MDOT
OFFICE OF RESEARCH & BEST PRACTICES
Michigan Department of Transportation

# Research Spotlight

## New lab tests show promise in verifying pavement mix designs

**Long-lasting asphalt pavements begin with a high-quality pavement mix. MDOT uses a variety of quality control measures in the lab and during construction to ensure hot-mix asphalt (HMA) pavement mixes meet MDOT standards. New lab tests for one of these quality control measures - specific gravity - show promise in saving time while providing reliable test results.**

Researchers tested two approaches to measuring specific gravity. The automated SSDetect method (left) uses infrared technology to test fine aggregates; the vacuum saturation apparatus (right) for testing coarse aggregates removes trapped air and replaces any air voids with water.

### Project Information

**REPORT NAME:** Development of New Test Procedures for Measuring Fine and Coarse Aggregate Specific Gravities

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**TOTAL COST:** $181,925

**COST SHARING:** 20% MDOT, 80% FHWA through the SPR, Part II, Program

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### Problem

The specific gravity of an aggregate is involved in critical calculations of volume (for example, air voids) in HMA pavement mix designs. Specifications for the testing of pavement mix designs define specific gravity as the ratio of the density of a material to the density of distilled water at a stated temperature.

Incorrect or unacceptable specific gravity values lead to errors in design calculations and problems with the pavement mix. Rutting can occur when the percentage of air voids is too low; when air voids are too high, the mix is permeable to air and water, which can result in premature cracking. Aggregate absorption - the increase in mass due to water in the pores of the aggregate - is measured by the same test procedure used to calculate specific gravity.

(continued)

*"The new tests show promise in measuring the specific gravity of aggregates used in HMA mixes. The potential exists to save time while not compromising accuracy and repeatability."*

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MDOT uses American Association of State Highway and Transportation Officials (AASHTO) test methods to determine the specific gravity and absorption of aggregates. These tests are labor-intensive, time-consuming and, for some aggregates, rely on operator judgment. MDOT is interested in alternative tests to measure specific gravity to supplement or consider as a replacement for the existing testing protocols.

## Approach

The current AASHTO tests - AASHTO T 84, Standard Method of Test for Specific Gravity and Absorption of Fine Aggregate, and AASHTO T 85, Standard Method of Test for Specific Gravity and Absorption of Coarse Aggregate - require 15 hours to 19 hours to complete. For an alternative test to be viable, it must provide accurate, repeatable results comparable to those achieved with AASHTO test methods and take less time to complete.

## Research

Lab testing for specific gravity measures the weight of an aggregate sample under three different conditions: dry; saturated surface dry (SSD), the state where water fills the aggregate pores but no film of water remains on the surface; and submerged in water. The weights and relationships among them are used to calculate apparent specific gravity and water absorption.

Researchers selected the automated SSDetect method as a possible alternative to AASHTO T 84 to test fine aggregates. The SSDetect method uses reflection and the scattering of light rays to determine when a sample reaches its SSD state. A sample of the fine aggregate material is injected with small amounts of water. As water is absorbed, an infrared signal scans the surface of the aggregate for traces of water to identify when the sample reaches the SSD condition.

To supplement or replace AASHTO T 85 to test coarse aggregates, researchers chose the vacuum saturation approach. This method uses vacuum pressure to remove all air trapped within the coarse aggregates and replaces any air voids with water. After vacuum saturation, the sample is rolled in a large absorbent cloth until the sample reaches the SSD state. Researchers tested vacuum saturation periods of 10, 20 and 30 minutes, finding that the 10-minute vacuum saturation period produces specific gravity and absorption values most similar to AASHTO T 85 test results.

## Results

For most materials, the alternative tests provide results similar to those produced using current AASHTO standards. The SSDetect method used for testing fine aggregates reduces testing time from at least 15 hours to 1.5 hours, and researchers report a reduction in operator errors and improved accuracy. Even greater time savings are associated with the vacuum saturation method, with total testing time of less than 30 minutes. The vacuum saturation test procedure is effective for use with both individual and blended coarse aggregates.

## Value

Measurements of specific gravity and absorption play a key role in verifying the quality of HMA pavement mix designs. Current time-consuming testing processes can be challenging, particularly each spring when MDOT tests a high volume of pavement mix designs as contractors prepare for the upcoming construction season. The trial specifications for the SSDetect and vacuum saturation methods, which MDOT may consider for possible incorporation into current testing practices, have the potential to help MDOT save time in the lab with quick, reliable tests of specific gravity.

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