RESEARCH
PROJECT CAPSULE [20-2C]
November 2019
TECHNOLOGY TRANSFER PROGRAM

Using the Portable XRF to Identify/Verify Field Material Properties

JUST THE FACTS:

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18 months

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March 31, 2021

Funding:
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Principal Investigator:
Jose Milla, Ph.D.
Concrete Researcher
Louisiana Transportation Research Center

Administrative Contact:
Tyson Rupnow, Ph.D., P.E.
Associate Director, Research
225-767-9124

Technical Contact:
Samuel B. Cooper, III, Ph.D., P.E.
Materials researcher Administrator
225-767-9164

Louisiana Transportation Research Center
4101 Gourrier Ave
Baton Rouge, LA 70808

Sponsored jointly by the Louisiana Department of Transportation and Development and Louisiana State University

POINTS OF INTEREST:

Problem Addressed / Objective of Research / Methodology Used / Implementation Potential

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PROBLEM

Currently, certain materials (e.g., concrete, limestone, thermoplastics, glass beads, bridge coatings) must be tested in a laboratory prior to use on a project for verification that specifications are met. This can be a labor intensive and expensive operation, with test results often delayed and some materials receiving only limited testing. The ability to provide a fast verification of material properties at the source or on the job site prior to use on a project can enhance quality assurance and potentially alleviate quality issues that may arise after a project's completion. Based on the findings from the Second Strategic Highway Research Program's report, portable spectroscopy technologies can be used for rapid identification of chemical compounds or detection of certain additives or contaminants in common construction materials. These technologies include X-Ray Fluorescence (XRF) and Attenuated Total Reflectance with Fourier-Transform Infrared (ATR FTIR) spectroscopy.

OBJECTIVE

The objective of this study is to develop a methodology for the Louisiana Department of Transportation and Development (DOTD) to use a portable XRF unit and ATR-FTIR device for evaluating material properties, and to determine the suitability of this equipment for determining whether certain materials meet DOTD specifications.

Figure 1
Laboratory technician using a portable XRF device to scan the composition of the metallic hollow tubes[1]

Figure 2
Portable XRF device used to analyze white paint used for pavement markings (left) and image of XRF result screen (right)[2]

Figure 3
Field use of portable XRF for a rapid material composition analysis. (Pictured here, the technician is looking for contaminants/metals in the soil)[3]

Picture sources

Figure 1: https://www.google.com/url?sa=i&source=images&cd=&cad=rja&uact=8&ved=2ahUKEwjWolGC9NXlAhUDYKwKHYMxCCYQjRx6BAgBEAQ&url=https%3A%2F%2Fwww.buscarfoto.com%2Fanalyzer-technician-job%2F151142271852504814 42&psig=AOvVaw08bqKPL308ONuKBlufThoZ&ust=1573140697093208

Figure 2: Report - National Academies of Sciences, Engineering, and Medicine 2013. Evaluating Applications of Field Spectroscopy Devices to Fingerprint Commonly Used Construction Materials. Washington, DC: The National Academies Press. https://doi.org/10.17226/22770

Figure 3: http://en.wiseok.com/view.asp?id=39

METHODOLOGY

An extensive literature review will be completed to determine the state-of-practice and current research endeavors regarding the use and adoption of portable spectrometers. A list of current laboratory XRF and ATR-FTIR testing currently performed by the DOTD Materials section will also be acquired. Materials with known compositions will be tested with the portable XRF and ATR-FTIR equipment to determine accuracy. Results will be compared with those from traditional laboratory tests, and a sensitivity analysis will be conducted to determine the identification accuracy and minimum detectable levels of the materials tested. Quantitative comparisons of elemental concentrations can be made with results from the laboratory devices. Statistical tests can then be employed to test for significance and precision of the portable equipment.

IMPLEMENTATION POTENTIAL

Field verification of material properties can lead to significant time and cost savings due to the reduced need to send samples to the DOTD Materials section or to private laboratories for testing.

The portable XRF and ATR-FTIR spectroscopy equipment may become a viable tool for field testing of materials. Results from this research may be used to improve the quality assurance of materials used on DOTD projects.