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Inside this issue

Regional News

National News

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NCAT
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Structural Experiment at the NCAT Test Track

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Construction of a structural experiment was recently completed as part of the 2003 research cycle at the NCAT Test Track. The eight test sections, funded by the Alabama Department of Transportation, the Indiana Department of Transportation and the Federal Highway Administration, were constructed to simulate typical pavement cross sections used in the Southeastern United States. The experiment is designed to address the trend toward more mechanistic-based approaches in pavement design, analysis and rehabilitation.

The primary objectives of the experiment are to address key issues regarding the implementation of mechanistic - based approaches, including:

1. Validation of computational mechanistic pavement models;
2. Development of transfer functions, also known as performance equations, for typical asphalt mixtures and pavement cross-sections used in Alabama;
3. Study of dynamic effects on pavement deterioration from a mechanistic viewpoint; and
4. Evaluation of the effect of thickness and polymer modification on structural performance.

The sections feature three hot-mix asphalt layer thicknesses (5, 7 and 9 in.) that are expected to exhibit differing types and amounts of distress over the next two years of trafficking. An additional experimental comparison was the use of modified binder in all pavement layers versus unmodified binders. Stone matrix asphalt mixes were used as the surface course of two sections, while one section utilized a rich bottom with the asphalt content raised 0.5% above optimum. The eight test sections (N1 - N8) are depicted in Figure 1. All eight sections were placed on 6 in. of dense crushed aggregate base.

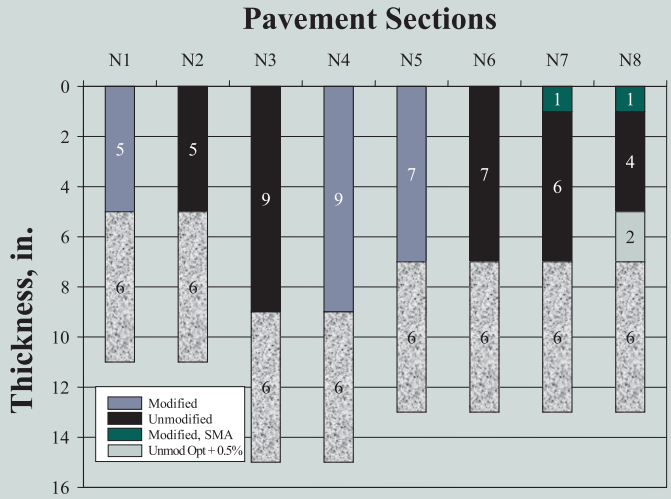

Figure 1. Structural Experiment Pavement Cross Sections

Continued on Page 2

A key component of the experiment is the use of instrumentation to capture in situ pavement responses under dynamic traffic loading. Asphalt strain gauges, base and subgrade pressure cells, moisture probes and temperature gauges were installed in each section. Figures 2 and 3 depict an array of the asphalt strain gauges and the paver approaching the array during construction. The strain gauges were positioned to record both longitudinal and transverse strain, and were spaced to capture the natural wheel wander of the trucks as they pass over the array. Measurements made by the instrumentation will aid in establishing a strong link between mechanistic response and observed distress such as rutting and pavement cracking.

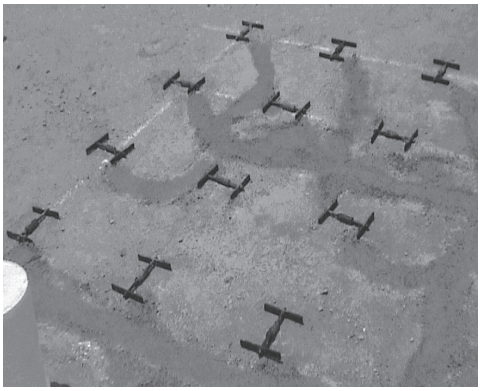

Figure 2. Asphalt Strain Gauge Array

Capturing data under dynamic traffic loading requires a system capable of sampling the gauges at a high rate. At the Test Track a system was implemented that can sample up to 250,000 samples per second. In other words, a two second burst of data corresponding to one truck pass can generate up to 500,000 data points for analysis. This allows for a very detailed and careful study of dynamic pavement response as it relates to the objectives enumerated above. Figure 4, below, shows a typical pavement strain response under one pass of the 8-axle tractor-trailer used at the Test Track where the passage of each axle is clearly evident.

In addition to in situ pavement response measurements described above, materials characterization, traffic monitoring and weekly performance evaluations will enable a comprehensive study of the structural response of the eight sections and satisfy the objectives of the project.

Figure 3. Paving over Gauges

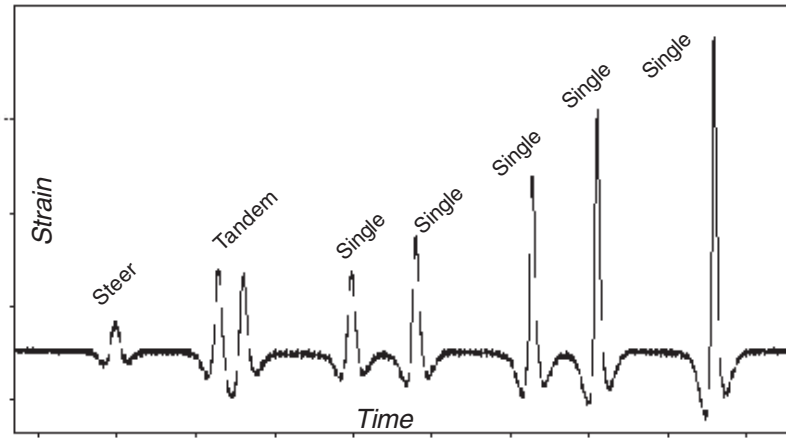

Figure 4. Strain Response Under 8-Axle Truck Loading

Micro-Deval Testing of Aggregates in the Southeast

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Background

Aggregates to be utilized in hot mix asphalt (HMA) must be both tough and durable. Aggregates must withstand the effects of HMA production, transportation and construction. Additionally, once placed on the roadway, aggregates must also resist the effects of traffic and the environment.

Historically, the toughness of aggregates has been determined using the Los Angeles (L.A.) Abrasion and Impact test (AASHTO T96). Some research has suggested that the L. A. Abrasion and Impact test does not provide a good evaluation of quality for HMA aggregates. Because of the large impact loads during the test procedure, high quality, coarse-grained crystalline materials, such as some granites, tend to yield high loss values, although they typically perform well in the field. Other lower quality, soft materials, like slates, tend to have low loss values because the crystalline structure of these materials can absorb the impact loads.

The long-term durability characteristics of aggregates are generally determined using a soundness test. Both the Magnesium and Sodium Sulfate Soundness tests are common methods of evaluating the durability of aggregates. These tests provide a measure of an aggregate's ability to resist weathering forces, particularly freeze-thaw conditions.

During the National Cooperative Highway Research Program (NCHRP) Project 4-19, *Aggregate Tests Related to Asphalt Concrete Performance in Pavements*, the L. A. Abrasion and Impact test and the two soundness tests were evaluated. Additionally, other tests, such as the Micro-Deval test, were assessed to evaluate the toughness/durability of aggregates used in HMA pavements. Based upon this large research study, the Micro-Deval test was recommended as an aggregate test related to raveling, pop-outs, and pot-holing. The Micro-Deval test, in conjunction with the Magnesium Sulfate Soundness test, was recommended in lieu of the L. A. Abrasion and Impact test and other soundness tests. A maximum Micro-Deval loss of 17-18% was suggested for asphalt concrete surface courses.

Micro-Deval Test

The test method for the Micro-Deval apparatus has been standardized in AASHTO TP 58-00, "Standard Test Method for Resistance of Coarse Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus." Because of the success that others have had with the Micro-Deval test method in characterizing coarse aggregates, a study was needed to characterize aggregates common to the Southeast utilizing this new test method.

Continued on Page 11

Micro-Deval

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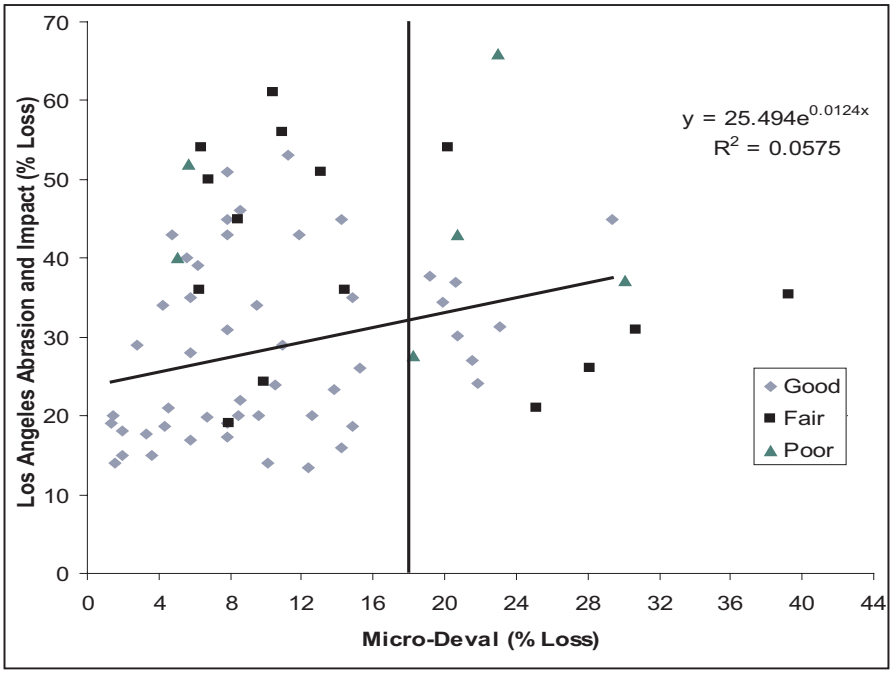

Figure 1: L. A. Abrasion vs. Micro-Deval

Objective

The objective of this research carried out by the Southeast Superpave Center at the National Center for Asphalt Technology was to characterize the toughness/durability of selected aggregates from throughout the Southeastern United States with respect to their Micro-Deval test results. This study involved comparisons between Micro-Deval test results and typically used toughness/durability tests.

Work Plan

The objective of this study was accomplished through the testing of 72 aggregates obtained from eight states. The historical field performance of each aggregate was indicated by the submitting state as Good, Fair or Poor. Each of the identified aggregates was tested to determine the percent loss during the Micro-Deval test in accordance with AASHTO TP 58-00. In order for comparisons to be made between the Micro-Deval and other typical toughness/durability test results, both the L.A. Abrasion and Impact and Sodium Sulfate Soundness values of each aggregate were obtained.

Test Results and Analysis

Figure 1 illustrates the relationship between L. A. Abrasion and Impact test results and Micro-Deval results. Based on the figure, there is a very poor relationship between L. A. Abrasion and Impact and Micro-Deval results. The R^2 value for the relationship was very low at 0.06. This was not totally unexpected because the two tests measure different characteristics of the aggregates. The L. A. Abrasion and Impact test measures an aggregate's resistance to both abrasion and impact, while the Micro-Deval test measures an aggregate's resistance to abrasion only. The trend line does, however, show increasing L. A. Abrasion and Impact results with increasing Micro-Deval results.

Figure 2 illustrates the relationship between Sodium Sulfate Soundness and Micro-Deval results. Again, there was a poor relationship between the two tests as the R^2 value was 0.10. The trend line does show increasing Sodium Sulfate Soundness test results with increasing Micro-Deval results.

Based on the data presented within this section, there is no relationship between Micro-Deval results and either L. A. Abrasion and Impact or Sodium Sulfate Soundness results. However, this was expected because each test measures a different quality characteristic. Of the three tests, the Los Angeles Abrasion and Impact test showed the least variability by performance category.

Conclusions

The objective of this study was to characterize aggregate sources using the Micro-Deval test. To accomplish this objective, 72 aggregates from eight different states were tested. These 72 aggregates were categorized by performance history by the respective states. Based on the results of this study, the following conclusions are provided:

- The Micro-Deval test had mixed results in categorizing aggregate sources in relation to the performance histories provided by the respective states.
- There was generally no relationship between either the L. A. Abrasion and Impact or Sodium Sulfate Soundness test results and the Micro-Deval test results for an individual state's data.
- There was no relationship between either the L. A. Abrasion and Impact or Sodium Sulfate Soundness test results and the Micro-Deval test results when the data was evaluated as a whole.
- Specifications developed for the Micro-Deval test method may need to be based upon the parent aggregate type. There were significant differences between aggregate types when aggregates categorized as good performers were compared.

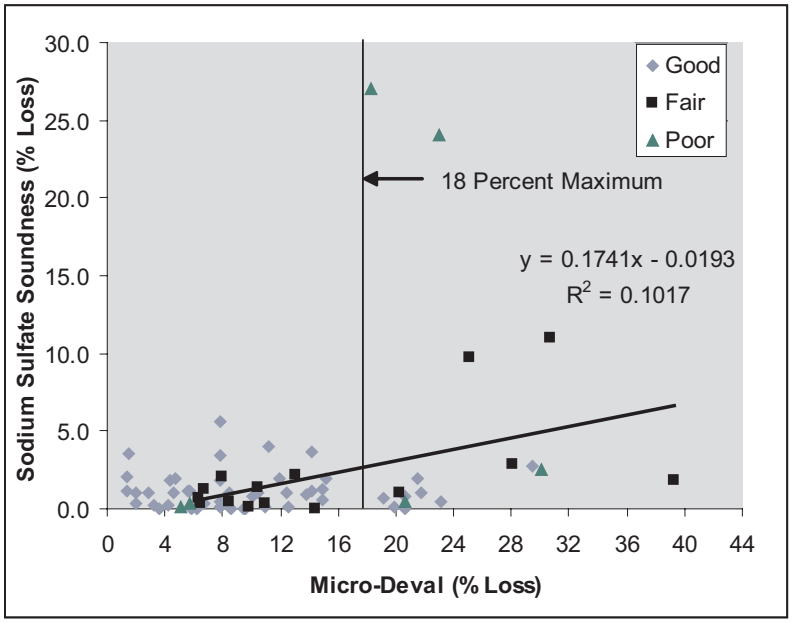

Figure 2. Comparison of Sodium Sulfate Soundness and Micro-Deval Test Results

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2004 Calendar of Events

May 19-20	**First Rubber Modified Asphalt Conference** Grand Rapids, Michigan Website: www.rubber.org/meetings/asphalt.htm
May 25	**Workshop for M-E Pavement Design Guide** Biloxi, MS http://www.fhwa.dot.gov/pavement/dgitfly2.htm
June 7 - 9	**First International Symposium on Design and Construction of Long-Lasting Asphalt Pavements** NCAT, Auburn, Alabama website: http://www.asphalt.org, e-mail: ISAP@eng.auburn.edu
June 15-24	**Professor Training Program in Asphalt Technology** NCAT, Auburn, Alabama Contact: Linda Kerr, kerrlin@eng.auburn.edu
June 21- 23 and June 23- 25	**41st Annual Petersen Asphalt Research Conference and the Asphalt Pavement Performance Prediction Symposium** Hitching Post Inn Resort and Conference Center Cheyenne, Wyoming website: www.petersenasphaltconference.org
Sept 16-21	**AASHTO Annual Meeting** Philadelphia, PA Website: http://www.transportation.org/aashto/home.nsf
Sept 26-29	**Second International Conference on Accelerated Pavement Testing** Minneapolis, MN Website: www.cce.umn.edu/engineering/accelerated_pavement
Nov. 16-18	**SEAUPG Annual Meeting** Baton Rouge, Louisiana Contact: Jill Baumgardner, SEAUPG@aol.com, (601) 206-5330

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