As roads deteriorate and costs rise, benefits of asphalt recycling become more apparent
- By Stephanie Harris

As we begin to establish ourselves in the 21st century, it is becoming more and more clear that all things as we know them are in fact getting older. The first paved roads began to appear over a century ago, and our interstate system is now an aging demicentenarian. Even our dear old Mother Earth is seeing the effects of age.

With age comes wear and tear, which our roads—and planet—have been experiencing more of recently. We've all heard it before: global warming; if we don't do something soon it will be too late; we all have to do our part to help save the earth; etc. This is all very true, and even the smallest acts can help in big ways.

Recycling is one of the simplest ways to cut back on the earth's aging process, and it is something we can all do. From newspapers to aluminum, materials can be used and reused again and again. Even asphalt, which is in fact the most recycled product in the U.S., can hold a second life.

The need exists

Although asphalt is the No. 1 recycled product in the U.S., only 3% of the roads in this country are being recycled, according to Blair Barnhardt, operations engineer, reclamation division, Blount Construction. The need exists for more recycling methods to be used on asphalt roads, and the benefits of recycling are being proven more and more.

According to Dr. Tarunjit Butalia, P.E., research scientist and coal combustion products coordinator, Ohio State University, the need for asphalt recycling derives from three major impetuses: failing road structures due to increased traffic loads and volume, decreased funding and the continuing need for a safe, efficient and cost-effective transportation system.

Increased traffic demands have led to the deterioration of sub-base structures. In many expanding suburban areas, secondary roads that were once on the outskirts of cities have now become a part of the city itself, according to Butalia, and these pavements need to be rehabilitated.

In areas where funding for road repairs is not so plentiful, such as at the county and township levels, recycling seems to be the ideal solution. When road reconstruction projects use recycled asphalt rather than virgin materials, most often they can be completed for up to "half or one-third of the cost of conventional reconstruction techniques," said Barnhardt, "and we're doing them in one-tenth of the amount of time."

Regional recycling

Of the common methods of asphalt recycling—cold planing, cold in-place recycling, hot recycling, hot in-place recycling and full-depth reclamation—there does not seem to be any one method that is currently being used more than others, according to Barnhardt. "There's an equal distribution between the disciplines and we're seeing even-paced growth," he said. "Certain disciplines work better in certain areas because of the deterioration level of the road."
Based out of Marietta, Ga., Barnhardt said that most of the recycling work Blount Construction sees is full-depth reclamation (FDR) because of the conditions of the roads in the southeastern U.S. "If we come down to southern Georgia, where the roads have been let go for so long at the county level, we really have no choice at that point but to go with the FDR," he said. "It really is a geographical decision."

With recent spikes in the cost of asphalt cement, the interest levels for alternative construction techniques have been raised, especially in terms of recycling methods. "We are seeing a spike in the interest levels, maybe not necessarily the job, but certainly in the interest level," Barnhardt said.

When the interest is raised, the application will eventually follow. Some states in the U.S. have been using recycling methods and applications for many years. The Nevada Department of Transportation (NDOT), for example, has been reclaiming roads for over 20 years and has saved over $600 million by doing so.

At the Asphalt Recycling and Reclaiming Association’s annual meeting in February, Sohila Bemanian, P.E., NDOT’s assistant chief material engineer, presented information on NDOT’s pavement preservation program.

Being the fastest growing state in the U.S. for the past 19 years, and with a pavement preservation funding level that has not increased since 1990, NDOT has had to turn to cost-effective strategies to maintain the state’s roadways. Since 1999, NDOT has used cold in-place recycling (CIR) to complete more than 1,600 lane-miles, or 12% of the state’s roadway system. In 2005, NDOT successfully used CIR over 350 lane-miles of roadway. And according to the Federal Highway Administration’s Highway Performance Monitoring System, NDOT had some of the smoothest roads in the country in 2005.

While some state DOTs are embracing the idea of recycling—such as the California DOT, which allows up to 15% of recycled asphalt to be put back into hot-mix production, and the Georgia DOT, which allows up to 20%—other states are still only in the experimental stages.

**Using and proving the methods**

At Ohio State University (OSU), research is under way to explore methods to recycle pavement materials. Responding to the need to rebuild and rehabilitate existing pavements, the OSU Department of Civil Engineering and Geodetic Science has partnered with the two fastest growing counties in Ohio—Delaware and Warren—to construct and monitor two pavement sections. Sections of failing asphalt pavements were recycled and placed in the summer and fall of 2006 using Ohio coal-generated fly ash as a cementing agent.

The state of Ohio has nearly 120,000 miles of highways, 90% of which are composed of asphalt, according to Butalia. "Most construction work that we see now is some construction of new pavements," said Butalia, "but a lot of what we see in terms of rehabilitation and construction is existing pavements that need to undergo repairs."

Many counties and townships today are recycling roads by removing the top couple of inches of asphalt, recycling and relaying it above the sub-base. However, "this doesn’t solve a problem if the base itself is failing," Butalia said.

The most cost-effective solution for a failing sub-base is FDR. "Essentially you take the wearing surface, base or sub-base; add some chemical additive, which can be cement, lime, fly ash or others; then you compact it down and essentially create a new stabilized base," Butalia said. "Short of doing a complete reconstruction, FDR is the only cost-effective rehabilitation technique that will correct a failing base."
The OSU research involved the construction of a 4-mile-long pavement section in Delaware County and a 0.4-mile-long section in Warren County. "We chose these counties because they were having significant issues keeping up with their pavements that were distressed," Buttalia said. "Both of them have suburbs that are expanding and have a need for the technology to reclaim their existing pavements."

The 4-mile-long Delaware County section had a 1/4-in. cross-slope consisting of an asphalt surface with thickness ranging from 5/8 to 14 in. The original pavement was underlaid by a base course ranging from 1 to 11 in. Nine sections were constructed in total using the following six mixes:

- 4% lime with 6% fly ash, 8 in. stabilization depth (0.7 mile);
- 5% lime-kiln dust with 5% fly ash, 8 in. stabilization depth (0.6 mile);
- 3% lime-kiln dust with 1.4 gal per sq yd emulsion, 8 in. stabilization depth (0.7 mile);
- 5% cement, 12 in. stabilization depth (0.8 mile);
- 2% cement with 1.6 gal per sq yd emulsion, 8 in. stabilization depth (0.3 mile); and
- 5 in. mill and fill (two 0.1 mile sections at the north and south ends of the project, and a 0.7 mile and 0.1 mile section near the middle of the project).

The FDR rehabilitation was completed in five phases. Beginning in August 2006, 5 in. of the existing asphalt surface pavement was milled and removed. In the second phase, the remaining pavement materials were pre-pulverized to the various depths. The third phase involved treating the pulverized pavement materials with admixtures. Water was then added to the mix and was compacted immediately. The last phase involved resurfacing the pavement with 5 in. of hot-mix asphalt and was completed by mid-October.

In Warren County, the failing pavement was 0.4 miles in length and had a 2-in. asphalt layer on top of 4-6 in. of pavement chip and seal or gravel. Two sections were constructed; one was 4% lime with 6% fly ash, 12 in. stabilization depth (0.32 mile), and the second was 5 in. mill and fill (0.08 mile).

FDR rehabilitation was completed in five phases: Beginning July 2006, 4 in. of existing asphalt surface pavement was milled and removed. In the second phase, the remaining pavement materials were pre-pulverized to a depth of 12 in. The third phase involved treating the pulverized pavement materials with lime at an application rate of 4% and allowed the material to mellow for a 24-hour period. After the mellow period, 8% fly ash was blended into the mix to a depth of 12 in. Water was added to the mix and was compacted immediately. The last phase involved resurfacing the pavement with 4 in. of hot-mix asphalt and was completed by mid-September.

During construction, the Delaware and Warren County pavement sections were instrumented and monitored, and data collection from the monitoring devices is being carried out on a quarterly basis.

Falling-weight deflectometer (FWD) tests to measure pavement load deflection behavior, resilient modulus of pavement layers and subgrade soil and base structural layer coefficient are being carried out by the Ohio DOT.

Based on observations and tests, FDR of the pavements with fly ash, lime or lime-kiln dust increased the elastic modulus of the base layer many folds. The fly ash sections exhibited elastic moduli of base layers similar to cement and cement-plus-emulsion sections. FWD tests will continue to be carried out twice a year to determine the long-term elastic moduli of the various sections constructed in this project.

Accepting the unknown

As with many things in life, people seem to have mixed emotions toward what is new or unknown. "If people are unfamiliar with the process, they like to stick with what's tried and true," said Barnhardt. "They're not as willing to embrace a new technology unless someone in their backyard does it and they can see it."

To increase the use of recycling in the U.S., Barnhardt suggested incentive offerings during the bidding process for projects that would use recycled materials. But most importantly, according to Barnhardt, is education.

Barnhardt teaches a two-day training course on recycling offered by the National Highway Institute. The course is held several times a year throughout the country and offers in-depth technical knowledge of recycling methods.

As the benefits of asphalt recycling continue to be proven, it is hoped that more states and counties will become aware and accepting of the technology.

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