Difficult Research Project To Yield Important Pavement Data

National Center for Asphalt Technology experiment applies diverse preservation treatments to dozens of short adjoining strips of a county road

Edited by Greg Sitek

The application of diverse pavement surface treatments to multiple, short sections on a county road as part of a research project is expected to provide important information for transportation officials and others interested in extending the service life of the nation's streets and highways.

The logistically challenging treatment applications to contiguous sections of the county road were conducted as part of a Preservation Group experiment by Auburn University's National Center for Asphalt Technology (NCAT).

Contractors East Alabama Paving, Strawser Construction Inc. and Vance Brothers Inc. applied various treatments to 25 100-foot test sections on Lee (County) Road 159 in Alabama. In addition, a triple chip seal, rejuvenating fog seal and FiberMat with lightweight aggregate were applied to NCAT's pavement test track. The group experiment is included in NCAT's 2012 Pavement Test Track – the organization's fifth research cycle. This is the first experiment to include a formal pavement preservation study, and is also the first time that off-track sections are being used for NCAT research.

NCAT's undertaking of a formal pavement preservation experiment reflects a significant shift in philosophy by state departments of transportation, the American Association of State Highway and Transportation Officials, and the Federal Highway Administration (FHWA), from one of letting road pavements deteriorate to the point where they require reconstruction, to one that emphasizes keeping the nation's good roads and bridges good.

This philosophy calls for making the right application to the right road and bridge at the right time. In line with this, funding at federal and state levels has been increasing for pavement preservation treatments as agencies recognize they can no longer afford the costs of reconstructing roads and bridges.

NCAT Research Cycles

Previous research cycles were conducted entirely on NCAT's 1.7-mile oval test track in Opelika, Ala., a facility well known for its comprehensive research on design, construction and performance of experimental pavements. Buzz Powell, P.E., Ph.D., NCAT assistant director, manages the test track.

NCAT research cycle durations are 3 years, allowing for constructing and rehabilitating sections, 2 years of truck trafficking, and analyzing data and preparing reports. The track, built in 2000, has 46 200-foot test sections that experience accelerated pavement loading. This loading compresses a 10- to 15-year design lifetime of truck damage to pavement into 2 years by means of almost continuous heavy truck traffic.

Trafficking subjects pavement test sections to 10 million equivalent single axles (ESALs) of 18,000 pounds each during the 2-year trucking cycles. To produce this loading, 2 shifts of drivers operate 5 8-axle, 140,000-pound trucks with trailers continuously around the track between 5 a.m. and 11 p.m.. Each truck travels 680 miles per day on average.

Test sections are available to such sponsors as the FHWA, state transportation agencies and private industry for each cycle, with the costs of construction, operation and research funded by the sponsors.

FP2 and States Fund Tests

Eight sponsors are underwriting the new preservation group experiment, including the departments of transportation of seven states – Alabama, Mississippi, Missouri, North Carolina, Oklahoma, South Carolina and Tennessee. The 8th sponsor is FP2 Inc., a non-profit trade association representing the pavement preservation industry. Each sponsor is providing $120,000 each year for the 3-year research cycle.

The goal of the group experiment is to help develop a method to predict the life cycle performance that could be expected from the application of various preservation treatments to pavements with given pretreatment conditions.

FP2 Inc. Executive Director Jim Moulthrop says the importance of this experiment can't be overstated.

"This is extremely important to the industry," said Moulthrop. "There is a lack of data for us to adequately answer the questions that public agencies have about preservation treatments.

"For example, when a member of the industry approaches a state DOT or local highway agency they're often asked 'How long do these treatments last, how long will they extend the life of the underlying pavement, and what is the life-cycle cost of different treatments?'

"Also, many agencies are risk averse and want to know, 'Why should we take a chance on these treatments? We're comfortable with what we've been doing.'"

Since the greatest portion of the group experiment takes place off-track on a county road, Moulthrop said he would like to see monitoring of these test sections continued once the three year research cycle is completed.

"Three years is a short time when you don't get the accelerated traffic that test sections get on the NCAT track," he pointed out.

Selecting Treatments

When FP2 Inc. decided to sponsor the Preservation Group experiment, Michael Buckingham, the group's president, named an ad hoc committee to work closely with Dr. Powell and the sponsoring states during the process of selecting types of treatment that would provide the most useful data. The committee consisted of Moulthrop, Mark Ishee, vice president for Pavement Preservation at Ergon Asphalt & Emulsions Inc., which is supplying all asphalt and emulsion products except that required for the FiberMat System, and Tim Harrawood, Southern Regional General Manager for Vance Brothers, one of the contractors chosen to apply various treatments at both the test track and off-track sections.

According to committee member Ishee, participating state DOT officials were enthusiastic about the program from the very beginning.

"The funding partners wanted to see specific preservation treatments perform under the real life conditions that this county road provided," he said.

"The states had previously determined the types of treatments they wanted to see included in the study," Ishee said. He added that the committee assisted states in deciding what combinations of treatments, construction practices, material properties and testing protocols might provide useful information for their pavement preservation programs.

By the time a consensus was reached, 25 different treatments and two control sections had been slated for approximately one half-mile of Lee Road 159. In addition, four treatments were scheduled for the NCAT track.

Ishee said the logistics of having so many different preservation treatments applied to such short sections of roadway were very challenging for material suppliers and the contractor, citing, for example, the difficulties Ergon plant personnel overcame to supply very small quantities of various asphalt products, and those overcome by Vance Brothers in applying the materials. Vance Brothers crews followed the construction sequence originally conceived by NCAT's Dr. Powell and laid out in detail by Harrawood.

Experimental Preservation Treatments

The short test sections on the half-mile of Lee Road 159 underwent diverse types of basic pavement preservation treatments and combinations of treatments. Basic treatments included the following:

Fog seal: A light application of a slow-setting, polymer-modified asphalt emulsion diluted with water (typically 2- to 3- parts water to 1- part emulsion) to the surface of an existing pavement surface.

Crack Seal: The placement of specialized materials either above or into working cracks to prevent the intrusion of water and incompressible material into the crack. Rubber-modified materials designed for low-stress elongation, especially at low temperatures, are preferred.

Chip Seal: A thin surface treatment consisting of spraying a polymer-modified asphalt emulsion on an existing pavement, overlaying with fine (typically ⅜-inch) aggregate, and rolling to embed the aggregate in the emulsion.

Scrub Seal: A modified chip seal process incorporating a polymer modified, cationic medium-setting emulsion containing an asphalt rejuvenator, and an assembly of brushes pulled by a liquid asphalt distributor truck to force emulsion into pavement cracks.

Micro Surfacing: A cold-mix material, manufactured on site in a continuous mix paver that blends mineral aggregate, Portland cement or other mineral filler, water, and a polymer-modified asphalt emulsion. It can be spread in variable thicknesses.

FiberMat Chip Seal: A patented process using a combination of polymer-modified asphalt emulsion, chopped fiberglass strands and aggregate placed with a special application machine. Fiberglass strands are added to emulsion before aggregate is placed over the emulsion.

Ultra Thin Bonded Surface Course: A gap graded, ultra thin hot-mix asphalt mixture applied over a thick polymer-modified asphalt emulsion membrane that seals the existing surface and produces high binder content at the interface with the existing pavement, all in one pass.

Other applications on the county road consisted of combinations and/or modifications of the above treatments. Some but not all of these were:

- Rejuvenating Fog Seal
- Single Layer Chip Seal over Crack Sealing
- Double and Triple Chip Seals
- Cape Seal (Micro Surfacing over Single Chip Seal)
- Cape Seal (Micro Surfacing over Single FiberMat)

There were also more than a half-dozen complex treatments combining core ingredients of 4.75 NMAS thin screenings mix, virgin mix or virgin asphalt binder and PG67-22 asphalt binder with the following materials: FiberMat Chip Seal, 50-percent fractionated reclaimed asphalt pavement, 5-percent post-consumer recycled asphalt shingles, and Kraton highly polymer modified PG88-22 binder.

Furthermore, four 200-foot test sections received preservation treatments over existing pavement structures on the NCAT test track. These comprised two sections of rejuvenating fog seal, one of FiberMat chip seal with lightweight aggregate, and one of triple layer chip seal placed before the application of a hot mix asphalt overlay.

Source: FP2 Inc. (Foundation for Pavement Preservation)

Brian Horner, Etnyre representative, also assisted in the application process by checking all machines – chip spreaders, asphalt distributors and others – for proper calibration and operating temperatures. This relieved job foremen from having to do these tasks, allowing them to focus on the actual applications of many different treatments on short adjoining stretches of roads.

Also taking part in the effort were assistant research engineers and graduate students from NCAT who monitored the process, documented applications, obtained calibration samples and mapped pre-existing conditions.

Mini-Jobs, Big Challenge

Treatments on Lee Road 159 included crack seals, fog seals, chip seals, micro surfacing, FiberMat, ultra thin overlays and various combinations of these. (See types of treatments in accompanying box.) Crews employed a variety of heavy equipment such as Enyre liquid asphalt distributors, Etnyre chip spreaders, Bergkamp continuous mix pavers, conventional pavers, spray pavers and rollers, to name a few.

Vance Brothers' Harrawood explained that the company's task was time-consuming and labor-intensive. He noted that all but one of the 25- 2-lane sections were just 100-feet long, and one was even shorter – a mere 30 feet in length. From a contractor's point of view, this off-track experiment was a continuous string of many mini-jobs, all different but located right next to each other. A real challenge for paving crews, he said.

"The pavement preservation industry is geared for high production, utilizing large pieces of equipment to apply large quantities of materials, which results in fewer days on the project and fewer delays for the end user," Harrawood said. "However, this particular project proved challenging due to the scope of work and the size of test sections.

"Here, crews were operating large pieces of equipment and installing small quantities of materials on very short stretches of road."

He cited one section requiring fog seal as an example.

"For that 22-foot by 100-foot section, we had a distributor truck apply asphalt emulsion at the rate of .1 gallon per square yard, and it was diluted with 50-percent water, resulting in just 12 gallons of emulsion being applied for that entire test section."

Since each section underwent a different preservation treatment from that of neighboring sections, the application crews isolated the section being treated from adjacent sections using plastic sheeting. Placed over a portion of the end of the preceding section and the beginning of the succeeding section, the plastic sheeting precluded possible contamination of adjacent sections – an event that could skew test results.

"We bought cases full of duct tape and nearly 900 feet of plastic sheeting to do this," Harrawood noted.

Rational Asset Management

According to NCAT's Dr. Powell, the results of these experiments could lead to development of a "unique curve that defines the relationship between pretreatment condition and life cycle performance for each preservation treatment."

This would enable transportation agencies to objectively select the best treatment for a pavement that would meet their own criteria, for instance, a desired life cycle for the method of treatment and the duration of extended life for the underlying pavement.

Such a curve would allow agencies to manage their infrastructure assets in a rational, cost-effective way – so critical in light of today's shrinking transportation budgets.