Asphalt Binder and Mixture Laboratory Look-In

Office of Infrastructure Research and Development

FACT SHEET

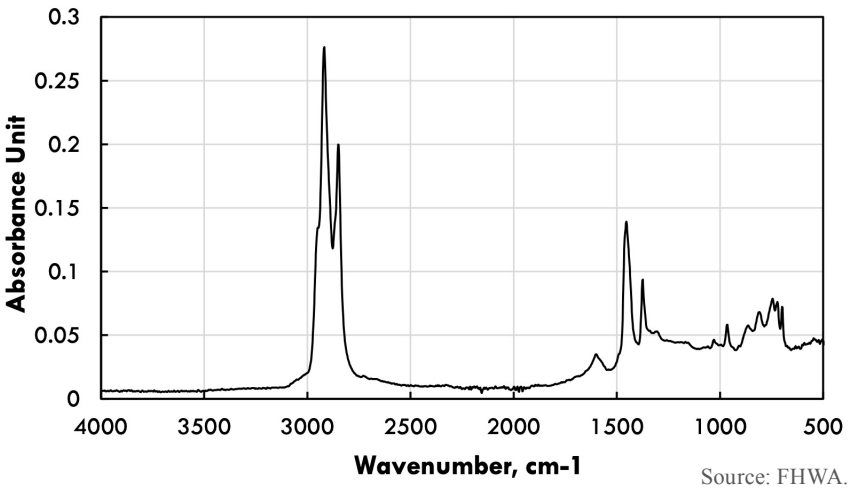
QUALITATIVE SPECTRAL ANALYSIS OF ASPHALT BINDERS

Background

Asphalt binders undergo changes due to varying crude sources, refining techniques, and the use of modifiers, all of which pose concerns about the consistency of the asphalt binder supplied to end users. The concerns are especially relevant because the current Superpave asphalt binder specification is inadequate for capturing the presence of certain additives. (See references 1, 2, 3, 4.) To address the issue, the Federal Highway Administration's Asphalt Binder and Mixture Laboratory conducted an evaluation of Fourier transform infrared (FTIR) spectra collected by the New Hampshire Department of Transportation (NHDOT) from various neat and modified binders obtained from different suppliers and plant locations for 2 yr.[5] The FTIR data represented 5 performance-grade asphalt binders (PG 58-28, PG 58-34, PG 64-28, PG 70-34, and PG 76-28) from 5 different suppliers sampled at 17 plant locations.[2] The primary objective of the study was to provide a qualitative analysis of asphalt binders that can determine consistency in binder supply, assess aging potential based on spectral changes with conditioning, and identify any potential modification of the binder.

Why Spectroscopy?

Spectroscopy is one of the most common techniques used by asphalt technologists for chemical analysis. Simply, it is the absorption measurement at different infrared frequencies. The main application of infrared spectroscopic analysis is for identification of specific chemical functional groups in asphalt binders. A typical asphalt binder spectrum is shown in figure 1.



Source: FHWA.

Figure 1. FTIR spectrum of unaged asphalt binder.

FTIR Peaks of Interest or Asphalt Engineers

- Interested in aging affects? Look for a sulfoxide peak of about 1,000 cm^{-1} and a carbonyl peak at 1,700 cm^{-1}.
- Does your specified binder have polymer additive? Look for polystyrene peaks at 695 cm^{-1} and butadiene peaks at 960 cm^{-1} to indicate the presence of polymers in asphalt binders.
- Want to know whether your asphalt binders have lime or calcium carbonate blends? Look for the presence of calcium hydroxide at 3,640 cm^{-1} and calcium carbonate at 1,390 cm^{-1}.
- Does your asphalt binder have phosphoric acid? Look for broader peaks from 800 to 1,000 cm^{-1}, which indicate the presence of phosphoric acid.

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Finding and Observations

- FTIR spectroscopy was found to be a useful tool in the verification of the consistency of asphalt binders, as demonstrated by the similarity and consistency of FTIR data from NHDOT asphalt binders obtained from different suppliers and sampled at multiple locations.
- FTIR spectroscopy provides insights into the aging effects of laboratory short- and long-term aged asphalt binders.
- FTIR spectroscopy verifies the presence of styrene-butadiene-styrene and other types of polymers in asphalt binders.
- FTIR spectroscopy identifies the presence of chemical impurities in asphalt binders.

Takeaways

- Collect FTIR fingerprints of well-characterized binders and compare them with the supplied binders to ensure consistency.
- Conduct a complete asphalt binder characterization if a specific supplied asphalt binder raises suspicion.
- The introduction of a new test is not the purpose of this evaluation. Instead, if agencies, paving contractors, or paving mixture producers are already collecting FTIR data on their projects, spectral analysis can serve as a useful tool for the assessment of chemical composition, for the identification of inconsistencies, for aging potential, for making modifications, for discovering impurities, and for examining additives that other physical tests may not capture.

References

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