BMD
IMPLEMENTATION WORKING GROUP

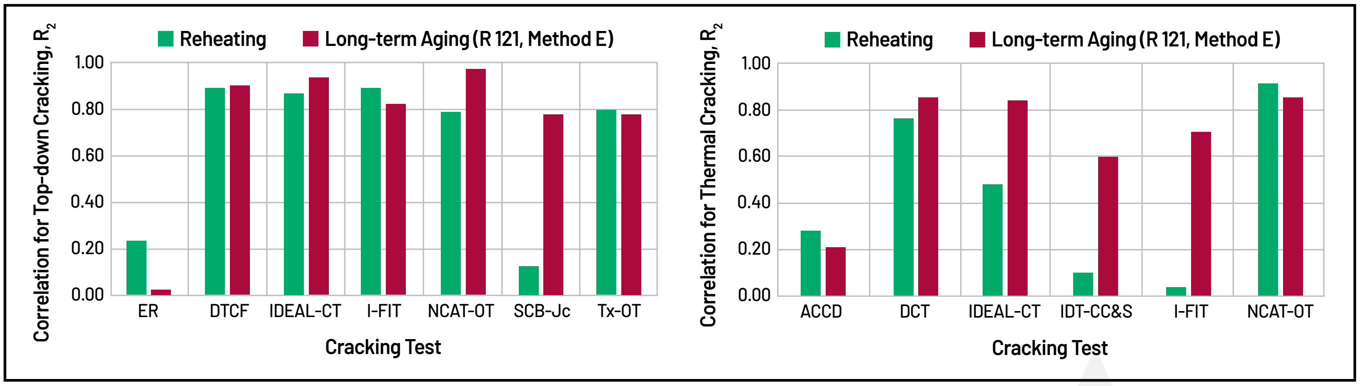
IN ASPHALT, AGING MATTERS

WHY DOES LONG-TERM AGING MATTER?

Cracking is a primary pavement distress that transportation agencies aim to address through laboratory cracking test(s) in Balanced Mix Design (BMD). Unlike rutting, which can manifest early in a pavement's life, cracking typically progresses over time due to the aging of the asphalt binder. As asphalt binder ages, it becomes stiffer and more brittle, making the mixture more susceptible to cracking.

The aging rate of asphalt binders varies significantly due to factors such as the source and grade of the virgin binder, the inclusion of reclaimed asphalt binders, the use of additives, climatic conditions, insufficient pavement density, and interactions with aggregates. These variables can make certain mixtures more prone to aging and cracking than others. Therefore, conducting mechanical tests on asphalt mixtures after long-term aging is critical to assess and enhance their long-term cracking performance.

Recent research at the National Center for Asphalt Technology (NCAT) Test Track and the Minnesota Road Research Facility (MnROAD) highlights the role of long-term aging in evaluating top-down and thermal cracking resistance of surface asphalt mixtures. As shown in **Figure 1**, many laboratory cracking tests conducted after long-term aging have exhibited stronger correlations with field cracking data than those conducted after short-term aging.



Key: ER = energy ratio test, DTCF = direct tension cyclic fatigue test, IDEAL-CT = indirect tensile asphalt cracking test, I-FIT = Illinois flexibility index test, NCAT-OT = NCAT overlay test, SCB-Jc = semi-circular bend test (critical strain energy release rate), Tx-OT = Texas overlay test, ACCD = asphalt concrete cracking device, DCT = disc-shaped compact tension test, IDT-CC&S = indirect tensile creep compliance and strength test

Figure 1. Correlation of Laboratory Cracking Tests to Field Cracking Data at NCAT Test Track and MnROAD: (left) Top-down Cracking Evaluation, (right) Thermal Cracking Evaluation

STANDARDIZED LONG-TERM AGING METHODS: AASHTO R 121-24

Recognizing the significance of asphalt aging progression over time, the American Association of State Highway and Transportation Officials (AASHTO) published R 121-24, *Standard Practice for Long-Term Laboratory Conditioning of Asphalt Mixtures*. This document describes five standardized laboratory aging methods, summarized in **Table 1**.

LONG-TERM AGING METHOD SELECTION

When selecting a long-term aging method, transportation agencies need to balance two critical considerations: accuracy (ability to replicate targeted field aging) and practicality (feasibility within laboratory schedules and turnaround times). Increasing temperatures can expedite aging, but higher temperatures may alter the mechanisms of long-term aging compared to field conditions.

As the aging temperature increases, the time required to achieve a specific aging level decreases, improving the practicality for routine mix design and production practices. However, this accelerated approach may compromise accuracy in replicating field conditions. Transportation agencies are encouraged to weigh these trade-offs based on the objectives of BMD.

If the goal is to predict pavement performance through mechanistic-empirical simulations, it is essential to prioritize accuracy in replicating field aging in the laboratory. Conversely, if the goal is to screen and eliminate poor-performing mixtures, practicality should take precedence, enabling quick turnaround of test results to support prompt mix design and production decisions.

LONG-TERM AGING METHODS AMONG BMD STATES

The implementation of BMD varies across agencies, each tailoring their long-term aging methods to suit specific regional conditions and objectives. States like Illinois, Louisiana, Virginia, and Wisconsin have adopted aging protocols that reflect their unique performance criteria and climatic conditions.

Table 1. Standardized Long-Term Laboratory Aging Methods in AASHTO R 121-24

Method	Condition	Aging Temperature	Aging Duration
A	Compacted Specimen	85°C	5 days
B	Loose Mixture	85°C	5 days
C	Loose Mixture	95°C	Varies depending on target field aging maps
D	Loose Mixture	100 to 125°C	20 hours
E	Loose Mixture	135°C	6 or 8 hours

For instance, some states may prioritize long-term aging to closely replicate field conditions, while others may adopt more accelerated methods to facilitate quicker testing turnaround.

For a comprehensive overview of the aging methods employed by BMD lead states, refer to the state summaries embedded behind the interactive implementation maps on the BMD Resource Guide (AsphaltPavement.org/BMD). These summaries outline each agency's BMD implementation approach and can serve as a valuable reference for other agencies exploring effective laboratory aging strategies. By understanding the diverse aging practices across states, agencies can make informed decisions that enhance the durability and performance of their asphalt mixtures.

ONGOING RESEARCH TO GUIDE IMPLEMENTATION

Further guidance on aging practices for BMD is forthcoming. For example, the National Cooperative Highway Research Program (NCHRP) 09-70 project will develop guidelines for incorporating aging effects into BMD for quality assurance. A National Road Research Alliance (NRRA) project is validating various loose mixture aging methods to assess cracking resistance in BMD. These initiatives will provide additional directions for addressing aging in BMD performance testing.

CONCLUSION

Aging plays a pivotal role in long-term pavement cracking performance. By adopting a tailored long-term aging protocol, transportation agencies can maximize the use of laboratory cracking tests to ensure the long-lasting performance of asphalt pavements.