TURNER-FAIRBANK HIGHWAY RESEARCH CENTER

Asphalt Binder and Mixture Laboratory (ABML) Look-In

August 2022 – Issue 2
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Assessment of Automated Extraction Technology

The Federal Highway Administration ABML–Implementation and Delivery (ABML-ID) evaluated the automated extraction procedure and its effect on performance grading. This document is a supplement to a previously released highlight document (FHWA-HRT-20-057).[1]

The objective of this study was to compare the high temperature (HT), intermediate temperature (IT), and low temperature (LT) performance grade (PG) property changes of asphalt binders extracted from traditional extraction (TE) methods (American Association of State Highway and Transportation Officials (AASHTO) T-164, Method A[2]) and an automated extraction (AE) device (ASTM D8159[3]). The study included the following materials: a PG 64-22 binder in 0 percent and 40 percent reclaimed asphalt pavement (RAP) mixtures and a RAP binder.

On extraction of the asphalt binder, the ABML's specialized recovery method was used before physical properties were assessed.

Specialized Recovery Method

Figure 1 shows the recovery equipment setup. Figure 2 describes the steps to recover asphalt binder from extracted asphalt solution.

Source: FHWA.

Figure 1. Recovery equipment setup.

Asphalt Binder Recovery Steps

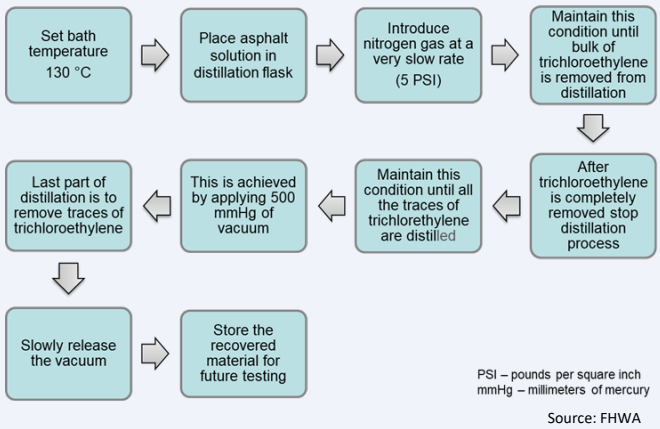

Figure 2. Asphalt binder recovery steps.

Asphalt Binder Analysis

Extractions were conducted on asphalt binder from a PG 64-22 in 0 percent and 40 percent RAP, and a RAP binder asphalt mixture using automated extraction and traditional extraction for evaluation. Testing was conducted on recovered asphalt binder to determine the properties at HT, IT, and LT. Error bars in the plots correspond to differences plus or minus one standard deviation from the mean. The following plots show binder complex shear modulus (G*) and binder phase angle (δ), creep stiffness (S), and the creep slope from the bending beam rheometer.

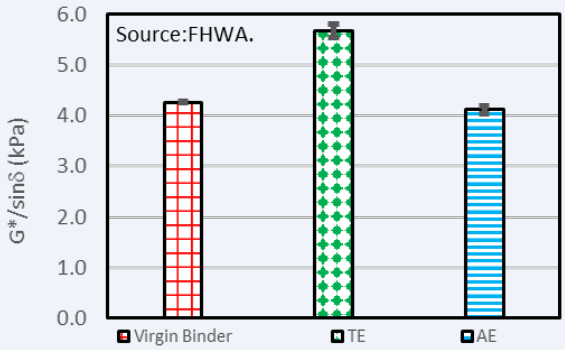

Figure 3. HT stiffness comparison.

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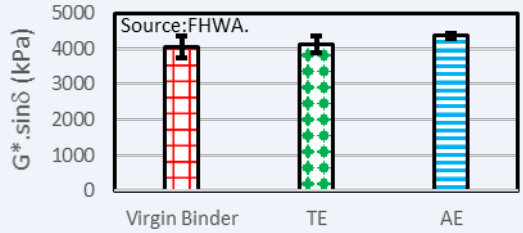

Figure 4. IT stiffness comparison.

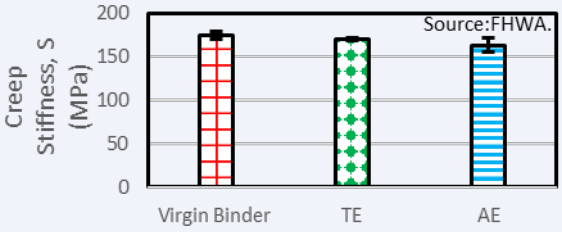

Figure 5. LT stiffness comparison.

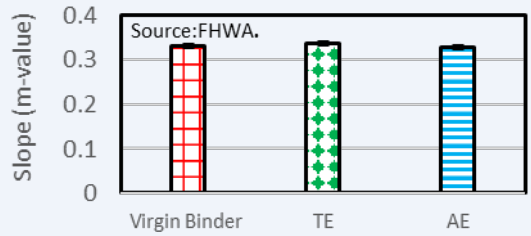

Figure 6. LT slope(m) comparison.

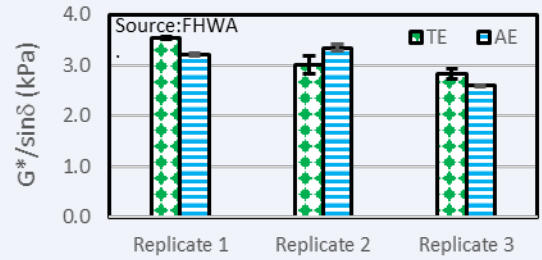

Figure 7. Virgin and 40 percent RAP Comparison.

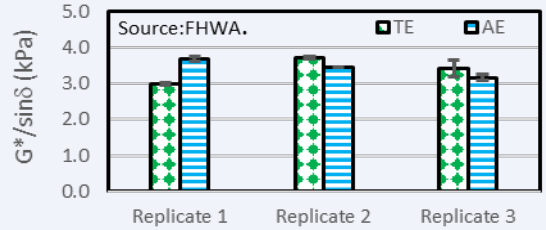

Figure 8. Comparison of 100 percent RAP.

Gradation Analysis

Table 1 shows the summary of gradations and asphalt content (AC) by weight of mixture of TE and AE compared to the job mix formula (JMF). These volumetric properties are often obtained by practitioners after extraction.

Table 1. Summary of gradations and AC content.

Size (mm)	JMF (percent)	TE-1 (percent)	TE-2 (percent)	AE-1 (percent)	AE-2 (percent)
12.5	100.0	100.0	100.0	100.0	100.0
9.5	85.8	85.1	85.4	85.8	86.3
4.75	47.4	44.8	45.5	47.5	47.8
2.36	27.4	23.6	24.2	27.8	28.1
1.18	20.3	16.0	16.0	20.6	20.9
0.6	15.7	11.4	11.5	16.1	16.4
0.3	11.1	6.9	7.0	11.8	12.1
0.15	7.5	3.3	3.4	8.5	8.7
0.075	5.0	0.6	0.7	6.1	6.3
AC	**5.1**	**5.0**	**5.0**	**5.0**	**5.0**

Observations

The following observations were made:

- Physical properties of extracted binder from AE were statistically similar to the unextracted control virgin binder.
- AC percent was found to be similar after AE, compared to JMF.
- Aggregate gradations were different at finer sizes after TE, compared to JMF. All fines passing the 0.075 mm sieve could not be recovered from the TE, and future users should exercise caution.

[1]Federal Highway Administration. 2020. *Asphalt Binder and Mixture Laboratory (ABML) Look-In*. Report No. FHWA-HRT-22-057. Washington, DC: Federal Highway Administration. https://www.fhwa.dot.gov/publications/research/infrastructure/pavements/20057/index.cfm, last accessed June 15, 2022. [2]AASHTO. 2014. *Standard Method of Test for Quantitative Extraction of Asphalt Binder from Hot Mix Asphalt (HMA).* T 164. Washington, DC: American Association of State Highway and Transportation Officials. https://global.ihs.com/doc_detail.cfm?document_name=AASHTO%20T%20164&item_s_key=00489046, last accessed June 15, 2022. [3]ASTM D8159. 2021. *Road and Paving Materials; Vehicle-Pavement Systems.* Vol 04.03. West Conshohocken, PA: ASTM International. https://www.mystandards.biz/publication/astm-volume-0403-road-and-paving-materials-vehicle-pavement-systems-1.6.2021.html, last accessed June 15, 2022.

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