

The **WRITE** *toolkit*

For Asphalt & Heavy Oil Insight

Micro Field Sampling and Extraction
+
Universal Simple Aging Test (USAT)
+
4mm Dia. Dynamic Shear Rheology
=
Fast, Easy Testing of Crack Sealants,
Emulsions, Hot, Cold & Warm Mix

SpectRelate™ Software makes data
understandable, usable, economical

The Asphaltene Determinator +
SARA Separation (SAR-AD™) reveals
the "DNA" of Asphalt and Heavy Oil

Insight = Savings

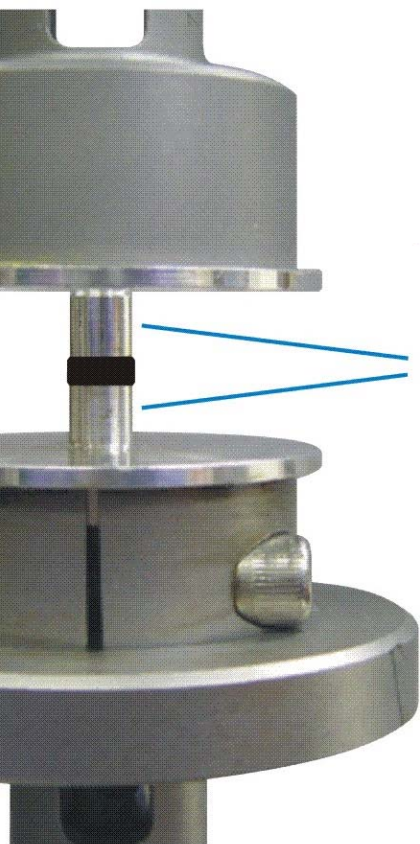
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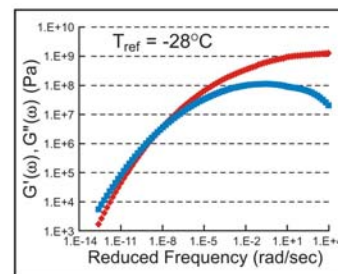
New from WRI

Western Research Institute (WRI), one of the world's foremost asphalt and heavy oil laboratories, brings you new tools for gaining unprecedented insight into materials (asphalt and heavy oils, additives, aggregate) for highway construction, refinery operations, blending, forensics, and new technology applications. WRI Fundamental Properties and Asphalt Research Consortium (ARC) teams have presented more than 70 new tools to FHWA Expert Task Groups (ETGs), the first step toward adoption as AASHTO standards. These tools include test methods, performance and material models, practices, analytical programs, and software for understanding and designing pavements, pavement materials, and additives, and predicting performance in the field. To experience the latest asphalt and heavy oil research first-hand, plan to attend WRI's Petersen Asphalt Research Conference.

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4mm Diameter Plate
Dynamic Shear
Rheology (DSR) and
new methods for
faster, easier asphalt
testing, specification,
and selection



Rheology

Low and Intermediate Temperature

- Asphalt
- Modified Binder
- Emulsion Residue
- Crack Sealant



Specifications

Asphalt

- AASHTO T 313
- AASHTO R 49-09
- Emulsion Residue
- Crack Sealant



Universal Simple Aging Test

Short and Long-Term

- Asphalt
- Modified Binder
- Warm Mix
- Emulsion Residue



Field Sampling

- Hammer Drill
- Rapid Sampling
- Easy Extraction

1 Small-Sample Dynamic Shear Rheometry (4mm DSR)

Before WRI developed 4mm dynamic shear rheology (DSR), rheometer compliance errors made it impossible to collect reliable data at low temperatures that could be used for specification testing. The 4mm DSR is now changing many of the tests and specifications used for asphaltic materials.

WRI took the methodology for instrument compliance correction in DSR measurements and applied it to asphalt low-temperature property measurements using small parallel plate geometry. DSR tests can now be conducted at low temperatures with approximately 25 mg of sample per test, about 500 times less than needed for bending beam rheology (BBR) testing.

This reduction in the sample size opens the way for new applications that were previously too expensive, time consuming, impractical, or impossible. These applications include low-temperature testing of asphalt emulsion residues and crack sealants, fast testing of pavement condition, asphalt blending studies, asphalt model validation, and pavement forensic studies.

The 4mm plate DSR method provides a potential low-temperature specification test for emulsion residues, crack sealants, and other “soft” or thermally sensitive materials. Of interest to producers, contractors, DOTs, and suppliers seeking to characterize the performance of these materials, the 4mm plate DSR method provides direct measurement of mechanical properties at or near the specification temperature, and full temperature range master curves can be created with no complex conversion from creep to relaxation. In comparison to bending beam rheometry (BBR) and 8mm DSR data for asphalt emulsion residues, the 4mm plate DSR shows great promise.

The AASHTO specification for DSR (T315) has been red-lined to include 4mm DSR and is under review by the Binder Expert Task Group. An ASTM version is also under development.

New products made possible by 4mm DSR include micro field sampling and extraction and an emulsion residue specification method (USAT). The 4mm DSR is being used in many laboratories, and rheology instrument manufacturers Malvern, Anton Paar, and TA Instruments now offer 4mm platens and software for their instruments.

All this is good for asphalt producers, state DOTs, research laboratories, modifier suppliers, and polymer and additive manufacturers.



4mm Dynamic Shear Rheology makes low-temperature testing possible.

2 Micro Field Sampling and Micro Extraction

This simple, small-scale method uses a hammer drill to collect pavement field samples for laboratory extraction and analysis. With 4mm DSR, small amounts of asphalt binder are sufficient to evaluate low-, intermediate- and high-temperature rheology. Large-scale coring and extraction are eliminated, and the micro-extraction process dramatically reduces the amount of solvent required to extract the asphalt, significantly reducing laboratory workers' exposure to solvent fumes. State DOTs, contractors, and researchers can use samples from Micro Field Sampling and Extraction to perform pavement aging studies, forensics, and analyses to optimize milling depths.



← **Micro Field Sampling vs. resource-intensive coring.** →



3 Universal Simple Aging Test (USAT)

WRI has developed thin film (300 μm) aging as an alternative to standard Rolling Thin Film Oven (RTFO) and Pressure Aging Vessel (PAV) tests. The technique, known as the Universal Simple Aging Test (USAT), was presented at the 5th Eurasphalt and Eurobitume Congress in Istanbul in June 2012 and was the subject of the top award winning poster at TRB in 2013.*

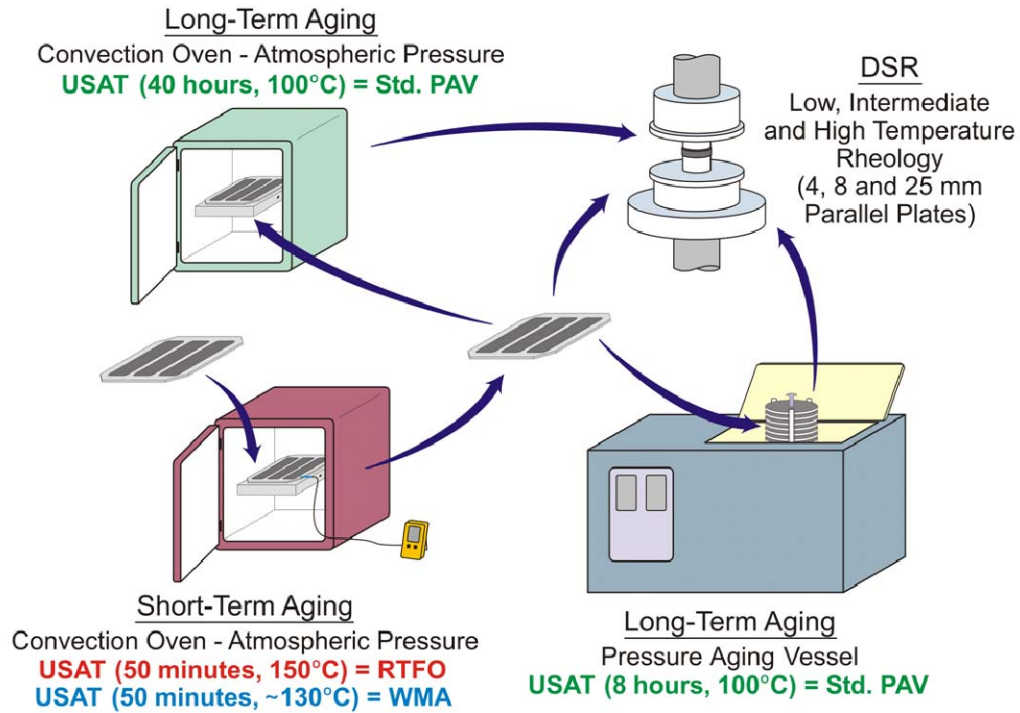
The USAT provides a valuable small-sample approach to characterizing asphalts, polymer-modified asphalts, emulsion residue, and recovered recycled asphalt. It can be used to simulate the aging that occurs during hot-mix and warm-mix production.

The USAT performs short-term aging in 50 minutes, which is 35 minutes less than required for RTFO. Even more significant, USAT long-term aging with the PAV takes 12 hours less than the standard PAV test (8 hours vs. 20 hours for standard PAV). By combining the USAT with 4mm diameter parallel plate dynamic shear rheometry (DSR), low-temperature rheology and specification parameters such as m-value and creep stiffness can be determined. Each USAT plate produces 3g of aged bitumen.

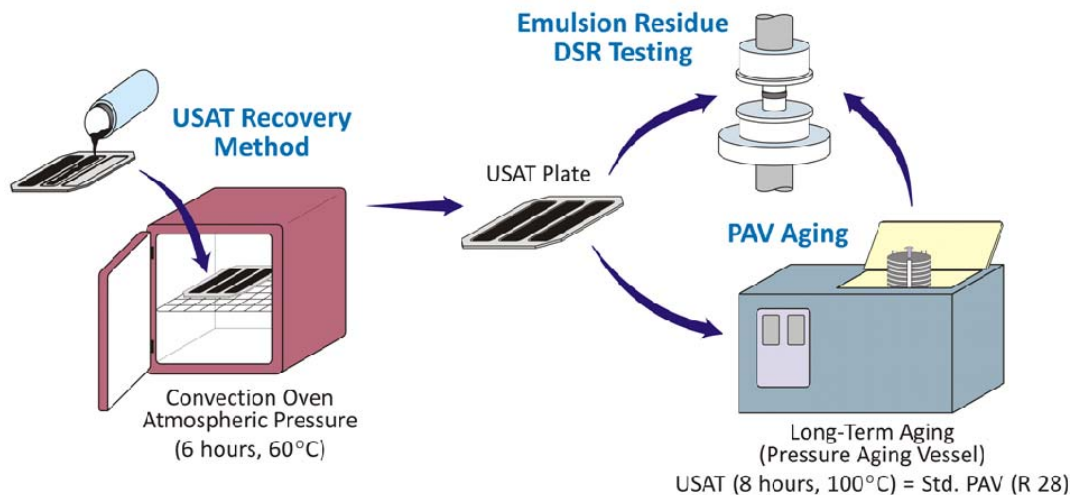


* Farrar, M.J., S.L. Salmans, J.P. Planche, "Recovery and Laboratory Testing of Asphalt Emulsion Residue: Application of Simple Aging Test and 4mm Dynamic Shear Rheometry."

USAT Aging and 4mm Rheology Testing for HMA and WMA



USAT Emulsion Residue Recovery, Aging and 4mm Rheology Testing



Advantages of the USAT Recovery Method Over AASHTO PP 72-11 Method B

- No silicone mat, no wet film applicator
- More uniform residue surface and thickness (300 μm)
- USAT plate can be placed directly in the PAV
- PAV time is reduced from 20 to 8 hours

Farrar, M.J., R.W. Grimes, C. Sui, J.P. Planche, S.C. Huang, T. F. Turner, R. Glaser, *Thin Film Oxidative Aging and Low Temperature Performance Grading Using Small Plate Dynamic Shear Rheometry: An Alternative to Standard RTFO, PAV, and BBR*, presented at the Eurasphalt & Eurobitume Congress, Istanbul, Turkey, June 13-15 2012.

4 SpectRelate[®] Correlation Program

Bridges the gap from data to decision

WRI's patent-pending SpectRelate[®] software program lets you view correlations between any combination of spectra and chemical and physical measurements. It helps "decode" spectra and reveal the meaning of data. The complete master curves it provides from infrared spectra can be used to characterize asphalt rheology, inexpensively monitor rheological changes in asphalt pavement, and determine surface treatment schedules and milling depths.

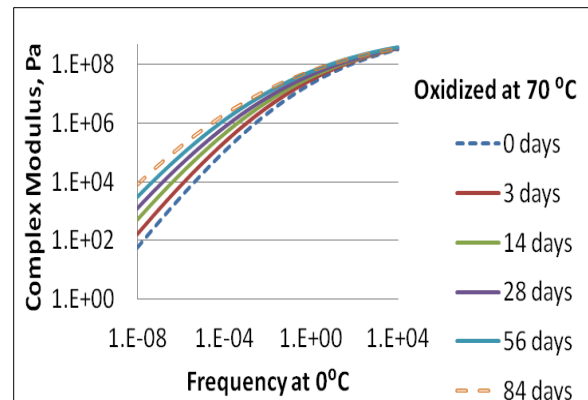
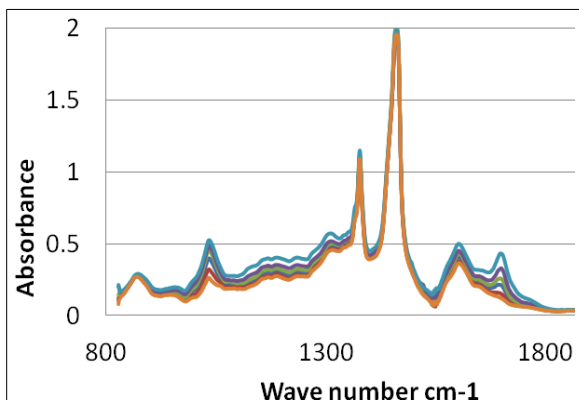
Makes data understandable, transportable, economical

Unlike some chemometric regression methods (e.g. Partial Least Squares, Artificial Intelligence, and Neural Networks), SpectRelate[®] clearly shows the data. Correlations are presented as measured variables in closed-form equations (no mysterious latent variables), and the regression equation can be transported outside the program. To support statistical validity, independent variables and the numbers of observations are clearly shown. (Complete ANOVA tables are provided.)

Chemical data, economical to acquire, can now replace heavier, more expensive physical data in asphalt materials development stages and later in performance assessment.

Insight made easy

SpectRelate[®] uses Microsoft Excel[®] files for input and output and provides clear, easy-to-read graphics for fit analyses. It steps you through the process and prevents overfits. SpectRelate[®] can be used in any discipline where spectral or chromatographic data are generated and relationships between multiple influences are sought. For example, it is as applicable to biochemistry as it is to correlating heavy oil composition and properties or asphalt composition and performance.



SpectRelate[®] provides a shear modulus master curve of asphalt oxidation (right) from inexpensive infrared measurements.

For inquiries about SpectRelate[®] or to request a free trial, please contact WRI.SpectRelate@uwyo.edu.

5 Asphaltene Determinator™

This WRI patented system separates asphaltenes into solvent-defined fractions and provides a reliable measure of aging severity. Asphalt blenders and buyers can use the Asphaltene Determinator™ to identify thermally degraded asphalt bases and airblown asphalts. It can also be used in forensic studies to identify thermally treated asphalt bases.



Some of the world's largest oil companies use WRI's Asphaltene Determinator™ (AD) to avoid coking during petroleum refining.

6 Integrated Automated SARA Separation (SAR-AD™)

Manual separation sequences take days and require large quantities of sample and solvent. Using the Asphaltene Determinator™ (AD) and Automated SAR (saturates, aromatics, and resins) together provides access to asphalt binder "DNA" in less than four hours with mere milligrams of sample. This new method provides researchers, refiners, and asphalt and modifier producers a way to determine aging and provide better blending. The SAR-AD™ works for asphalts, heavy oils, and recycled asphalt pavement and shingles (RAP and RAS).

The Integrated SAR-AD™ provides a tool to achieve the following:

- Characterize and select asphalt binders and heavy oils to mitigate the effects of refining processes and crude oil source variations.
- Identify airblown asphalt.
- Correlate composition with mechanical properties to predict asphalt binder performance.
- Monitor asphalt aging and schedule surface treatments.
- Predict compatibility of recycled asphalt (RAP and RAS), polymer-modified asphalts, bio-binder modifiers, and warm- and cold-mix additives (foams and emulsions).
- Conduct forensic studies on failed pavements.

Join Us!

Petersen Asphalt Research Conference

The annual Petersen Asphalt Research Conference hosted by WRI brings together an international community of researchers, highway officials, producers and others working to advance the specification and performance of petroleum asphalts. For 50 years, research presented and discussed at the Petersen Asphalt Research Conference has led to safer, longer-lasting, and more cost-effective highways throughout the world.

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Laramie, Wyoming

July 14-16, 2014

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Laramie, Wyoming

July 13-15, 2015

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**with the ISAP Symposium
Jackson Hole, Wyoming**

July 19-21, 2016



The Petersen Conference is known for its friendliness as well as its top-notch technical content. Optional outdoor activities offer opportunities to enjoy the Rocky Mountains.



*Plan a visit
to Yellowstone
in 2016!*

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