First of all

12 million: According to the U.S. Environmental Protection Agency, that’s how many tires are ground up and recycled into crumb rubber for use in asphalt pavements each year.

Yet, despite this impressive figure, the practicality of paving with crumb rubber remains an untried novelty in many jurisdictions.

This was certainly the case in western Pennsylvania, until Pennsylvania Department of Transportation (PennDOT) District 11 teamed with the Federal Highway Administration (FHWA) to launch the region’s first crumb rubber project in 2014.

As part of the project’s $17 million-plus contract, Lindy Paving Inc. of New Galilee, Pa., was subcontracted to pave 5.4 miles of I-376 using crumb rubber pavement (CRP) as the wearing course, in conjunction with other asphalt materials. The project was located in Lawrence County and stretched from the Mitchell Road exit to the Mercer/Lawrence county line.

Known as I-376 Section L04 in Lawrence County, this stretch of four-lane highway is a major north/south artery that brings traffic in and out of the greater Pittsburgh metropolitan area. The average daily traffic for this section is 15,946 vehicles, 15% of which are trucks.

Under the guidance of general contractor Swank Construction, the aforementioned stretch of I-376 received a host of repairs before the asphalt pavement could be completed, including concrete patching and concrete transitions at six mainline structures—three eastbound, three westbound. The project also included latex concrete bridge-deck preservation; bridge jacking and realignment; bridge fascia beam replacement;
cable guardrail systems and guardrail end treatment upgrades; and drainage upgrades and cleaning. In addition, the job called for concrete pavement replacement at intersecting state routes connecting to I-376.

**Coordination command**

To meet the PennDOT/FHWA crumb-rubber pavement requirements, Lindy Paving added 2,016 tons of crumb-rubber modifier (CRM) to its 12.5-mm warm-mix wearing course. Adding to the sustainability of the project, 8,900 tons of reclaimed asphalt pavement was used in the binder and leveling courses. Warm-mix asphalt (WMA) was used to produce all 70,191 tons of mix required for the job. Lindy Paving’s daily asphalt production for the job ranged from 1,700 to 3,600 tons. The material was produced at the company’s asphalt facility in Koppel, Pa.

“The crumb rubber mix Lindy designed for the project was a gap-graded 12.5-mm mix that contained 7.8% CRM produced using PG 64–22 asphalt,” said Dan Ganoe, Lindy Paving’s vice president of operations. “The asphalt binder component of the mix was required by specification to include at least 15% CRM. The CRM product was composed of 100% recycled tire rubber with all fabric, fibers and metals already removed.”

“This CRM product, which comes in very finely ground crumb form, was blended with a PG 64–22 binder in a separate unit before introduction into the drum,” said Joe Conti, Lindy Paving’s quality control manager. “The mix also included 0.5% Evotherm warm-mix additive.”

The CRM product and the liquid asphalt had to be mixed at 350˚F for the blending process to work. The prepared CRM liquid asphalt was ready to use after about an hour, but could only be held for up to 16 hours prior to being used to produce a pavement mix.

Staying within these limits required a very high degree of coordination between the delivery of the liquid asphalt, the CRM and the management of the project schedule to ensure that material was available when needed and that nothing was wasted due to limited storage time. “Communication between the project staff and the plant was critical,” Ganoe said.

**Taking care of three**

The new asphalt pavement structure on I-376 consisted of three lifts of WMA. A leveling lift was placed using ¾ in. of 9.5-mm WMA (10,941 tons), followed by a variable-depth binder lift of 19-mm WMA at depths ranging from 2.5 to 4 in. to correct the cross slope (34,945 tons). The surface lift, or wearing course, was made up of 12.5-mm skid-resistant rubber gap-graded WMA at 1.5 in. (16,759 tons).

“The paving train for the mainline placement consisted of a Caterpillar AP1055 paver with a receiving hopper that worked in conjunction with a Roadtec SB 2500 material transfer unit and four Sakai SW800 rollers,” said Ganoe. “The transfer vehicle hopper and the paver hopper insert represented a 32-ton surge on the road, which was essential to achieving the ultimate goal of a continuous paving operation—a key component to providing the highest quality asphalt pavement.”

Grade control and finish quality on I-376 was maintained using a Topcon automated contact sensing system in conjunction with two over-the-screed skis during paving. “This delivery and sensing system, plus a well-planned production and trucking schedule, provided uniformity in appearance and compaction of the mat as well as the high degree of smoothness achieved on the project,” Conti said.

Lindy Paving matched its production mix schedule to the paving plan so that the paving passes stopped at the highway’s bridges and other major structures. This approach meant that across the entire 21.6 lane-miles of paving only one transverse joint occurred. All the other joints were at structures or the limit of work. “To achieve this shows the tremendous amount of effort, planning, coordination and commitment to quality on the part of our project staff,” Ganoe said.

“In order to achieve a consistent appearance of compaction and smoothness of the mat, we utilized four Sakai high-frequency rollers,” he added.

The rolling pattern consisted of between five and seven vibratory passes per roller. “The last roller in the paving train was operated primarily in the static mode,” said Ganoe. “Whenever possible, the rollers would arc off the mat at the end of their passes onto a previously placed surface.”

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**Communication [on this project]**

between staff and the plant was critical.

— Dan Ganoe, VPO, Lindy Paving
“We also employed the ‘Maryland Method’ approach for longitudinal joints on all mainline lifts,” said Conti. “A joint density spec was in place on the project, as well as the typical mat density specs.”

Lindy Paving dedicated a nuclear technician to monitoring joint density using Troxler 3440 gauges throughout the project.

**A few questions**

Paving western Pennsylvania’s first crumb-rubber roadway posed a number of questions for Lindy Paving and PennDOT. They included everything from material compaction and handling to CRM’s interaction with the company’s equipment and testing procedures.

To answer these questions before the rubber literally hit the road, Lindy Paving held a pre-construction CRP training session with Mark Edsall of All States Materials Group, Sunderland, Mass.

“All States supplied the crumb rubber and the equipment necessary to blend the material before we started mixing it in our 400-ton-per-hour Gencor plant,” Conti said.

Two more sessions were subsequently held between Lindy Paving, PennDOT and other involved parties. These sessions, plus the placement of a 100-ton CRM pavement test section, got everyone ready for the pioneering task ahead.

Then there was the issue of stickiness. Downy fabric softener was used to help keep the CRM mix from gluing itself to equipment and tools, but “finding the proper storage container for box samples was a problem,” said Conti. “Experience had taught us that a fair amount of asphalt could remain adhered in the usual PennDOT-approved cardboard containers.”

The solution turned out to be Dura-Fibre silicone-lined boxes, which can withstand temperatures greater than 400˚F while delivering minimal unwanted content adhesion.

The unfamiliarity of working with CRP convinced Lindy Paving to maximize its knowledge base, and standardize its equipment usage throughout the project. “Specifically, we used the same people and the same equipment day after day,” said Ganoe. “This allowed our crews to master the procedures quickly and to achieve consistency early on.”

Warm-mix asphalt was used to produce all 70,191 tons of mix required for the job.

**138.1 in. of smoothness**

Meticulous pre-planning, a strict adherence to quality control and constant monitoring of the paving operation resulted in a picture-perfect result for Lindy Paving’s I-376 project.

The numbers speak for themselves: Before this stretch of interstate was rebuilt, its average IRI was close to a bone-jarring 170 in./mile. Afterwards, the IRI was reduced to a smooth-riding 31.9 in./mile and the company received 90% of the available ride bonus.

Lindy Paving also achieved an average 92.5% compaction on the centerline joint. This allowed the company to claim 95% of the available joint bonus. (It also achieved a 95% mat density average.)

“All materials were 100% within tolerance for the other two pay parameters of asphalt and percent passing a 200 sieve,” said Conti.

The result: Western Pennsylvania’s first crumb-rubber paving project was a success, proving that there’s a place for crumb rubber on this state’s highways—and another option for recycling a portion of those 12 million discarded tires each year.

“The results and accomplishments on this project were exceptional and we are extremely proud to have been a part of it,” said Ganoe. “This project is a success due to the teamwork, commitment to quality, dedication and pride in workmanship of everyone involved; from PennDOT’s inspection staff and the general contract Swank Construction to the skilled men and women that performed the work.”

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Careless is a freelance writer based in Ottawa, Ontario, Canada.

For more information about this topic, check out the Asphalt Channel at www.roadsbridges.com.