procedure in Section 9 to determine Ash Factor.
- 7.21 Agitate the liquid collected in the 2000-mL graduate thoroughly, and immediately withdraw a 100-mL sample from the middle third of the liquid by means of a 100-mL pipette and suction bulb.
- 7.22 Pour the 100 mL into the tared silica dish and evaporate the solvent on a gas or electric hot plate under a hood or well-ventilated area.  
*CAUTION:* Depending upon the solvent used, the evaporating fumes may be toxic and flammable.
- 7.23 Ignite the residue over a burner, or, if available, place the dish in a muffle furnace for 45 min., at approximately 1,400°F (760°C), to ash the bituminous material. Whether burner or muffle furnace is used, continue the process (for an extended period, if necessary) until the ashing is complete.  
**Note 7**—Complete ashing should be obvious from visual observation. Should any doubt arise, completion of ashing can be determined by continuing the process to a constant weight condition.
- 7.24 Cool and add just enough ammonium carbonate [(NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub>] to wet the ash remaining in the dish.  
**Note 8**—Omit the use of ammonium carbonate if prior tests do not indicate a need for re-carbonation of the ash.
- 7.25 Place the dish on a hot plate and evaporate to dryness at low temperature.
- 7.26 Cool the dish and contents to room temperature in a desiccator, if available, weigh to the nearest 0.01 g, and record the net weight as *I* under Section 43.3.
- 7.27 Determine the total ash content in accordance with Section 43.3.
- 7.28 Add the weight of fine material retained in the filter ring and the weight of ash in the total centrifuged liquid to the weight of material passing the No. 200 (75 µm) sieve in accordance with Section 43.3 for use in calculating the sieve analysis.

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## 8. RETENTION FACTOR

- 8.1 Certain types of aggregate retain a small amount of bitumen after the extraction test. If this occurs, consider it when calculating the final percent of bitumen in the mix.
- 8.2 Use the following procedure to determine a factor to make the required adjustment. Where the retention factor is determined to be less than 0.1%, disregard it. Once a retention value is determined for a particular design, use this value until a design change occurs or for any other valid reason. Check it periodically during lengthy projects.
- 8.3 *Procedure:*
- 8.3.1 Perform this procedure separately on at least two representative specimens of aggregate used in the mix.
- 8.3.2 Dry the aggregate specimens to a constant weight at a minimum temperature of 200°F (93°C).
- 8.3.3 Mix the design amount of asphalt with the aggregates in accordance with Tex-205-F.
- 8.3.4 Place the mixture in an oven and heat to the anticipated plant mixing temperature. Hold at that temperature for the period estimated as that between plant mixing and sampling for extraction. If the extraction sample is cured in an oven for 2 hr. at 250 ± 5°F (121 ± 3°C) with material for laboratory compaction, it is also necessary to cure the retention factor samples an additional 2 hr. at 250 ± 5°F (121 ± 3°C).
- 8.3.5 Begin the extraction process at the same mixture temperature as that used during job control tests.
- 8.3.6 Calculate the average of the two residual bitumen values in accordance with Section 43.2.
- Note 9**—If the values vary by more than 0.2 %, run additional tests.

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## 9. ASH FACTOR ALTERNATIVE

- 9.1 The ash factor is an amount of ash that is to be used repeatedly as part of the total aggregate portion of an extraction test. It takes the place of the ash value usually determined for each extraction.
- 9.2 The ash factor may differ for each individual due to personal differences in laboratory technique. Therefore, each technician must establish an ash factor.
- 9.2.1 Run a minimum of four extraction tests during four different days of production.
- 9.2.2 Record the total ash for each extraction.

- 9.2.3 If the total ash values of the four extractions do not vary by more than 0.1% by weight of the total sample weight, the number of grams of total ash can become the ash factor for each extraction test, as long as:
- there is no change in the aggregate gradation or source,
  - the asphalt content does not change, and
  - the plant production remains uniform.
- 9.2.4 Periodic checking of the ash factor by ash determination is essential for justifying its continued use.
- 9.2.5 Omit ash determination when using extraction for the sole purpose of cleaning aggregate for sieve analysis.

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## 10. CALCULATIONS

- 10.1 Calculate the percent asphalt in the mixture in accordance with Section 43.3. Report asphalt content to the nearest tenth.

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## PART II—VACUUM EXTRACTION METHOD

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### 11. SCOPE

- 11.1 This part describes the vacuum extraction method using chlorinated solvent.

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### 12. APPARATUS

- 12.1 *Vacuum extractor*, complete with vacuum pump, extractor O-rings, tubing, filter support plate, tank, and funnel ring. The Department recommends a vane-type vacuum pump. An exhaust hose is required to immediately carry the fumes from the vacuum pump to the front of the exhaust fan of the ventilation system.
- 12.2 *Ventilation*, as required by current specifications for asphalt mix control laboratories. System requirements for non-chlorinated solvents apply unless tests show that the alternate system lowers solvent vapor to safe levels throughout the testing process.
- 12.3 *Ultrasonic cleaner*, with non-perforated insert tray (optional).
- 12.4 *Filter paper*, size 331 mm (13 in.), having a 20–25  $\mu\text{m}$  retention factor.
- 12.5 *Forced draft oven*, capable of attaining a temperature of at least  $200 \pm 9^\circ\text{F}$  ( $93 \pm 5^\circ\text{C}$ ).
- 12.6 *Balance*, Class G2 in accordance with Tex-901-K.
- 12.7 *Small scoop or spoon, spatula, trowel, and small brush*.
- 12.8 *Large, flat drying pan or microwave container*.

- 12.9 *Plastic wash bottles and glass beaker graduates.*
- 12.10 *Container, of adequate size to hold test sample and solvent without spilling when stirred.*
- 12.11 *Comb, hair-pick type, with long, stiff tines approximately 3.8 × 6.4 mm (0.125 × 0.25 in.) apart. The comb can be metal or plastic, provided the tine ends are smooth and rounded.*
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### 13. MATERIALS

- 13.1 *Extraction solvent—1,1,1 trichloroethylene or methylene chloride.*
- 13.2 *Diatomaceous silica filtering aid—Celite 110 or equivalent (optional).*
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### 14. SAFETY CONSIDERATIONS

- 14.1 Follow the safety considerations detailed in Section 41 to perform this procedure safely.
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### 15. TEST RECORD FORMS

- 15.1 [HMAC Mix Properties](#)
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### 16. PREPARING MATERIAL SAMPLE

- 16.1 Prepare the sample as described in Section 6.
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### 17. PROCEDURE

- 17.1 Weigh and record the laboratory size sample for extraction to the nearest 0.1 g.
- 17.2 Transfer the weighed sample into the sample container or ultrasonic cleaner insert tray.
- 17.3 Place the sample container or ultrasonic cleaner insert tray next to the ventilation system airflow.
- 17.4 Carefully cover the sample with solvent.  
**Note 10**—Exercise caution during the initial addition of solvent to the hot extraction sample, since the mix will shortly heat the solvent to temperatures above the solvent flash point and could present a flammability hazard. With stirring, the temperature should cool below the flash point within 2–5 min.
- 17.5 Gently stir the solvent and mixture sample in the container until asphalt is visible in the solution. If using an ultrasonic cleaner, fill the tank with water to a level that will closely approximate the solvent level after placing the insert tray in the water bath.  
**Note 11**—Add a small quantity of wetting agent (liquid detergent) to the water. Water may be stored in the bath for future testing. Occasional replacement is necessary.
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- 17.6 Place the insert tray and its contents in the ultrasonic cleaner and activate the cleaner. In order to achieve the best cleaning, the tray should not touch the side of the water bath.
- 17.7 Stir the mixture occasionally. Do not place hands or fingers in the water bath or solvent when the ultrasonic cleaner is on.
- 17.8 Center the filter support over the O-ring of the extractor base.
- 17.9 Dry the filter paper in an oven at a maximum temperature of 280°F (138°C).
- 17.10 Weigh the clean, dry filter paper to the nearest 0.1 g and record as *B* under Section 43.4.
- 17.11 Place the filter paper on the filter support, replace the funnel ring, and tighten the wing nuts by hand. Inspect the filter paper and filter support for improper alignment and tears.  
**Note 12**—Reduce clogging of the filter paper by using more than one filter or by placing a pair of No. 16 (1.18-mm) and No. 200 (75- $\mu$ m) sieves, nested together, onto the filter paper.
- 17.12 Place approximately 30 g of diatomaceous filtering aid, weighed to the nearest 0.1 g, into a beaker and add approximately 500 mL of solvent. Record the weight of filtering aid as *H* under Section 43.4.  
**Note 13**—The filtering aid should be dried and maintained in a moisture-free environment. It should consist of material passing the No. 200 (75  $\mu$ m) sieve only. If particles coarser than the No. 200 (75  $\mu$ m) sieve are present, sieve all of the material to be used over the No. 200 (75  $\mu$ m) sieve, discarding the coarser particles  
**Note 14**—Mixtures containing rubber or polymer additions may require up to 100 g to adequately assist with filtering.
- 17.13 Vigorously stir the contents of the beaker and immediately pour the solution onto the filter paper. Rinse any filtering aid remaining in the beaker onto the filter paper.
- 17.14 Start the vacuum pump and continue to run the pump until the pad formed by the filtering aid is surface dry. Eliminate use of the diatomaceous filtering aid when the filter paper being used allows efficient extraction of dissolved asphalt without loss of very fine aggregate.  
**Note 15**—Some diatomaceous filter aid is very fine and may wash through the filter paper. This material will be included in the determination of the percent passing of the No. 200 (75  $\mu$ m) sieve, and the gradation may not meet specification. If the gradation does not meet specification, perform blank tests to determine the amount of filter aid lost through the filter paper. Subtract this correction factor from the percent passing the No. 200 (75- $\mu$ m) sieve.
- 17.15 After gently stirring the test sample in the container, or once the container has undergone several minutes of ultrasonic cleaning, gently decant the solvent from the container or insert tray into the vacuum extractor. Decant the solvent onto a trowel placed on the filter paper to avoid undue disturbance of the filtering aid pad. Use a trowel to prevent aggregate from falling from the bowl or insert tray during the decanting process.

- 17.16 Again cover the sample in the container or insert tray with solvent and either gently stir or place into and activate the ultrasonic cleaner.
- 17.17 Continue the vacuum until all the solution has disappeared from the filter paper. If the time to filter out the solvent is considerable or a hard crust appears, gently pull a comb across the filter paper while the pump is running to break the crust, being careful not to tear the filter paper. Use additional clean solvent to help rinse the excess asphalt through the filter paper (Sections 17.18–17.20).
- 17.18 Turn the pump off and add approximately 300 mL of clean solvent into the vacuum extractor when the time to filter out the solvent is considerable and after gently combing across the filter paper.
- 17.19 Gently stir the solution with the comb for several minutes.
- 17.20 Turn the pump on and decant the solvent into the vacuum extractor.
- 17.21 Repeat Sections 17.15–17.20 until the solvent is reasonably clean and the aggregate is visually clean.
- 17.22 After the last washing, pour the entire sample into the extractor.
- 17.23 Use a wash bottle with solvent to rinse the aggregate particles from the bowl or insert tray and spoon into the extractor. Also rinse the inside of the funnel ring to wash down any asphalt or aggregate fines that may have splattered and adhered to the funnel sides.
- 17.24 With a spatula, carefully distribute the aggregate evenly over the filter paper.
- 17.25 After vacuuming all the liquid off, stop the vacuum pump and use a spatula to move the sample away from the funnel ring and toward the center of the filter paper. Continue to run the vacuum pump to further aid in drying, if desired.
- 17.26 Weigh a drying pan to the nearest 0.1 g and record as *F* under Section 43.4.
- 17.27 Remove the funnel ring and brush any clinging aggregate into a tared drying pan.
- 17.28 Pick up the filter paper and the aggregate on the filter support plate and transfer the aggregate into the drying pan.
- 17.29 Using a spatula and brush, remove the clinging aggregate from the filter paper into the drying pan.
- 17.30 Fold and place the filter paper in the drying pan with the sample.
- 17.31 Place the pan containing the extracted aggregates in a vented oven and dry to constant weight at a maximum temperature of 280°F (138°C).
- 17.31.1 Stagger placement of samples into the oven by at least 1 hr. when extracting multiple samples.

- 17.31.2 Place the most recently extracted sample closest to the exhaust vent. Do not block the exhaust vent with a sample pan.
- 17.32 Dry the extracted aggregate and filter paper to constant weights, then weigh and record the individual weights to the nearest 0.1 g.
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## 18. RETENTION FACTOR

- 18.1 Calculate retention factor in accordance with Section 8.
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## 19. CALCULATIONS

- 19.1 Calculate the percent asphalt in the mixture in accordance with Section 43.4. Report asphalt content to the nearest tenth.
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## PART III—CENTRIFUGE EXTRACTION METHOD USING NON-CHLORINATED SOLVENT

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*SPECIAL NOTICE: The solvents used in these procedures are toxic, flammable, and/or combustible. Follow all safety precautions carefully.*

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## 20. APPARATUS

- 20.1 *Centrifugal extractor*, motorized, with explosion-proof features, consisting of a bowl mounted in an assembly so that the bowl revolves at a controlled speed. The apparatus should have a container or outer shell for catching the solvent thrown from the bowl and a drain for collecting the solvent.
- 20.2 *Ventilation*, as required by current specifications for asphalt mix control laboratories. Specific requirements contained herein for the arrangement and capacity of the ventilation system may be waived or varied, if tests show that the alternate system lowers solvent vapors to safe levels throughout the testing process.
- 20.3 *Filter paper*, to fit the rim of the bowl, 20–25  $\mu\text{m}$  retention factor.
- 20.4 *Scoop, spatula, trowel, and small brush.*
- 20.5 *Graduates*, 2000 mL capacity minimum.
- 20.6 *Filtrate containers.*
- 20.7 *Screw-top container*, 4 L (1 gal.), of metal or polyethylene.
- 20.8 *Balance*, Class G2 in accordance with Tex-901-K, with a minimum capacity of 4000 g.
- 20.9 *Balance*, Class G1 in accordance with Tex-901-K, with a minimum capacity of 4000 g.
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- 20.10 *Forced draft oven*, vented to the outside and capable of attaining a temperature of at least 200°F (93°C).
  - 20.11 *Drying oven*, capable of attaining a temperature of at least 200°F (93°C).
  - 20.12 *Large, flat pan, solvent pouring container, wash bottles, beakers.*
  - 20.13 *Glass fiber filter paper*, Whatman GF/F 12.5 cm (1/2 in.) glass micro fiber filters or equivalent.
  - 20.14 *Porcelain Buchner filter funnel*, 126 mm (5 in.) internal diameter.
  - 20.15 *Vacuum pump*, with an exhaust hose to carry fumes to immediately in front of the exhaust fan of the ventilation system.
  - 20.16 *Vacuum filtering flask*, 1000 mL.
  - 20.17 *Desiccator* (optional).
  - 20.18 *Sealed magnetic stirrer* (optional).
  - 20.19 *Pipette*, 100 mL capacity.
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## **21. MATERIALS**

- 21.1 *Extraction solvent*, biodegradable, meeting the requirements of the Department's specification for non-chlorinated extraction solvent for bituminous mixtures.
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## **22. SAFETY CONSIDERATIONS**

- 22.1 Follow the safety considerations detailed in Section 41 to perform this procedure safely.
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## **23. PREPARING MATERIAL SAMPLE**

- 23.1 Prepare the sample as described in Section 6.
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## **24. PROCEDURE**

- 24.1 Weigh and record the laboratory size sample for extraction to the nearest 0.1 g.
  - 24.2 Transfer the weighed sample into the extractor bowl, taking care not to lose any of the material.
  - 24.3 Place the extractor bowl next to the ventilation system airflow.
  - 24.4 Carefully cover the sample with solvent. If necessary, use a small amount of solvent and wash any material remaining in the pan into the bowl.
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**Note 16**—Exercise caution during the initial addition of solvent to the hot extraction sample, since the mix will shortly heat the solvent to temperatures above the solvent flash point and could present a flammability hazard. With stirring, the temperature should cool below the flash point within 2–5 min.

- 24.5 Stir the mixture in the extractor bowl frequently over a period of approximately 10 min. Stirring every 2–4 min. is desirable.
- 24.6 If necessary, dry the filter ring in an oven at a maximum temperature of 280°F (138°C).
- 24.7 Weigh the clean, dry, paper filter ring to the nearest 0.1 g and record as *B* under Section 43.5.
- 24.8 Place the filter paper and top on the extractor bowl, and screw on the funnel-clamp until tight.
- 24.9 Place the bowl containing the sample and solvent into the machine, tighten the lock nut, and secure the extractor lid.
- 24.10 Place a container under the drain to catch the liquid extracted from the sample and start the machine.
- 24.11 When the solvent ceases to flow, stop the centrifuge and collect the discharged liquid in a 2000-mL graduated cylinder.
- 24.12 Add approximately 300 mL of solvent to the bowl through the funnel, and start the centrifuge.
- 24.13 Collect the discharged liquid, stop the centrifuge, pour the discharged liquid back into the bowl, and restart the centrifuge.
- 24.14 Stop the centrifuge and add the discharged liquid to that liquid already in the graduate.
- 24.15 Continue this procedure, centrifuging each addition of solvent several times until the extract has a faint brown appearance or is reasonably clear. Stop the motor each time before pouring solvent into the funnel.
- Note 17**—Due to the nature of the extraction process, it is impossible to secure a perfectly clear extract without disintegrating some of the aggregate or using an excessive quantity of solvent.
- 24.16 Collect and measure the total amount of discharged liquid and reserve for use in Section 24.31.
- 24.17 Add about 300 mL of warm water (preferably above 110°F [43°C]) to the extractor.
- 24.18 Start the extractor and collect the filtrate. Discard the filtrate in a manner acceptable to safety and environmental standards.
- 24.19 Repeat Sections 24.17 and 24.18 until the rinse water is clear.

- 24.20 Operate the centrifuge for several minutes to remove as much rinse material from the mix as possible.
- 24.21 Carefully remove the top and filter paper from extractor bowl, and brush all clinging aggregate particles back into the bowl.
- 24.22 Dry the filter paper to constant weight and record its dry weight to the nearest 0.1 g as *C* under Section 43.5.  
**Note 18**—Constant weight is the weight at which further oven drying does not alter the weight by more than 0.05% in a 2-hour or longer drying interval in accordance with Section 6.7.
- 24.23 Subtract the original weight of filter paper (recorded in Section 24.7) from the final weight (measured in Section 24.22) to obtain the weight of the fine mineral matter (assumed to be particles passing the No. 200 [75 μm] sieve) contained in it.
- 24.24 Weigh a drying pan to the nearest 0.1 g and record as *F* under Section 43.5.
- 24.25 Transfer the aggregate from the extraction bowl to the pan, and record the weight to the nearest 0.1 g as *E* under Section 43.5.
- 24.26 Place the pan containing the extracted aggregate in a vented oven and dry to a constant weight at a maximum temperature of 280°F (138°C).
- 24.26.1 If another extraction sample is already in the oven, stagger placement of the samples into the oven by at least 1 hr.
- 24.26.2 Place the most recently extracted sample closest to the exhaust vent. Do not block the exhaust vent with a sample pan.
- 24.27 Remove from oven and cool.
- 24.28 Place a clean, dry glass fiber filter paper in the Buchner funnel, weigh to the nearest 0.01 g and record as *J* under Section 43.5.
- 24.29 Dry the fiber filter paper in an oven at a maximum temperature of 280°F (138°C), if necessary.
- 24.30 Place the Buchner funnel containing the glass fiber filter paper in the vacuum filter flask. Wet the glass fiber filter paper using clean asphalt extraction solvent from a wash bottle and start the vacuum.
- 24.31 Pour the solvent-asphalt mixture from Section 24.16 into a 4-L (1-gal.) screw-top container.
- 24.32 Agitate thoroughly and immediately pour 100 mL into a 100-mL graduate. An optional method of agitation is to place a magnetic stirring bar in the graduate or beaker containing the solvent and then place this on a sealed magnetic stirrer. If a sealed magnetic stirrer is used, draw a 100-mL sample from the middle third of the liquid when stirring, by means of a 100-mL pipette and suction bulb.

- 24.33 Pour the 100-mL sample into the Buchner funnel and filter out the mineral matter (dust).
- 24.34 Repeat Sections 24.32 and 24.33 to filter a total of 200 mL of the solvent-asphalt mixture.
- 24.35 Rinse the graduated cylinder with clean asphalt extraction solvent.  
**Note 19**—This ensures that all mineral matter washes into the filter.
- 24.36 Rinse the sides of the funnel, washing all material onto the glass fiber filter paper. Rinse the glass fiber filter paper with solvent five times (just covering the surface of the glass fiber filter paper), allowing the glass fiber filter paper to drain completely between rinses.
- 24.37 Continue the vacuum until the glass fiber filter paper and contents appear dry.
- 24.38 Rinse the sides of the funnel with a wash bottle filled with the warm water (preferably above 110°F [43°C]) and cover the glass fiber filter paper with it. It is not necessary to fill the funnel with the water.
- 24.39 Allow the glass fiber filter paper to drain dry under the vacuum.
- 24.40 Repeat Sections 24.38 and 24.39 seven times. Use only a small amount of rinse material for each rinse. Cover the surface of the glass fiber filter paper each time.
- 24.41 Dry the Buchner funnel, glass fiber filter paper, and retained fines in an oven at a maximum temperature of 280°F (138°C) to constant weight.
- 24.42 Weigh the Buchner funnel, glass fiber filter paper, and mineral matter to the nearest 0.01 g, and record as *I* under Section 43.5.
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## 25. RETENTION FACTOR

- 25.1 Calculate retention factor in accordance with Section 8.
- 

## 26. ASH FACTOR ALTERNATIVE

- 26.1 The ash factor is an amount of Buchner fines used repeatedly as part of the total aggregate portion of an extraction test. It takes the place of the Buchner fines value usually determined for each extraction.
- 26.2 The ash factor may differ with each individual due to personal differences in laboratory technique. Therefore, each technician must establish an ash factor.
- 26.2.1 Run a minimum of four extraction tests during four different days of production.
- 26.2.2 If the Total Buchner fines values of the four extractions do not vary by more than 0.1 % by weight of the total sample weight, the number of grams of total Buchner fines can become the ash factor, as long as:
- there is no change in the aggregate gradation or source,

- the asphalt content does not change, and
- the plant production remains uniform.

- 26.2.3 Periodic checking of the ash factor by Buchner fines determination is essential for justifying its continued use.
- 26.3 Omit Buchner fines determination when using extraction for the sole purpose of cleaning aggregate for sieve analysis.

---

## 27. CALCULATIONS

- 27.1 Calculate the percent asphalt in the mixture in accordance with Section 43.5. Report asphalt content to the nearest tenth.

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## PART IV—VACUUM EXTRACTION METHOD USING NON-CHLORINATED SOLVENT

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*SPECIAL NOTICE: The solvents used in these procedures are flammable and/or combustible. Follow the safety precautions herein.*

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## 28. APPARATUS

- 28.1 *Vacuum extractor*, complete with vacuum pump, extractor O-rings, tubing, filter support plate, tank, and funnel ring. The Department recommends a vane-type vacuum pump. An exhaust hose is required to immediately carry the fumes from the vacuum pump to the front of the exhaust fan of the ventilation system.
- 28.2 *Ventilation*, as required by current specifications for asphalt mix control laboratories. Specific requirements contained herein for the arrangement and capacity of the ventilation system may be waived or varied, if tests show that the alternate system lowers solvent vapors to safe levels throughout the testing process.
- 28.3 *Filter paper*, size 331 mm (13 in.), 20-25  $\mu\text{m}$  retention factor.
- 28.4 *Forced draft oven*, vented to the outside and capable of attaining a temperature of at least 200°F (93°C).
- 28.5 *Balance*, Class G2 in accordance with Tex-901-K, with a minimum capacity of 4000 g.
- 28.6 *Small scoop or spoon, spatula, trowel, and small brush.*
- 28.7 *Large flat drying pan or microwave container.*
- 28.8 *Plastic wash bottles and glass beaker graduates.*
- 28.9 *Container*, of adequate size to hold test sample and solvent without spilling during stirring.



- 28.10 *Comb*, hair-pick type, with long stiff tines approximately 3.8–6.4 mm (0.125–0.25 in.) apart. The comb can be metal or plastic, provided the tine ends are smooth and rounded.
- 

## 29. MATERIALS

- 29.1 *Extraction solvent*, biodegradable, meeting the requirements of the Department's specification for non-chlorinated bituminous mixtures extraction solvent.
- 29.2 *Diatomaceous silica filtering aid* (Celite 110 or equivalent) (optional).
- 

## 30. SAFETY CONSIDERATIONS

- 30.1 Follow the safety considerations detailed in Section 41 to perform this procedure safely.
- 

## 31. PREPARING SAMPLE

- 31.1 Prepare the sample as described in Section 6.
- 

## 32. PROCEDURE

- 32.1 Weigh and record the laboratory size sample for extraction to the nearest 0.1 g.
- 32.2 Transfer the weighed sample into a sample container. Carefully cover the sample with solvent. Pour all solvents immediately in the airflow of the ventilation system.  
**Note 20**—Exercise caution during the initial addition of solvent to the hot extraction sample since the mix will shortly heat the solvent to temperatures above the solvent flash point and could present a flammability hazard. With stirring, the temperature should cool below the flash point within 2–5 min.
- 32.3 Gently stir the solvent and mixture sample in the container until visually noticing the asphalt in the solution. Soak for approximately 10 min.
- 32.4 Center the filter support over the O-ring of the extractor base.
- 32.5 Dry the clean filter paper in an oven at a maximum temperature of 280°F (138°C).
- 32.6 Weigh and record the weight of the clean, dry filter paper to the nearest 0.1 g.
- 32.7 Place the filter paper on the filter support, replace the funnel ring, and tighten the wing nuts finger tight. Inspect the filter paper and filter support for improper alignment and tears.  
**Note 21**—Reduce clogging of the filter paper by using more than one filter or by placing a pair of No. 16 (1.18-mm) and No. 200 (75- $\mu$ m) sieves, nested together, onto the filter paper.
-

- 32.8 Place approximately 30 g of diatomaceous filtering aid, weighed to the nearest estimated 0.1 g, into a beaker and add about 500 mL of solvent.
- 32.8.1 Mixtures containing rubber or polymer additions may require up to 100 g to adequately assist with filtering.
- 32.8.2 The filtering aid should be dried and maintained in a moisture-free environment. It should consist of material passing the No. 200 (75- $\mu$ m) sieve only.  
**Note 22**—Sieve the filtering aid over the No. 200 (75- $\mu$ m) sieve and discard the coarser particles coarser than the No. 200 (75- $\mu$ m) sieve.
- 32.9 Record the weight of filtering aid used.
- 32.10 Vigorously stir the contents of the beaker and immediately pour the solution onto the filter paper. Rinse any filter aid remaining in the beaker onto the filter paper.
- 32.11 Start the vacuum pump and continue to run the pump until the pad formed by the filtering aid is surface dry. Eliminate use of the diatomaceous filtering aid when using filter paper that allows efficient extraction of dissolved asphalt without loss of very fine aggregate.  
**Note 23**—Some diatomaceous filter aid is very fine and washed through the filter paper. This material will be included in the determination of the percent passing of the No. 200 (75- $\mu$ m) sieve and the gradation may not meet specification. Perform blank tests to determine the amount of filter aid lost through the filter paper if the gradation does not meet the specification. Subtract this correction factor from the percent passing the No. 200 (75- $\mu$ m) sieve.
- 32.12 Gently stir the test sample in the container, decant the solvent from the container onto the filter paper in the vacuum extractor (or, if used, pair of nested sieves described in Note 21).
- 32.13 After gently stirring the test sample in the container or has undergone several minutes of ultrasonic cleaning, gently decant the solvent from the container or insert tray into the vacuum extractor. Decant the solvent onto a trowel placed on the filter paper to avoid undue disturbance of the filtering aid pad. Use a trowel to prevent aggregate from falling from the bowl during the decanting process.
- 32.14 Again cover the sample in the container tray with solvent and gently stir.
- 32.15 Continue the vacuum until all the solution has disappeared from the filter paper. If the time to filter out the solvent is considerable or a hard crust appears, gently pull a comb across the filter paper while the pump is running, to break the crust, being careful not to tear the filter paper. Add clean solvent to help rinse the excess asphalt through the filter paper.
- 32.16 Turn the pump off and add approximately 300 mL of clean solvent into the vacuum extractor when the time to filter out the solvent is considerable and after gently combing across the filter paper.
- 32.17 Gently stir the solution with the comb for several minutes.

- 32.18 Turn the pump on and decant the solvent into the extractor.
- 32.19 Repeat Sections 32.12–32.18 until the solvent returns to its original color and the aggregate is visually clean.
- 32.20 Add 300 mL of warm water (preferably above 110°F [43°C]) to the mixture in the bowl and stir with a trowel or spoon.
- 32.21 After stirring 1 or 2 min., start the vacuum pump and decant this solvent rinse material mixture into the vacuum extractor until there is no standing liquid on the filter paper's surface.
- 32.22 Repeat Sections 32.20 and 32.21 until the rinse water is clear.
- 32.23 After the rinse, pour the entire sample into the extractor. Use a wash bottle filled with water to rinse all particles from the bowl into the extractor and rinse the inside of the funnel ring to wash down all clinging particles.
- 32.24 Using a spatula, distribute the aggregate evenly over the surface of the filter cake.
- 32.25 Continue operating the vacuum pump for at least 5 min. and remove most of the rinse fluid from the aggregate.
- 32.26 Weigh the drying pan to the nearest 0.1 g.
- 32.27 Remove the funnel ring and brush any clinging aggregate into the drying pan.
- 32.28 Pick up the filter paper and aggregate on the filter support plate, and transfer the aggregate into the drying pan.
- 32.29 Using a spatula, remove most of the clinging aggregate and filter aid from the filter paper into the drying pan, and fold the filter paper in the pan to aid in drying it.
- 32.30 Place the pan containing the extracted aggregates in a vented oven and dry to constant weight at a maximum temperature of 280°F (138°C).
- 32.30.1 Stagger placement of samples into the oven by at least 1 hr. when extracting multiple samples.
- 32.30.2 Place the most recently extracted sample closest to the exhaust vent. Do not block the exhaust vent with a sample pan.
- 32.31 Weigh the extracted aggregate and filter paper individually to the nearest 0.1 g.

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**33. RETENTION FACTOR**

- 33.1 Calculate retention factor in accordance with Section 8.

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## 34. CALCULATIONS

- 34.1 Calculate the percent asphalt in the mixture in accordance with Section 43. Report asphalt content to the nearest tenth.

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## PART V—AUTOMATIC BINDER EXTRACTION METHOD

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*SPECIAL NOTICE: The solvents used in these procedures are flammable and/or combustible. Follow the safety precautions herein.*

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## 35. APPARATUS

- 35.1 *Automated binder extractor*, complete with washing drum, insulated washing chamber, sealing cap for washing chamber, centrifuge filler cup, insulated centrifuge chamber, internal vacuum extraction device, stabilize solvent and case for alkalinity test of extraction solvent.
- 35.2 *Ventilation*, as required by current specifications for asphalt mix control laboratories. Specific requirements contained herein for the arrangement and capacity of the ventilation system may be waived or varied, if tests show that the alternate system lowers solvent vapors to safe levels throughout the testing process.
- 35.3 *Filter paper*, size 381 x 206 mm (15 x 8 1/8 in.).
- 35.4 *Forced draft oven*, vented to the outside and capable of attaining a temperature of at least 200°F (93°C).
- 35.5 *Balance*, Class G2 in accordance with Tex-901-K, with a minimum capacity of 4000 g.
- 35.6 *Large flat drying pan*.
- 35.7 *Small scoop or spoon, spatula, trowel, and small brush*.
- 35.8 *Round-bottom glass flask*.
- 35.9 *Wooden counter brush*.

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## 36. MATERIALS

- 36.1 *Extraction solvent*, meeting the requirements of the Department's specification for chlorinated bituminous mixtures extraction solvent. See manufacturer's recommendations for machine compatible extraction solvent, since different trichloroethylene grade may be required for different machines.
- 36.2 *Basylion grease*, to apply outside the bottom part of centrifuge cup before each use.

**37. SAFETY CONSIDERATIONS**

37.1 Follow the safety considerations detailed in Section 41 to perform this procedure safely.

**38. PREPARING SAMPLE**

38.1 Prepare the sample as described in Section 6.

**39. PROCEDURE**

39.1 Verify that the filler cup is clean. Assure that there are no residuals on the bottom or under the rim of the cup.

39.2 Line with filter paper the inside lateral surface of the centrifuge cup.

39.3 Record the weight of the empty cup containing the filter paper to the nearest 0.1 g.

39.4 Grease the bottom rim of the centrifuge cup and place it into the centrifuge chamber.

39.5 Close the centrifuge chamber and manually lock it if necessary.

39.6 Verify that the washing drum and the lid are clean. Assure that there are no residuals on the bottom, under the rim, or inside the lateral mesh. Use an air pressure hose to clean if necessary.

39.7 Record the weight of the empty washing drum with a secured lid to the nearest 0.1 g.

39.8 Place between 1200-1800 g of sample material into the washing drum and close lid.

**Note 24**—It is suggested that the sample material is below 176°F (80°C) when placing it into the washing drum.

39.9 Weigh the washing drum filled with the sample and the secured lid. Record the weight to the nearest 0.1 g.

39.10 Place the drum into the washing chamber. Close the door and manually lock it if necessary.

39.11 Set the proper number of washing and drying cycles in accordance with the material characteristics and start the extraction process. Table 2 provides the suggested extraction settings.

**Table 2— Suggested Number of Washing and Drying Cycles**

Sample Type	Sample Size, g	Wash Cycles	Dry Cycles
Recycled Asphalt Shingles (RAS)	250	9	6
Recycled Asphalt	1200-1800	10	6

Pavement (RAP)			
Virgin HMA	1500-3000	8	6
25% Asphalt Binder Replacement HMA	1500-2500	10	6
50% Asphalt Binder Replacement HMA	1500-2200	12	6

**Note 25**—The number of washing and drying cycles are a guide that can be followed, but less or more cycles can be used based on experience. The flowing extraction solvent can be observed through the sight glass located on top of the centrifuge chamber. If solvent color is not clear by the end of the last washing cycle, add additional cycles until solvent color is clear.

**Note 26**—PFC or mixes containing fibers could clog the mesh observed through the sight glass. If the machine clogs while operating, the machine should be paused and the fibers have to be removed to continue the procedure.

- 39.12 After the extraction is complete, open washing chamber and remove washing drum. The usage of gloves is encouraged since drum is hot after washing procedure.
- 39.13 Record the weight of washing drum to the nearest 0.1 g.
- 39.14 Remove centrifuge filler cup. The usage of gloves is encouraged since the centrifuge filler cup is hot after washing procedure.
- 39.15 Record the weight of centrifuge filler cup to the nearest 0.1 g.

## 40. CALCULATIONS

- 40.1 Calculate the percent asphalt in the mixture in accordance with Section 43.6. Report asphalt content to the nearest tenth.

## 41. SAFETY CONSIDERATIONS

- 41.1 *Chlorinated Solvents:*
  - 41.1.1 Refer to the Safety Data Sheet for trichlorethylene and methylene chloride.
- 41.2 *Non-Chlorinated Solvents:*
  - 41.2.1 Do not exceed bulk storage inside the laboratory of 19 L (5 gal.) fresh solvent, plus up to 19 L (5 gal.) of used solvent.
  - 41.2.2 Keep stored solvent in closed containers and away from any oven or other heating device.
  - 41.2.3 The storage location must drain away from any known source of ignition.
  - 41.2.4 Have available means to clean solvent spills.

- 41.2.5 Equip any room where solvents are stored and used with a portable fire extinguisher for burning liquids.
- 41.2.6 Use a vent fan with at least a 30 m<sup>3</sup>/min. (1,000 CFM) rating, which adequately removes fumes. The 1,000 CFM rating is the minimum rating and may not be adequate for all laboratories. If needed, use a higher capacity fan to adequately remove all fumes. Pour all solvents even with or below the height of the fan outlet. It is preferable to locate the fans beneath a workbench constructed of expanded metal top and enclosed front and sides. Pull the exhaust through the front opening of the workbench by installing a sliding panel. This design accommodates both centrifuge and vacuum extraction equipment while providing for exhausting fumes from floor spills. The fan must have an explosion proof (sealed) motor or do not draw the solvent vapors where the motor is located. Wire the vent fan and extraction equipment to a single switch so the vent fan will always operate during extraction. Include a means for cutting power to the extraction equipment while the ventilation fan is operating.
- 41.2.7 Do not place ordinary electrical equipment, including switches, in the immediate hazardous area. Keep this room in negative pressure with respect to the rest of the room by a vent fan. The immediate hazardous area is the space both above and below the centrifuge extractor and the airflow space between the centrifuge and the outside exhaust.
- 41.2.8 Do not permit sources of open flame (pilot lights, smoking, Bunsen burners, etc.) in the room where solvents are stored or handled.

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**42. NOTES**

- 42.1 Exercise caution during the initial addition of solvent to the hot extraction sample since the mix will shortly heat the solvent to temperatures above the solvent flash point and could present a flammability hazard. With stirring, the temperature should cool below the flash point within 2–5 min.
- 42.2 If the sample is dry when extracted, moisture and hydrocarbon volatiles equal zero.
- 42.3 Remove solvent from the vacuum tank at least once per day so that solvent attack on the tank is limited.
- 42.4 Correction for ash contained in the solvent is generally unnecessary with the vacuum extraction method.
- 42.5 When decanting liquids from the container, pour off as much liquid as possible first, then rap the container with a spoon or trowel to settle the contents. More liquid may then be decanted.
- 42.6 Add the weight of fine material retained in the filter ring and the weight of ash in the total centrifuged liquid to the weight of material passing the No. 200 (75- $\mu$ m) sieve for use in calculating the sieve analysis.

*For Automatic Binder Extraction Method:*

- 42.7 Carefully clean out washing drum after each extraction with brush. Avoid using excessive force while cleaning drum since it may damage inner mesh.
- 42.8 Use brush to sweep out fines from washing chamber after extractions.
- 42.9 Use compressed air to clean out RAS fibers residuals from washing drum mesh.
- 42.10 Empty the binder/solvent chamber after every 4 to 5 extractions to avoid overflow. If the binder will be recovered for further asphalt testing, empty the chamber after every test to ensure no cross contamination.
- 42.11 Run a clean cycle with an empty drum at the end of the day if multiple extractions are performed. Two washing and three drying cycles are recommended.
- 42.12 Sections 45.1 - 45.5 are encouraged to be performed on a daily basis
- 42.13 Follow procedure of inspection of extraction solvent quality as provided by manufacturer. This section is encouraged to be performed on a weekly basis if manufacturer does not specify it.
- 42.14 If machine is not in use, drain and flush binder/solvent chamber.

### 43. CALCULATIONS

- 43.1 Calculate the percent difference in weight:

$$\text{PercentDifference} = \left( \frac{\text{InitialWeight} - \text{FinalWeight}}{\text{InitialWeight}} \right) * 100$$

- 43.2 Calculate retention factor:

$$R_F = J_A - J_E$$

Where:

$R_F$  = retention factor

$J_A$  = percent residual bitumen added to each mix

$J_E$  = average percent residual bitumen determined from the test specimens.

- 43.3 *Part I—Centrifuge Extraction Method Using Chlorinated Solvent:*

- 43.3.1 Calculate the weight of fines retained in the filter paper:

$D = C - B$  Where:

$B$  = original weight of filter paper, g

$C$  = final weight of filter paper, g

$D$  = amount of fines retained on filter paper, g.

- 43.3.2 Calculate the weight of extracted aggregate:



$$G = E - F$$

Where:

$E$  = pan and extracted aggregate, g

$F$  = pan, g

$G$  = extracted aggregate, g.

43.3.3 Calculate the weight of ash per 100 mL:

$$H = I - J$$

Where:

$H$  = weight of ash per 100 mL, g

$I$  = weight of dish with ash, g

$J$  = weight of dish, g.

43.3.4 Calculate the total ash content:

$$K = \frac{H \times L}{100}$$

Where:

$K$  = total ash content, g

$L$  = total solvent used, mL.

43.3.5 Calculate the total weight of extracted fines, aggregate, and ash:

$$M = D + G + K$$

Where:

$M$  = weight of fines, aggregate, and ash, g.

43.3.6 Calculate the total weight loss:

$$N = A - M$$

Where:

$A$  = weight of total sample, g

$N$  = total loss, g.

43.3.7 Calculate the total percent loss:

$$P = \frac{N}{A} \times 100$$

Where:

$P$  = total loss, %.

43.3.8 Calculate the percent asphalt content:

$$R = P - S - Q + T$$

Where:

$Q$  = hydrocarbon volatiles, %

$R$  = asphalt content, %

$S$  = moisture content, %

$T$  = ash factor, %.

43.3.9 Calculate the percentage of dry aggregate:

$$U = \left[ \frac{I}{A} \times 100 \right] - T$$

Where:

$U$  = dry aggregate, %.

43.3.10 Calculate the total weight percentage of the mixture:

$$V = S + Q + R + U$$

Where:

$V$  = total, %.

43.4 *Part II—Vacuum Extraction Method and Part IV—Vacuum Extraction Method Using Non-Chlorinated Solvent:*

43.4.1 Calculate the weight of fines retained in the filter paper:

$$D = C - B$$

Where:

$B$  = original weight of filter paper, g

$C$  = final weight of filter paper, g

$D$  = amount of fines retained on filter paper, g.

43.4.2 Calculate the weight of extracted aggregate:

$$G = E - F$$

Where:

$E$  = pan and extracted aggregate, g

$F$  = pan, g

$G$  = extracted aggregate, g.

43.4.3 Calculate the total weight of extracted aggregate and fines:

$$I = D + G - H$$

Where:

$H$  = weight of filtering aid, g

$I$  = weight of fines and aggregate, g.

43.4.4 Calculate the total weight loss:

$$M = A - I$$

Where:

$A$  = weight of total sample, g

$M$  = total loss, g.

43.4.5 Calculate the total percent loss:

$$J = \frac{M}{A} \times 100$$

Where:

$J$  = total loss, %.

43.4.6 Calculate the percent asphalt content:

$$L = J - N - K$$

Where:

$K$  = hydrocarbon volatiles, %

$L$  = asphalt content, %

$N$  = moisture content, %.

43.4.7 Calculate the percentage of dry aggregate:

$$O = \frac{I}{A} \times 100$$

Where:

$O$  = dry aggregate, %.

43.4.8 Calculate the total weight percentage of the mixture:

$$P = N + K + L + O$$

Where:

$P$  = total, %.

43.5 *Part III—Centrifuge Extraction Method Using Non-Chlorinated Solvent:*

43.5.1 Calculate the weight of fines retained in the filter paper:

$$D = C - B$$

Where:

$B$  = original weight of filter paper, g

$C$  = final weight of filter paper, g

$D$  = amount of fines retained on filter paper, g.

43.5.2 Calculate the weight of extracted aggregate:

$$G = E - F$$

Where:

$E$  = pan and extracted aggregate, g

$F$  = pan, g

$G$  = extracted aggregate, g.

43.5.3 Calculate the weight of Buchner fines per 200 mL:

$$H = I - J$$

Where:

$H$  = weight of Buchner fines per 200 mL, g

$I$  = weight of Buchner, filter, and Buchner fines, g

$J$  = weight of Buchner and filter, g.

43.5.4 Calculate the total Buchner fines content:

$$K = \frac{H \times L}{200}$$

Where:

$K$  = total Buchner fines content, g

$L$  = total solvent used, mL.

43.5.5 Calculate the total weight of extracted fines, aggregate, and Buchner fines:

$$M = D + G + K$$

Where:

$M$  = fines, aggregate, and Buchner fines, g.

43.5.6 Calculate the total weight loss:

$$N = A - M$$

Where:

$A$  = weight of total sample, g

$N$  = total loss, g.

43.5.7 Calculate the total percent loss:

$$P = \frac{N}{A} \times 100$$

Where:

$P$  = total loss, %.

43.5.8 Calculate the percent asphalt content:

$$R = P - S - Q + T$$

Where:

$Q$  = hydrocarbon volatiles, %

$R$  = asphalt content, %

$S$  = moisture content, %

$T$  = ash factor, %.

43.5.9 Calculate the percentage of dry aggregate:

$$U = \left[ \frac{I}{A} \times 100 \right] - T$$

Where:

$U$  = dry aggregate, %.

43.5.10 Calculate the total weight percentage of the mixture:

$$V = S + Q + R + U$$

Where:

$V$  = total, %.

43.6 *Part III—Automatic Binder Extraction Method:*

43.6.1 Calculate the weight of aggregate:

$$\text{Weight of Aggregate} = (D + E) - (B + C)$$

Where:

*B* = weight of washing drum with sample

*C* = weight of empty centrifuge cup

*D* = weight of washing drum with washed aggregate

*E* = weight of centrifuge cup with fines

43.6.2 Calculate binder content (%):

$$\text{Binder Content \%} = \frac{(A - E)}{A} \times 100$$

Where:

*A* = empty washing drum weight

*E* = weight of centrifuge cup with fines

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## 44. ARCHIVED VERSIONS

44.1 Archived versions are available