DRISI
Caltrans Division of Research,
Innovation and System Information

Research Results

Asphalt Rubber Binder Testing and Acceptance

A dynamic shear rheometer with a concentric cylinder geometry can measure the performance properties of asphalt rubber binders

Pavement

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Project Title:
Rubber Binder Testing and Acceptance

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WHAT IS THE NEED?

Each year the United States disposes of nearly 300 million tires, most of which end up in landfills with the consequent environmental impacts. To reduce dumping, one solution is to grind old tires into crumbs and add them to asphalt binder to produce rubberized hot mix asphalt. In California, recycled crumb rubber is generally added to asphalt binders.

The Superpave Performance Grading system is commonly used to test the performance properties of asphalt binders. The testing procedure uses a dynamic shear rheometer (DSR) with a parallel plate geometry that is not suitable for asphalt rubber binders because the gap between the plates cannot accommodate the crumb rubber particles. Therefore, instead of the Superpave parameters, the current Caltrans specification for testing asphalt rubber binders focuses on measuring the viscosity at the plant using a handheld rotational viscometer. Although viscosity is an important parameter for assessing the workability of the binder and hence the mix, it does not directly correlate to the in-service performance of the asphalt rubber binder within rubberized hot mix asphalt (R-HMA). In addition, because of the particulate phase of the asphalt rubber binders, viscosity measurements alone lack sufficient accuracy to completely describe their complex properties.

New test procedures and equipment that can evaluate the performance characteristics of asphalt rubber binders are needed to ensure good performance in the field, aid pavement design, and establish contract acceptance criteria for asphalt rubber binders.

WHAT WAS OUR GOAL?

The goal was to develop new test procedures and equipment that can evaluate the performance characteristics of asphalt rubber binders.

WHAT DID WE DO?

Caltrans, in partnership with the University of California Pavement Research Center, tested samples using a DSR with a concentric cylinder geometry and compared the results to a DSR with a parallel plate geometries. The researchers prepared conditioned samples in the laboratory using short-term aging via thin film oven and long-term aging via pressurized aging vessel. The research team evaluated the ability of the concentric cylinder geometry to test neat binders, polymer modified binders, rubber modified (terminal blend) binders, and asphalt rubber binders. The study conducted a thorough statistical evaluation of the repeatability and reproducibility of the new concentric system.

WHAT WAS THE OUTCOME?

The interim results indicated that the concentric cylinder and parallel plate geometries had no significant differences in terms of the performance properties of rubber modified and asphalt rubber binders with fine crumb rubber particle sizes (<250 µm). However, the correlations between results from the two geometries became increasingly weaker as the crumb rubber particle size (up to 2 mm) increased, indicating that the parallel plates did not perform as well with larger particle sizes. The proposed alternative geometry for measuring the rheological properties of asphalt rubber binder is considered feasible.

This research has also set the stage for Task 2671, during which contract acceptance criteria for asphalt rubber binders for the new DSR system will be established.

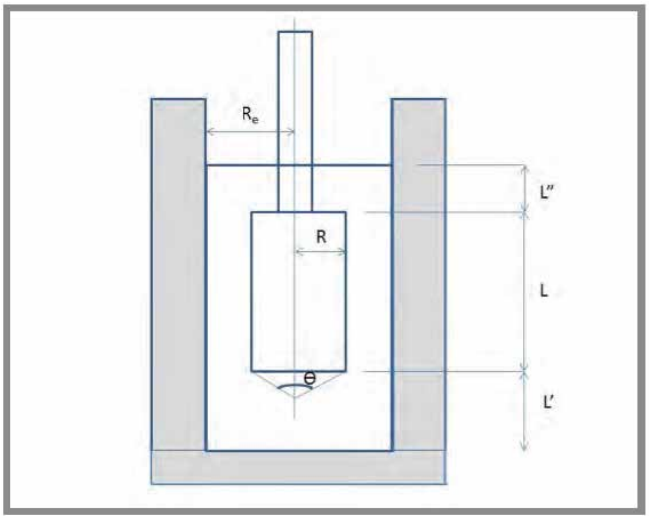
WHAT IS THE BENEFIT?

Recycling scrap tires benefits the environment and reduces landfills, but using crumb rubber requires effective methods for testing the performance of asphalt rubber binders. The study results will help develop contract acceptance criteria for these binders based on engineering properties. Establishing a targeted performance grading system minimizes the risk of designing and constructing R-HMA mixes with poor performance and durability.

LEARN MORE

To view the complete report:
www.ucprc.ucdavis.edu/PDF/UCPRC-TM-2014-02.pdf

IMAGE



The proposed DSR concentric cylinder measuring system for evaluating asphalt binders has two cylinders: the inner cylinder is called the bob and the outer cylinder is called the cup.