PennDOT Trials Asphalt Fiber Technology

The Tarentum Bridge over the Allegheny River was one of the test sites for fiber-reinforced asphalt on a bridge deck.

Pa. pilot projects look to save money and improve performance

By Natasha Ozybko

Actively seeking ways to stretch limited highway dollars while building better roads, the Pennsylvania Department of Transportation (PennDOT) recently partnered with structural fiber manufacturer FORTA Corp. to explore how the company's fiber-reinforcement technology could improve its asphalt pavements through the construction of well-monitored pilot projects.

The pilot projects, approved by the U.S. Federal Highway Administration (FHWA), were inspired by PennDOT's Next Generation initiative, which has realized more than $50 million in savings for the state since it began. The program encompasses technology improvements, employee suggestions, and private sector innovations all aimed at using resources more efficiently, reducing costs, and building tougher, safer roads.

Go stronger, go longer

Pennsylvania-based FORTA Corp., which has long produced fibers for reinforcing concrete, recently developed a patented blend of three-dimensional fibers for asphalt called FORTA-FI. The product distributes strong, heat-resistant aramid and polyolefin fibers throughout an asphalt mix for added strength.

Fibers have long been used in stone-matrix asphalt (SMA) to prevent asphalt from draining down from the aggregate mixture, but generally fibers were not manufactured to increase strength and performance.

Research conducted by Kamil Kaloush, Ph.D., P.E., at the Arizona State University National Center of Excellence on SMART Innovations, has found that contractors can use structural fibers, such as FORTA-FI, to help extend the life of an asphalt roadway or to reduce pavement thickness without compromising strength or durability.

PennDOT set out to test these claims on Pennsylvania's roadways.

From the backcountry roads of Lancaster County, to busy four-lane intersections in downtown business districts, from Pittsburgh's rugged bridges to high-traffic construction zones around Philadelphia, these pilot projects posed challenges that DOTs face every day.

Making the grade

PennDOT's first project was a side-by-side comparison on State Route 3036 in rural Lancaster County. Using a ratio of 1 pound of fibers for every ton of asphalt, road maintenance crews placed 150 tons of asphalt infused with high-tensile strength fiber alongside a standard asphalt mix without fibers.

Fourteen core samples from the project were sent to Tom Bennert, Ph.D., a researcher at Rutgers University's Center for Advanced Infrastructure and Transportation, for evaluation.

Using the Texas Overlay Test for fatigue cracking, Bennert found that the samples with the fiber withstood three times more cycles than those without fibers before crack initiation, and the Asphalt Paver Analyzer showed a 20 percent reduction in rutting for the fiber mixes. (See Figures 1 and 2 on page 27.)

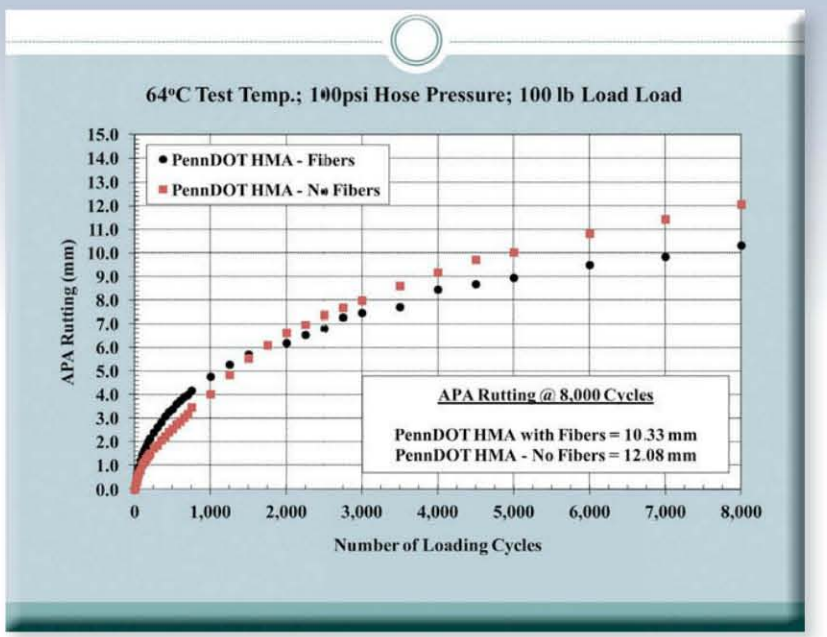

Figure 1: Rut Resistance Test Results With and Without Fibers.

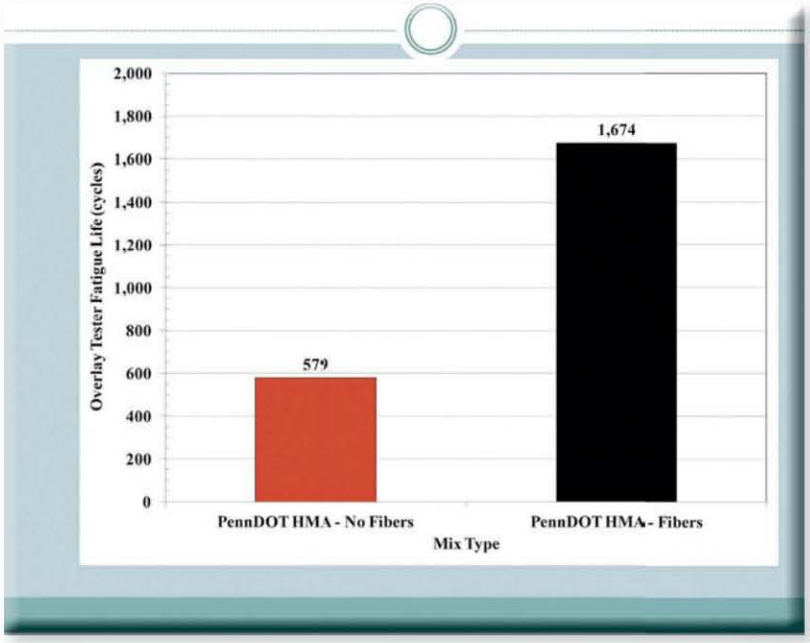

Figure 2: Fatigue Crack Testing Results With and Without Fibers.

Better reinforcement at intersections

A second project looked at the use of fibers to provide additional reinforcement at intersections. A $1.8 million resurfacing project on Pennsylvania State Route 45 in downtown Lewisburg was selected due to high residential usage and heavy truck traffic, which had caused significant rutting and shifting at intersections.

In summer 2012, a 2.1-mile section of PA 45 was divided into test sections on either side of US 15. The contractor milled the road, placed a binder course and followed with a wearing course. Some sections of the wearing course were paved with a polymer-modified PG 76-22 asphalt mix, others used a PG 64-22 binder and FORTA-FI fibers. The fibers were added to the asphalt mixture through a fiber-feeder system at Eastern Industries' asphalt plant in Lewisburg.

Greg Brouse, quality control manager at Eastern Industries, worked with FORTA and PennDOT Engineering District 3-0 to determine if a fiber-reinforced PG 64-22 binder would deliver the same or better performance than the polymer-modified PG 76-22 under heavy truck traffic.

Dan King, Assistant District Executive for Construction in PennDOT Engineering District 3-0, who led the trial project before

continued on page 29

retiring in 2012, projected that the fiber-reinforced PG 64-22 would perform better than the more costly non-reinforced PG 76-22 on PA Route 45.

After 18 months, the product is performing as promised. As a truck comes to a stop, the aramid fibers spread the force throughout the treated layer, reducing strains and deformation where the tires meet the road.

New level of performance on bridges

In PennDOT Engineering District 11, which covers three counties in southwestern Pennsylvania, engineers and asphalt producers discovered a new way to take advantage of FORTA-FI's unique structural properties — waterproofing bridges.

Bridge maintenance is especially important in states like Pennsylvania that deal with a dramatic freeze-thaw cycle, abuse from snowplows, and the corrosive effects of road salt.

With 1,180 state-owned bridges in Allegheny County alone, and ever-tightening budgets to maintain them, producers like Martin Libertini of The Lane Construction Corp. were scratching their heads over how to cut costs and enhance safety.

"When the temperature drops and you get any kind of water on a bridge deck, it gets icy real quick," said Libertini, who serves as quality control manager for Lane Construction's Pittsburgh-area operations.

"The state called for an SMA mix, which we know can be difficult to compact on bridges. After expressing my concerns to PennDOT, we obtained approval to use a fiber-reinforced hot-mix blend as a waterproofing membrane, followed by a 9.5 millimeter wearing course of PG 76–22, also with FORTA-FI, which should increase the strength and prevent premature cracking."

After completing a successful pilot project on the McKeesport–Duquesne Bridge over the Monongahela River last summer, PennDOT specified FORTA-FI for another Pittsburgh-area bridge. The Tarentum Bridge, which rises from 50 to 150 feet above the Allegheny River, carries 21,000 motorists each day over four lanes on PA Route 366. Part of a multi-year, $7.7 million project to revamp about 2 miles of PA Route 366, the fiber-reinforced bridge resurfacing was completed in August 2013.

As an asphalt producer, Libertini appreciates that PennDOT is open to new ideas.

"I like that they're taking a different approach. They're actually looking for different ways to get the job done," said Libertini. "Together we're working to find innovative solutions to get longer life out of pavement and to reduce the cost."

With several new hot-mix and warm-mix asphalt projects in the PennDOT pipeline, FORTA Corp. is beginning its final year in the three-year product evaluation required for inclusion in PennDOT's Bulletin 15 list of Approved Construction Materials.

Sustainable solutions

PennDOT continues to look for options and opportunities to cost-effectively improve the longevity of pavements. The laboratory and field-test results demonstrate some of the performance benefits of the three-dimensional aramid and polyolefin fibers for asphalt. The next step is to quantify the pavement life extension.

As a result of PennDOT's research efforts, Daniel E. Clark, P.E., chief of PennDOT's Evaluations & Research Unit in the Bureau of Project Delivery's Innovation & Support Services Division, was selected by the Federal Highway Administration (FHWA) to serve on a National Cooperative Highway Research Program (NCHRP) panel that will explore innovative practices and establish standards for using fiber-based additives in asphalt materials. The group convened its first panel in September and expects to release findings in 2014. AP

Pennsylvania State Route 45 served as one of the test beds for fiber-reinforced asphalt.

Natasha Ozybko is Northeast Regional Sales Representative for FORTA-FI. She is a graduate of Arizona State University.