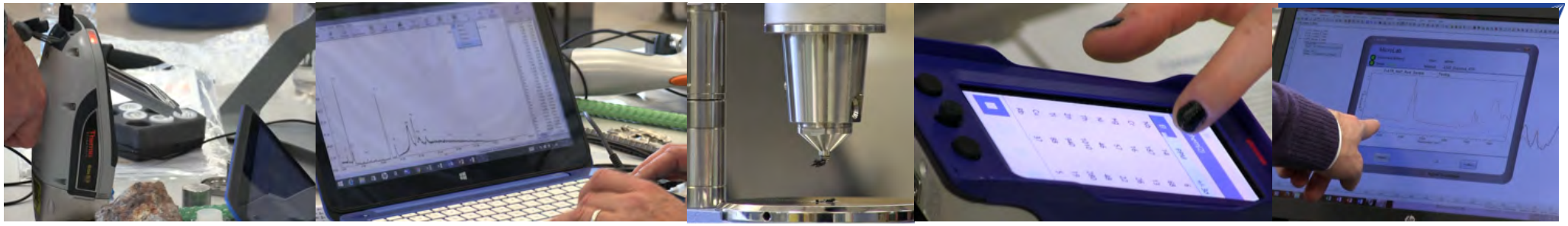

SHRP2 SOLUTIONS
TOOLS FOR THE ROAD AHEAD

Techniques to Fingerprint Construction Materials--R06B

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U.S. Department of Transportation
Federal Highway Administration

American Association of State Highway and Transportation Officials
AASHTO

Techniques to Fingerprint Construction Materials (R06B)

Challenge

- To verify material properties and specifications without sampling and analysis delays—delays which are not just time-consuming, but also expensive.

Solution

- Technologies to fingerprint construction materials in real time and on site, or in a lab setting in with little required sample preparation and analysis.

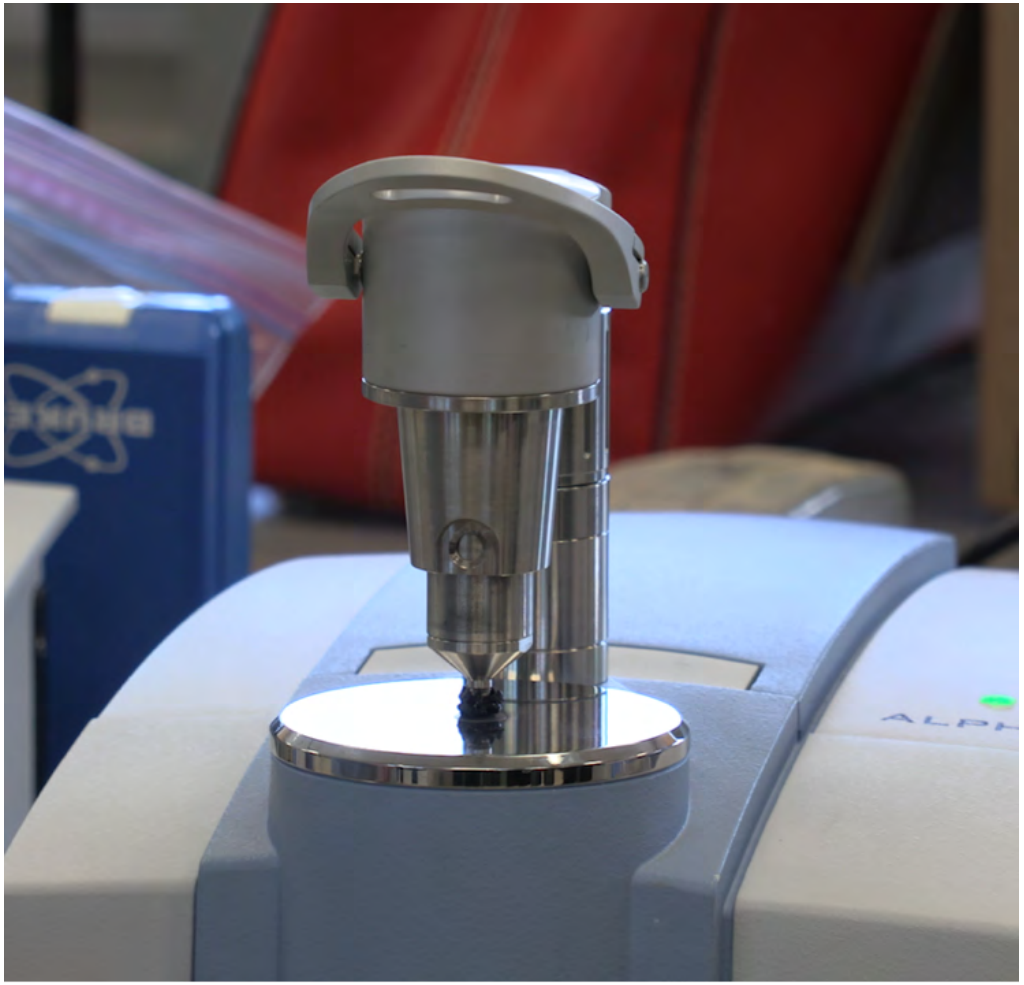
R06B Benefits

- Maximize the use of real-time nondestructive testing to verify properties of construction materials
- Cut test time and cost
- Reduce the use of out-of-specification materials

R06B Technologies

- **X-Ray Fluorescence Spectroscopy (XRF)**
  - Suited for identifying the elemental composition of any solid material (elements ranging from sodium (Na) to uranium (U))
  - Cost-effective handheld devices available

R06B Technologies



Fourier-Transform Infrared Spectroscopy (FTIR)

- Suited for fingerprinting pure chemical compounds, mostly organics; additives or contaminants in complex mixtures
- Portable benchtop and handheld equipment available for lab and field use

XRF Applications

- Detection of Pb and As in glass beads
- Detection of heavy metals in soils, aggregates, or any other materials
- Detection of REOB and PPA in asphalt
- Steel grade QA/QC
- QC for epoxies, thermoplastics and traffic paints
- Chloride content of concrete
- Portland cement composition

XRF Advantages and Limitations

Advantages

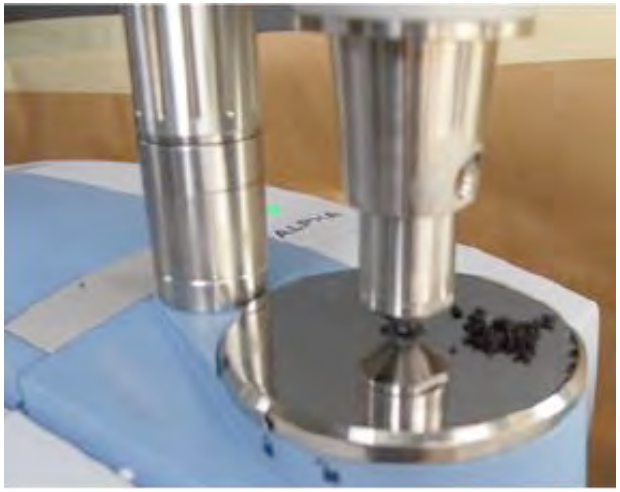
- Pre-calibrated for a wide range of elements
- Automatic reading—no analysis experience required
- 1-2-minute testing time
- Little or no sample prep required
- No maintenance required—costs only associated with equipment acquisition ($35-$40K)
- Several applications possible (more bang for your buck)

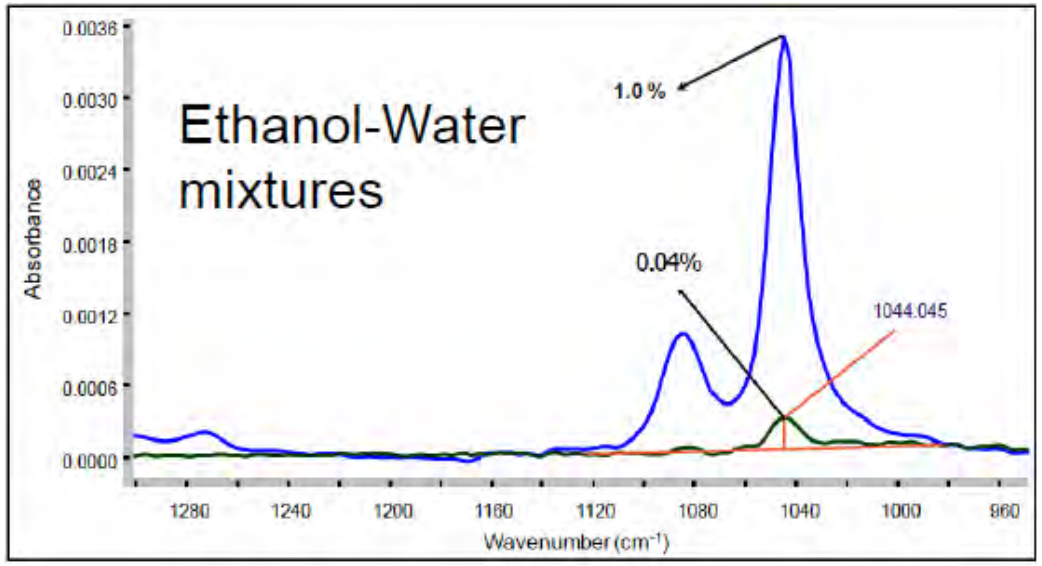
Limitations

- Can only be used by certified personnel
- Upper and lower limits—different calibrations needed for trace metals vs. ores vs. paints and thermoplastics

How FTIR Works

1. Obtain a reference spectrum of a pure compound (identify characteristic peaks)
2. Compare material mixture with reference and determine whether the characteristic peaks of the compound show up—detection
3. Use height of observed peaks to infer concentration—quantification





FTIR applications

- Lime identification in asphalt
- Polymer detection and potentially quantification in asphalt
- Identification of additives and organic contaminants in asphalt
- Evaluation of RAP and RAS oxidation

FTIR Advantages and Limitations

Advantages

- Only available method for the particular applications proposed
- Little to no sample preparation
- 3-5-minute actual testing time
- No maintenance costs
- Widely acceptable for a wide range of organic materials (e.g. solvents)

Limitations

- Detection limits fairly high for admixtures
- Training and experience required to interpret spectra, especially for the RAP application
- Library of reference spectra has to be developed for construction materials (some available from R06B)

Implementation Assistance Program States

Round 7
Alabama
Maine
Tennessee

Save Lives

Minimizes the likelihood of failure due to poor quality materials, thus ensuring long-term material performance and reducing future safety impacts to the driving public.

Save Money

Avoids costly transportation and laboratory testing of common construction materials.

Save Time

Eliminates the time-consuming process of transporting samples to a laboratory for testing to verify the materials meet contract specifications.

R06B—Alabama

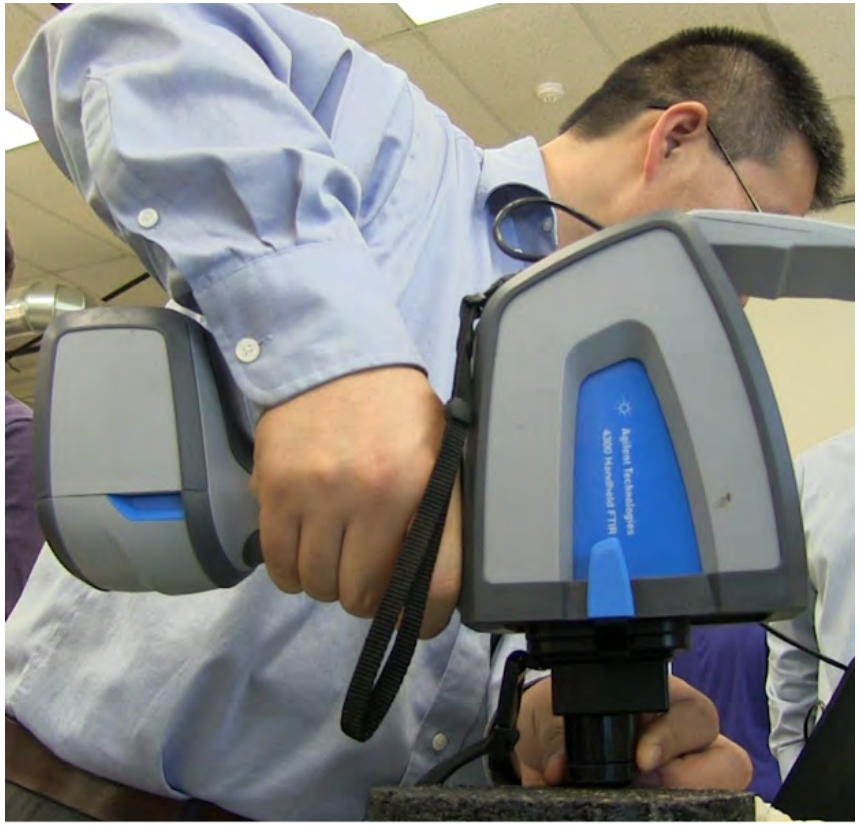
- Working with both technologies
- Goals:
  - Explore use of the FTIR technology to evaluate the oxidation level of RAP and RAS stockpiles
  - Develop a procedure for use of the portable XRF to field measure amount of TiO_2 in thermoplastic products

R06B—Maine

- Working with both technologies
- Goals:
  - XRF: Develop procedure for field analysis of Portland cements, measure chloride intrusion in concrete, determine steel grade and thickness of galvanized rail coatings, quality control of glass beads ad traffic paints
  - FTIR: Polymer and lime detection in asphalt mixes

R06B—Tennessee

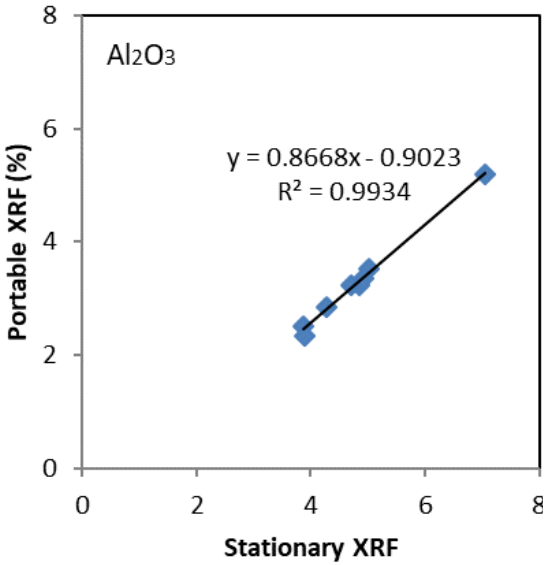
- Focusing on XRF technology implementation
- Goals:
  - Use XRF for rapid lab and/or field evaluation of
    - Thermoplastics
    - Glass beads
    - Aggregates

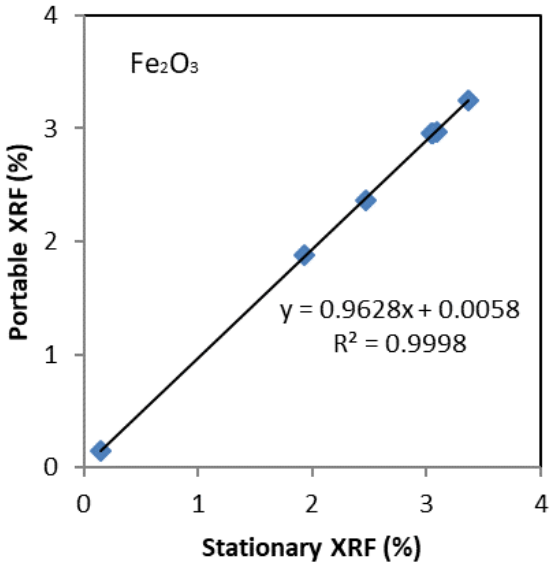


Some early promising results

TDOT

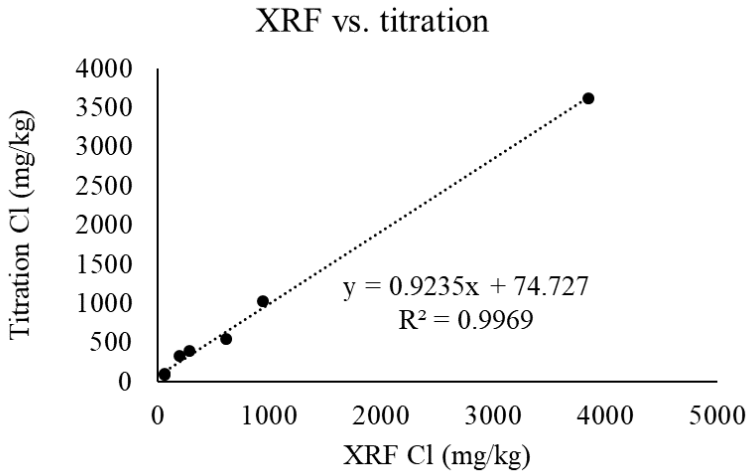
XRF of Portland cement





Maine DOT

XRF of chloride intrusion in concrete



What's Next for R06B

Webinars

Product website, with primer on technologies

Peer exchange

Final Reports of IAP states

For More Information on R06B

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Additional Resources:

GoSHRP2 Website:	fhwa.dot.gov/GoSHRP2
AASHTO SHRP2 Website:	http://shrp2.transportation.org
R06B Product Page	**Coming soon**