

UTC Project Information

Project Title	Estimation of the Rolling Resistance performance of a pavement in view of the roughness profile
University	Michigan State University
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Funding Source(s) and Amounts Provided (by each agency or organization)	\$58,342 USDOT \$15,861 MSU
Total Project Cost	\$74,448
Agency ID or Contract Number	DTRT13-G-UTC44
Start and End Dates	January 31, 2017 to January 30, 2018
Brief Description of Research Project	The oxidation of binders in asphalt pavements has been a subject of interest for a significant number of years given that oxidative aging constitutes a primary cause of binder hardening in pavements, thus contributing to various forms of pavement failures. The action of oxygen is one of the principal factors responsible for the occurrence of aging phenomena. When asphalt is exposed to atmospheric oxygen, a slow autoxidation occurs, the chemical nature of which depends to a very large extent upon the temperature. As binders oxidize, carbonyl groups are formed increasing the polarity of their host compounds and making them much more likely to associate with other polar compounds. As they form these associations, they create less soluble asphaltene materials, which behave like solid particles. This composition change, results in orders-of-magnitude increases in both the asphalt's viscous and elastic properties. The end result is a material that increases its stress greatly with deformation and simultaneously cannot relieve the stress by flow, leading to a pavement that is very brittle and susceptible to fatigue and thermal cracking. Current techniques do not allow for the detection of asphalt aging levels in the field. Most of the experimental techniques are

limited to laboratory settings, thus leading to erroneous simulation predictions compared to actual observed degradation levels in the field. The objective of this project is to design and implement a low cost, easy to install, and implementable in the field, sensing system. The process is based on the inclusion into the material of chemical compounds that exhibit similar oxidation kinetics properties as to the used asphalt binder. These engineered compounds will also contain fluorescent elements which exhibit a varying fluorescence emission spectrum depending on levels of concentration of surrounding reactants (such as oxygen). The system will characterize the levels of oxidation in a particular location where the engineered compounds have been added, and will be interrogated using remote imaging analysis (detection of emission spectrum). Successful development of this technique would allow for: (1) field sensing and evaluation of levels of oxidative aging of asphalt; (2) improve prediction models and correct for discrepancies between laboratory and field observations, thus improving planning in the context of pavement network preservation.

Describe Implementation of Research Outcomes (or why not implemented)

N/A

Place Any Photos Here

Impacts/Benefits of Implementation (actual, not anticipated)

The study results will produce the following specific deliverables:

1. Guidelines for a new sensing methodology and associated installation procedures that would allow the placement of the sensing system at the pavement surface applied without major modifications to the regular SHAs maintenance activities
2. Guidelines for the design of the system to achieve early detection of aging zones, which will help improve scheduling and planning of preservation actions.
3. Guidelines for efficiently viewing, analyzing and reporting the new pavement degradation data consistent with existing pavement management systems. because it would dissipate more energy.

Web Links

<www.chpp.egr.msu.edu>

- Reports
- Project website