

# Monitoring Oxidation in Asphalt Pavements by Portable Infrared Spectroscopy (PIRS) to Establish Optimal Timing for Preservation Treatments

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**Lead Institution:**

Louisiana Tech University

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Tran-SET

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**Total Project Cost:**

\$ 60,709

## *Implementing PIRS to establish optimal timing for preservation treatments*

The objective of this research is to incorporate a cutting-edge technology into PMS that will enhance durability and service life of infrastructure through effective pavement maintenance techniques. The specific objectives are to (1) Develop a PIRS test procedure that will effectively determine pavement aging status. The developed test procedure needs to be noninvasive (Diffuse Reflectance method), quick and reproducible. A PRIS-based universal aging scale will be developed by modifying previously developed scale to determine the aging status; (2) Develop a mildly invasive (Attenuated Total Reflectance) PIRS test procedure to determine pavement aging. The accuracy and precision of the non-invasive (DR method) method will be compared with the mildly invasive (ATR) method; (3) Investigate if an aging threshold based on PIRS test can be developed to incorporate it in the decision tree for preventive and post distress pavement maintenance. Surveys on pavement preservation methods will be conducted on Region 6 agencies and selected DoT districts, Counties and Cities. At least thirty roads will be selected to conduct PIRS-based in-situ non-invasive and mildly invasive tests for evaluation of environmental aging status. The roads will be selected based on environment, age, design/maintenance data availability, condition and distress types, mix and/or maintenance types, traffic, accessibility and distance, etc. A comparative analyses will be performed between aging condition and distress and the obtained data will be analyzed for determining the aging threshold for optimal timing of preventive and regular pavement maintenance treatments. It is to be noted here that in determining optimal timing, the cost-benefit analyses will not be performed in this study.

## Problem Statement

Typically, DOTs assign some percentages by weight to pavement condition and some percentages by weight to the ride quality in making pavement management decisions on thin overlays and chip seals. Those treatments are designated to slow down oxidative aging of asphalt surface. Therefore, it only seems logical to

use the best available technology to monitor asphalt oxidation such as Portable Infrared Spectroscopy (PIRS). A fast and inexpensive field procedure for using PIRS in pavement preservation decisions, if incorporated into DOT PMS, will save expenditures on expensive automated systems for pavement data collection, which cannot detect increased rate of oxidation before the surface cracking occurs. A PIRS-based method would compliment pavement distress analysis and lead to a more rational performance-based approach to pavement preservation and at a lower cost.

## Objectives

The objective of this research is to incorporate a cutting-edge technology into PMS that will enhance durability and service life of infrastructure through effective pavement maintenance techniques. The specific objectives are as follows:

- 1) Develop a PIRS test procedure that will effectively determine pavement aging status. The developed test procedure needs to be noninvasive (Diffuse Reflectance method), quick and reproducible. A PRIS-based universal aging scale will be developed by modifying previously developed scale to determine the aging status.
- 2) Develop a mildly invasive (Attenuated Total Reflectance) PIRS test procedure to determine pavement aging. The accuracy and precision of the non-invasive (DR method) method will be compared with the mildly invasive (ATR) method.
- 3) Investigate if an aging threshold based on PIRS test can be developed to incorporate it in the decision tree for preventive and post distress pavement maintenance. The environmental consideration will be limited to some locations of the Region 6.





**Figure 1. PIRS Data Collection using Non-Invasive (DR) Method**

## Intended Implementation of Research

The PI is currently working in developing an in-field micro-extraction process that will be needed to determine the oxidation/aging status of asphalt pavements for optimal timing determination. Research results will be disseminated with a webinar or workshop (as suitable) and conference presentations and peer reviewed journal publications. The PI will participate in the Engineering and Science Day (E&S Day) of College of Engineering and Science in which over 750 area high school students participate. FT-IR tests are quick and will be demonstrated to the groups (about 20 students in each group) that visit asphalt lab. Transportation Leadership Council (TLC) students will be invited to participate in a field demonstration event that will involve FT-IR spectrometer for evaluation of oxidation/aging of asphalt pavement.

## Anticipated Impacts/Benefits of Implementation

This project will provide a product (deliverables) that can achieve an immediate impact on the durability of Region 6 asphalt pavements. The application of this research extends beyond state highway agencies, as it will also be used by manufacturers to make durable materials. Additionally, it is nationally implementable and addresses the FAST research priority four (Improving the durability and extending the life of transportation infrastructure).



## Web links

- Tran-SET's website  
<https://transet.lsu.edu/research-in-progress/>

## Tran-SET

Tran-SET is Region 6's University Transportation Center. It is a collaborative partnership between 11 institutions (see below) across 5 states (AR, LA, NM, OK, and TX). Tran-SET is led by Louisiana State University. It was established in late November 2016 "to address the accelerated deterioration of transportation infrastructure through the development, evaluation, and implementation of cutting-edge technologies, novel materials, and innovative construction management processes".

## Learn More

For more information about Tran-SET, please visit [our website](#), LinkedIn, Twitter, Facebook, and YouTube pages. Also, please feel free to contact Dr. Momen Mousa (Tran-SET Program Manager) directly at [transet@lsu.edu](mailto:transet@lsu.edu).