RESEARCH
PROJECT CAPSULE [17-1B]
October 2017
TECHNOLOGY TRANSFER PROGRAM

Field Implementation of Handheld FTIR Spectrometer for Polymer Content Determination and for Quality Control of RAP Mixtures

JUST THE FACTS:

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24 months

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July 13, 2019

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POINTS OF INTEREST:

Problem Addressed / Objective of Research / Methodology Used Implementation Potential

PROBLEM

Fourier-transform infrared spectroscopy (FTIRS) is a rapid, portable, non-destructive field technique that requires minimal sample preparation and minimal training of operators. Polymer content determination and quantification of aging in recycled asphalt pavement (RAP) mixtures are possible without extracting the binder from the asphalt mixtures when using FTIRS.

Figure 1
A bench top Brucker FTIR

(Source: https://www.bruker.com/fileadmin/_processed_/csm_TENSOR_II_FTIR_Spectrometer_1028793c69.jpg)

Identification of variables that affect the differences between actual and field-determined FTIRS polymer/RAP percentages are still under investigation. Such variables include, but are not limited to, aggregate particle size, level of compaction, plant mixing duration/temperature, binder blending, RAP variability, binder film thickness, and aggregate mineralogy.

Two FTIRS methods, attenuated total reflectance (ATR) and diffuse reflectance (DR), have been used for asphalt mixtures and for in-place pavements. FTIRS methodology influences the accuracy of polymer/RAP content determinations. Results from the ATR and DR methods need to be compared over a large number of field projects.

Computational techniques for data analyses also differ. Peak-to-peak ratio and area-to-area ratio (with or without baseline correction) are common techniques. In this study, selected techniques will be used with asphalt mixtures and with in-place pavements. Data will be collected from multiple field projects. Since no standard test method is available for FTIRS, guidelines and specifications need to be developed.

OBJECTIVE

The purpose of this research study is to determine if the implementation of FTIRS in Louisiana for determining polymer content in asphalt mixtures and for quality control of recycled asphalt mixtures is feasible. The ultimate objective is to develop a FTIRS test procedure for the quality control of asphalt mixtures.

METHODOLOGY

After an extensive literature review of current and prior research on use of FTIRS with asphalt materials, the research team will evaluate capabilities of available FTIRS equipment and recommend purchase of a selected brand/model.

Figure 2
An Agilent 4300 Handheld FTIR Spectrometer
(Source: https://www.good-design.com/wp-content/uploads/2015/03/4300E-1200x1402.jpg)

Materials will be collected from asphalt plants and from in-place pavement for multiple field projects. Several factors will be considered so that the asphalt mixtures cover the test factorial for this study, e.g., polymer type, polymer/RAP percentages, aggregate size, and presence of rejuvenating agents.

The ATR method will be used for FTIRS of loose asphalt mixtures and the DR method will be used for FTIRS of in-place pavement. The ATR method uses a crystal of high refractive index. For this study, the use of two crystal types (diamond and germanium) will allow further classification of FTIRS results.

Statistical regression (single variable/multivariable and linear/non-linear) analyses will be performed to establish correlations between asphalt sample properties and FTIRS results, as well as to identify variables that most influence the correlations.

IMPLEMENTATION POTENTIAL

A standard test method for polymer content determination and for quality control of RAP mixtures using FTIRS will be developed. Specifications and criteria for acceptance or rejection of polymer-modified asphalt binders and RAP mixtures will be recommended. Training materials will be prepared for immediate implementation.