



Transportation Consortium of South Central States

Key Points

Project Number:

17BLSU01

Start Date:

05/08/2017

End Date:

11/08/2018

Principal Investigator(s):

Dr. Nazimuddin Wasiuddin
Louisiana Tech University
Email: wasi@latech.edu

Lead Institution:

Louisiana Tech University

Funds Requested to UTC:

\$54,000

Funding Source(s):

Tran-SET
Louisiana Tech University
Louisiana Transportation Research
Center (LTRC)

Total Project Cost:

\$108,000

Development of a Standard Test Method for Characterization of Asphalt Modifiers and Aging-Related Degradation Using an Extensional Rheometer

Brief Project Description

This study has been initiated to (a) Characterize modified asphalt binders in relation to their aging-related degradation; (b) develop a new standard and specification to supplement the knowledge gap in the performance grade (PG) system for modified asphalt binders. In the proposed study, an extensional rheometer fixture will be used in a DSR platform to perform a suite of tests. Elongation tests and fracture tests will be carried out using the extensional rheometer varying sample geometry, temperature, and strain rate. To replace the ductility test (American Association of State Highway and Transportation Officials [AASHTO] T51), the final strain in elongation test will be analyzed along with other parameters. The second force peak of force ductility test (AASHTO T300) will be compared to the second force peak in the elongation test. A novel and direct low temperature cracking susceptibility test will be developed by analyzing fracture strength and fracture energy parameters in fracture test using extensional rheometer. Extensional stress relaxation modulus and strain hardening will be investigated to determine the influence of polymer microstructures such as linear and radial styrene-butadiene-styrene (SBS). The proposed study will also examine and quantify (a) the degradation of modifiers with aging, and (b) how polymers/modifiers influence aging susceptibility.

Problem Statement

In last few decades, due to heavier trucks and increased volume, use of modifiers in asphalt binders increased significantly. The current Superpave Performance Grading (PG) system (AASHTO M320) was developed more than two decades ago primarily using unmodified asphalt cements. In AASHTO M320, high-temperature binder grading is based on dynamic shear rheometer (DSR) tests performed within linear visco-elastic region, whereas, modified binders and failures such as rutting are engaged in non-linear region. Therefore, how PG tests and specifications reflect performance of modified binders remain largely unknown to manufacturers and users. Some states use PG Plus specifications for modified binders. PG Plus tests are mostly empirical, and specifications and even the test methods are often



Transportation Consortium of South Central States

inconsistent across the states. Recently, the Multiple Stress Creep Recovery (MSCR) test (AASHTO TP70) based PG system (AASHTO MP19) has been introduced. Only the high-temperature binder grading requires MSCR tests and no signification changes have been made in low-temperature binder grading of MSCR based PG system. As such, there is a knowledge gap that needs to be addressed regarding the performance grade (PG) system for modified asphalt binders.

Objective

The objective of this study is to (a) characterize modified asphalt binders with respect to their aging-related degradation; and (b) develop a new standard and specification to supplement the knowledge gap in the performance grade (PG) system for modified asphalt binders.

Intended Implementation of Research

Technology Transfer

A standard test method and its corresponding specifications will be developed for immediate implementation. Moreover, Louisiana Transportation Research Center (LTRC) and ASTM committees will be communicated with the findings and feedback will be implemented to proceed forward on publishing a Standard Method of Test and Specifications. The PI N. Wasiuddin will attend LTRC and ASTM Committee meetings in this regard during the implementation period.

Education, Workforce Development, and Outreach

Workforce Development: Research results will be disseminated with a webinar or workshop (as suitable) and conference presentations and peer-reviewed journal publications.

Education: PI N. Wasiuddin will enhance his course materials in CVEN427-Design of Highway Pavements and CVEN414/514-Bituminous Mixture Design by the inclusion of a course module related to the developed test method.

Outreach: The PI will participate in the College of Engineering and Science Day (E&S Day) so that one of the visiting student groups of high school students can get experience with the newly developed extensional rheometer based tests for asphalt binders.

Anticipated Impacts/Benefits of Implementation

Weblinks:

- [Tran-SET's website \(http://transet.lsu.edu/completed-research/\)](http://transet.lsu.edu/completed-research/)
- [TRB's Research in Progress \(RIP\) database \(https://rip.trb.org/view/1466859\)](https://rip.trb.org/view/1466859)