

The **WRITE** *Toolkit*

For Asphalt & Petroleum Insight

Micro Field Sampling and
Extraction

+

Universal Simple Aging Test
(USAT)

+

4mm Dynamic Shear
Rheology

=

Fast, Easy Testing of Hot,
Cold and Warm Paving,
Roofing, Emulsion and
Sealant Binders

ExpliFit™ Software =
Understandable, Usable and
Economical Data

SAR-Asphaltene Determinator
(SAR-AD™) = "Fingerprint"
of Asphalt and Crude Oil

Automated Flocculation
Titrimeter = Compatibility
Prediction, Assessment of
Additive Efficiency

Insight = Savings

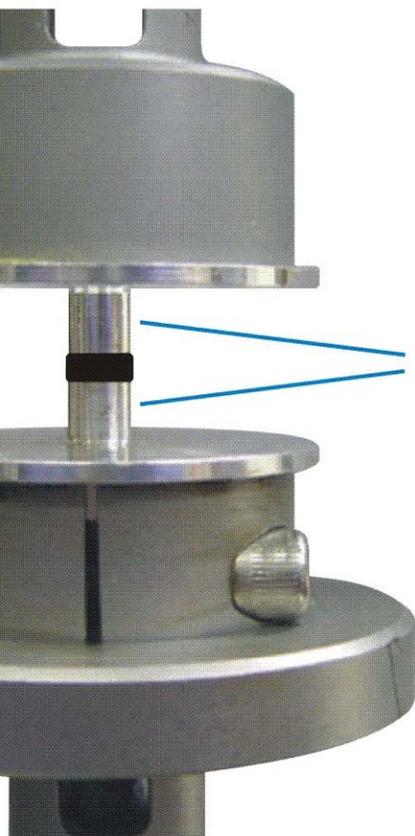
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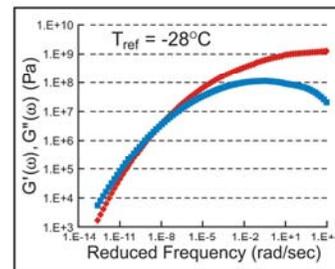
New from WRI

Western Research Institute (WRI), one of the world's foremost leaders in asphalt and petroleum research, brings new tools for unprecedented insight into materials (asphalts, crude oils, additives, mixes, etc.) for highway construction, refinery operations, blending, forensics, mitigation, process optimization and new technology applications. WRI led Fundamental Properties, Asphalt Research Consortium (ARC) and Heavy Oil Research Consortium teams have delivered more than 100 new tools to the asphalt and petroleum industries. These tools include analytical test methods, performance test methods, material models and correlations, laboratory best practices and software for understanding and designing pavement materials, binders, additives and predicting long term performance in the field.

To experience the latest in asphalt research first-hand, plan to attend WRI's Petersen Asphalt Research Conference.



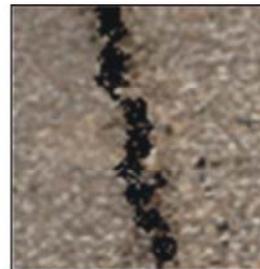
4mm Diameter Plate Dynamic Shear Rheology (DSR) and other new methods for faster, easier asphalt testing, specification, and selection



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 using standard plate geometries for specification testing. The 4mm DSR is now changing many of the tests and specifications used for asphalt materials.

WRI took the methodology for DSR instrument compliance correction 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, which is about 500 times less material than needed for traditional bending beam rheology (BBR) testing.



This reduced sample size has allowed to develop new applications that were previously too expensive, time consuming, impractical or impossible. These applications include low-temperature testing of asphalt emulsion residues, crack sealants, roofing asphalts, recycled aged binders, faster testing at pavement condition, asphalt blending studies, 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 in-use temperatures, and full temperature range master curves can be created without complex conversion from creep to relaxation. When compared to bending beam rheometry (BBR) and 8mm DSR test methods for asphalt emulsion residues, the 4mm plate DSR shows great promise.

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

New products made possible by 4mm DSR include micro field sampling, micro extraction, emulsion residue specification method, and micro aging (USAT). The 4mm DSR is being practiced in many laboratories, and offered by most DSR manufacturers. This is providing new quick and easy tools for suppliers, state DOTs, contractors and research entities.



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 the development of 4mm DSR, small amounts of asphalt binder are sufficient to evaluate low-, intermediate- and high-temperature rheology. Thus, large-scale coring and extraction methods are not necessary. The micro-extraction process dramatically reduces the amount of solvent required to extract the asphalt, significantly reducing cost and exposure to solvent fumes.



State DOTs, contractors, and researchers can benefit from Micro Field Sampling and Extraction to perform pavement aging studies, forensics, and analyses.

← **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). The new technique, known as the Universal Simple Aging Test (USAT), was presented at the 5th EE Congress in Istanbul in 2012 and was the top award winning poster at TRB in 2013.* It is now available as a FHWA TECHBRIEF - Publication No.: FHWA-HRT-15-054.

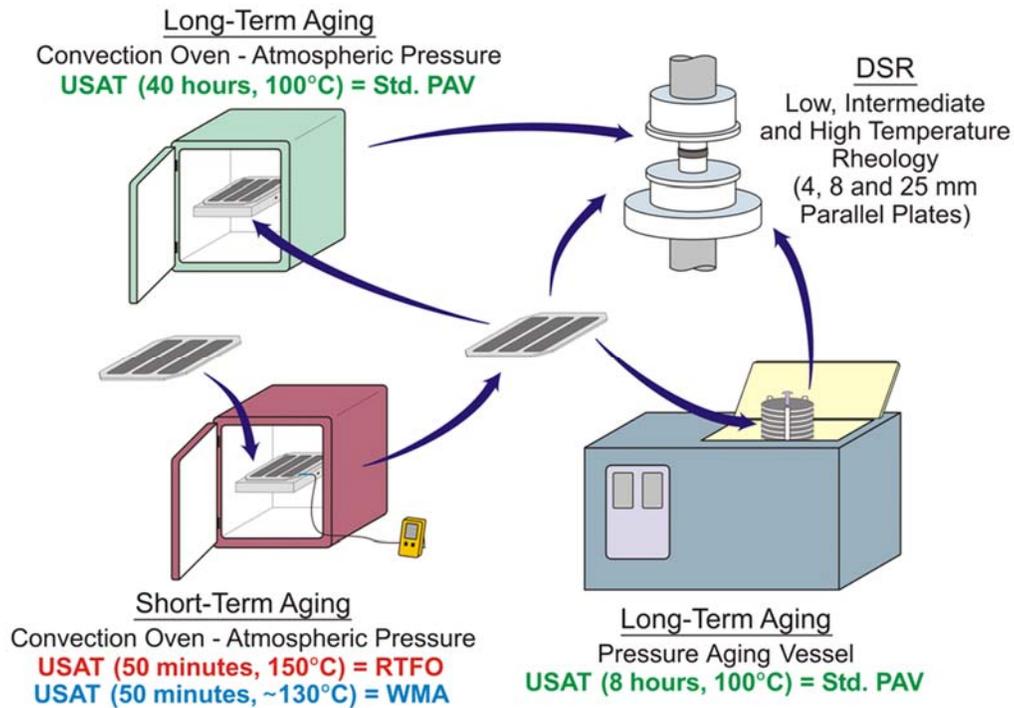
The USAT provides a valuable small-sample approach to characterizing the aging behavior of asphalts, polymer-modified asphalts, emulsion residue, recycled asphalt and other recovered materials. It can also be used to simulate the aging that occurs during hot-mix and warm-mix production.

The USAT performs short-term RTFO equivalent aging in 50 minutes. Even more significant, USAT performs long-term aging PAV equivalent aging in 8 hours: a 12 hour time saving compared to standard PAV. By combining the USAT with 4mm DSR, low-temperature rheology and specification parameters, such as m-value and creep stiffness, can be determined on samples of limited quantity. Each USAT plate produces 3g of aged bitumen.

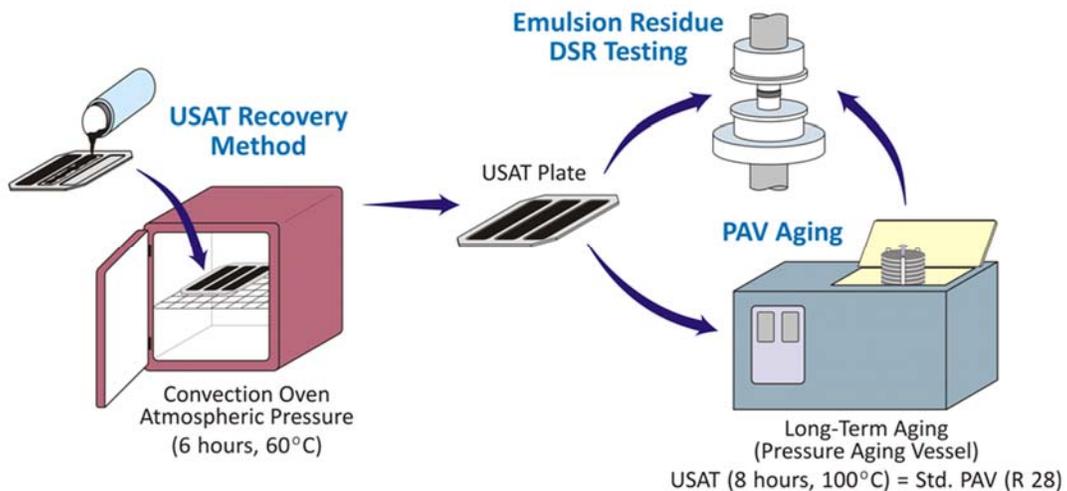


* Farrar, M.J., S.L. Salmans, J.P. Planche, "Recovery and Laboratory Testing of Asphalt Emulsion Residue: Application of Simple Aging Test and 4mm Dynamic Shear Rheometry."

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 ExpliFit® Correlation Software

Bridges the Gap from Data to Decision

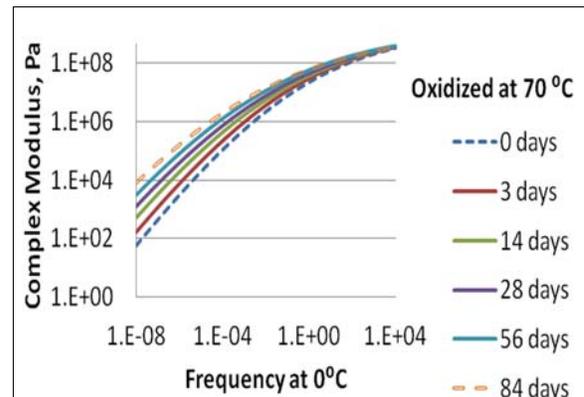
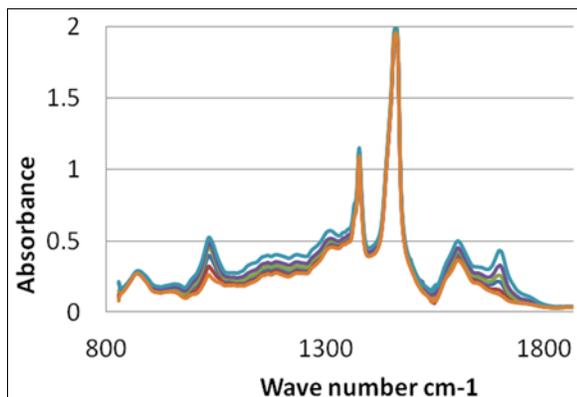
WRI's patent-pending ExpliFit® software program lets you view correlations between any combination of spectral, chemical or physical data measurements. For example, it helps "decode" spectra and reveal the link to physical data: it can link master curves to infrared spectra or asphalt SAR-AD fractions. The correlation equations can then be used to characterize asphalt rheology using only chemical data, to inexpensively monitor binder changes in asphalt pavement, 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), ExpliFit® clearly defines the variables of importance. Correlations are presented as measured variables in closed-form equations (no complicated latent variables), and the regression equation can be transported outside the program and easily fit to additional data. For statistical validation, independent variables and the numbers of observations are clearly shown (complete ANOVA tables are provided). Chemical data, which is often more economical to acquire, can now replace higher material consuming and more expensive physical data collection methods used for asphalt material development, and in performance assessment and prediction.

Insight Made Easy

ExpliFit® uses Microsoft Excel® files for input and output and provides clear, easy-to-read graphics for fit analyses. Users are guided through the process to prevent overfitting data. ExpliFit® can be used in any discipline where spectral, chemical or compositional data are generated and where relationships between multiple influences are desired. It has applications ranging from biochemistry to petroleum product composition and performance.



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

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

5 Automated Asphaltene Determinator™

This WRI patented HPLC based system separates asphaltenes into multiple solvent-defined fractions and provides quantification for upgrading, aging severity, coking, fouling potential and additive evaluation. The Asphaltene Determinator™ (AD) can also be used to identify thermally degraded asphalt bases, airblown asphalts and other unconventional feedstocks and blends.



Some of the world's largest oil companies use WRI's Asphaltene Determinator™ to avoid coking

with additives. Now a FHWA TECHBRIEF - Publication No.: FHWA-HRT-15-055.

6 Integrated Automated SARA Separation (SAR-AD™)

Traditional chromatographic separations take days and require large amounts of sample and solvent. Combining the Asphaltene Determinator™ (AD) and SAR (saturates, aromatics, and resins) separation provides access to a petroleum product "fingerprint" in just a few hours with only milligrams of sample. This new tool provides researchers, refiners, producers and contractors a way to determine aging, processing and blending guidelines. SAR-AD™ works for paving and roofing asphalt binders, crude oils, recycled asphalt pavements or shingles, and blends



Integrated SAR-AD™ Tool Provides the Following:

- Characterize and select asphalt binders and crude oils to mitigate poor performance due to refining processes or crude oil source variations.
- Provide composition related to mechanical properties and performance.
- Monitor asphalt aging and schedule asphalt pavement surface treatments.
- Predict compatibility of recycled asphalt (RAP and RAS), polymer-modified asphalts, bio-binder modifiers or rejuvenators, and warm- and cold-mix additives.
- Conduct forensic studies to understand mechanisms of pavement failure.

7 Automated Flocculation Titrimeter (AFT)

If refiners can't predict when coking will occur, they may stop processes too soon to avoiding fouling of processing or upgrading equipment, tanks, and transfer lines. This leads to lost profits through reduced distillate yield. The Automated Flocculation Titrimeter (AFT) developed by WRI, provides a fast and accurate way to collect maltene and asphaltene stability parameters. The data is useful for predicting coking and optimizing yield, to predict or determine blend stability, or gauge the effectiveness of additives. The K47100 AFT is available through Koehler Instruments.

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 more than 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.

54th **Laramie, Wyoming**
July 17-19, 2017

Find everything you need at
www.petersenasphaltconference.org

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Contact: Jean-Pascal Planche, PHD
Senior Vice President
Asphalt and Petroleum Technologies
(307) 721-2325 jplanche@uwyo.edu



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 Mountain West.



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