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Asphalt recycling gains mom

The Federal Highway Administration (FHWA) estimates that of the 90 million tons of hot mix asphalt (HMA) that are milled and removed each year, 90% is reused in highway applications in one form or another, including pavements, subbase and fill. About ⅓ of the 90 million tons is recycled into HMA, according to documents published by the National Asphalt Pavement Association (NAPA).

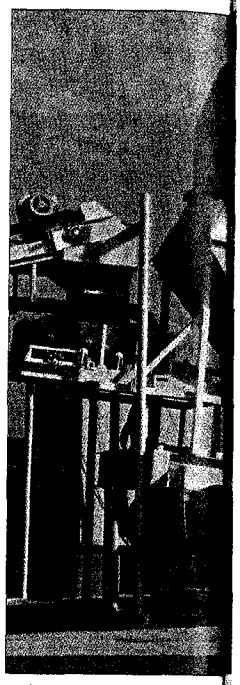
Today public works directors have an unprecedented number of options in asphalt recycling either at the hot mix plant or cold-in-place on the road. At the plant, engineers and contractors have become expert at making mixes using recycled asphalt pavement (RAP). And cold-in-place options now include foamed asphalt, which is gaining interest as a cost-effective way to rehabilitate deteriorated low-volume roads.

States will accept varying amounts of RAP in their HMA for pavements. Usually a state will accept more RAP for base and intermediate courses, and less for surface courses. Typically a specification allows a certain percentage of RAP versus virgin materials for different mix types. Florida recycles fully ¾ of its RAP into HMA pavements. "Fifteen percent is very common and up to 30% or 35% is usually the upper limit," said Kent Hansen, director of engineering at NAPA. "Some commercial projects go up to 50%, but that's very rare."

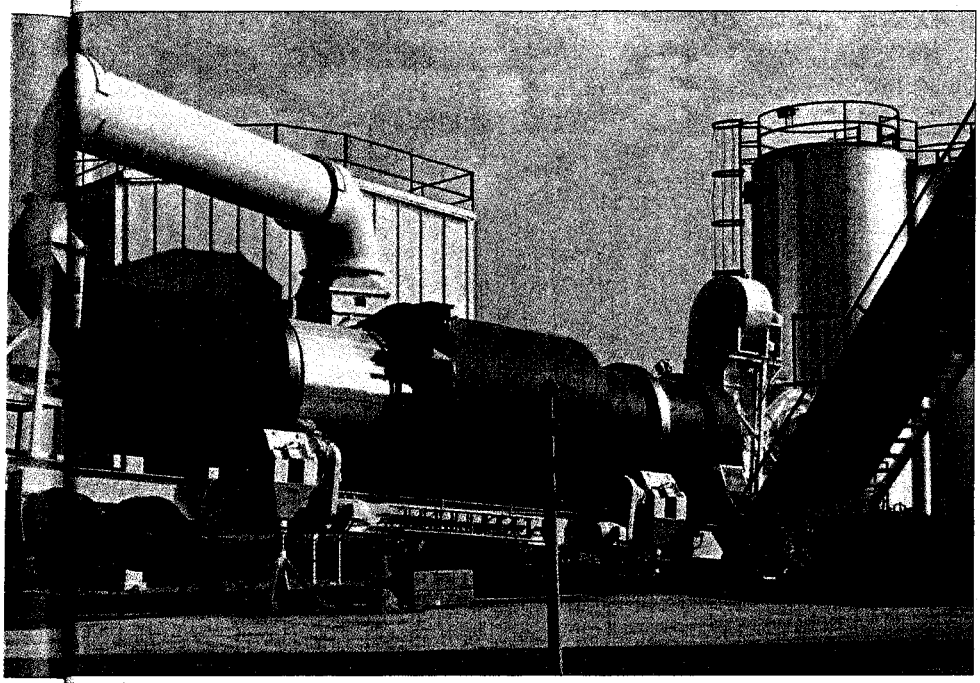
RAP AND SUPERPAVE

Specifications in Superpave, the current federal system of volumetric mix design, did not provide for the use of RAP. It was used extensively before Superpave, and with the proper design work, its use can be accommodated by Superpave. According to NCHRP 9-12, a study from Purdue University, continued RAP use is desirable because:

- RAP has performed well in the past and is expected to perform well in Superpave mixtures, if properly accounted for in the mix design
- The use of RAP is economical and can help offset the increased initial costs sometimes associated with Superpave binders and mixtures
- Using RAP conserves natural resources and helps with disposal problems.



When designing asphalt mixes with RAP, technicians seek to add virgin binder that complements the properties of the asphalt in the RAP. NCHRP 9-12 reports that a subgroup of the FHWA Superpave Mixtures Expert Task Group developed some guidance for the use of RAP based on past experience. These guidelines established a tiered approach for RAP usage. Up to 15% RAP could be used with no change in the virgin binder grade. With between 15% and 25% RAP, the virgin binder grade should be decreased one grade—to soften the blend—on both the high and low



Terex Roadbuilding's TRIPLE-DRUM asphalt plant is proficient at running high percentages of reclaimed asphalt pavement. Photo: Terex Roadbuilding, Oklahoma City

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temperature scales. By softening the blend, engineers aim to improve the fatigue resistance of the mixture. For more than 25% RAP, blending charts should be used to determine how to design the binder grades.

"Some of our field engineers are more liberal than others in their acceptance of RAP," said Mike Heitzman, state bituminous engineer with the Iowa DOT. "In general we allow RAP in intermediate and base courses. To give us more control of surface mixes, RAP is only permitted by the engineer's approval."

RAP ON THE INTERSTATE

"In 2003, we had a project that allowed 26% RAP in the surface and intermediate courses on an Interstate 35 project near the Missouri border," said Heitzman. "That area of the state does not have an abundance of good virgin aggregates."

In the transition to Superpave, Iowa simply translated all of its successful Marshall mixes (hammer-compacted designs) to the use of a gyratory compactor. "In general, we see 10% to 20% RAP in about 15% to 20% of our mixes," said Heitzman. "By our mix design method, once the contractor reaches 20% RAP, we automatically soften the binder grade by one temperature

entum

Various methods are available for paving

increment (one grade). For example, if the project required PG 64-22, and the mix design used 21% RAP, the virgin binder used would be a PG 58-28." (The first number is the high-temperature durability point in degrees Celsius, and the second number, such as a minus 28, is the low temperature durability mark.)

"If a mix designer gets up to 30% RAP, then we do an actual laboratory procedure to determine what grade of asphalt we would soften to," said Heitzman. "In

RAP is desirable for highways because it conserves natural resources and can help with disposal problems.

Foamed asphalt **saves money and resources**

From coast to coast, road agencies and road builders in North America are waking up to the tremendous benefits that base recycling with foamed asphalt can bring to their taxpaying customers," said an enthusiastic Stuart W. Murray, president of Wirtgen America Inc., writing in his company magazine.

Wirtgen America, Nashville, Tenn., is one of at least three North American companies that market systems for mixing foamed asphalt with in-place, pulverized asphalt pavements and base materials. Several specialty contractors across North America offer the technology; systems are also marketed by Caterpillar Paving Products, Minneapolis, and Terex Roadbuilding (formerly CMI Corp.) of Oklahoma City.

"Foamed" or "expanded" asphalt is created by mixing a small amount of water with hot asphalt cement and spraying the foaming mixture into the cutting chamber of a pavement remixer or stabilizer. The foam is created by a reaction very similar to tossing water droplets into hot oil. The big reclaimer-stabilizer units work much like asphalt milling machines, but their cutters go full-depth—typically 6 to 9 inches deep through the pavement and into the base. The foamed liquid asphalt is blended with the pulverized asphalt pavement during the in-place mixing. Compaction follows, and usually an asphalt overlay is applied over the stabilized base.

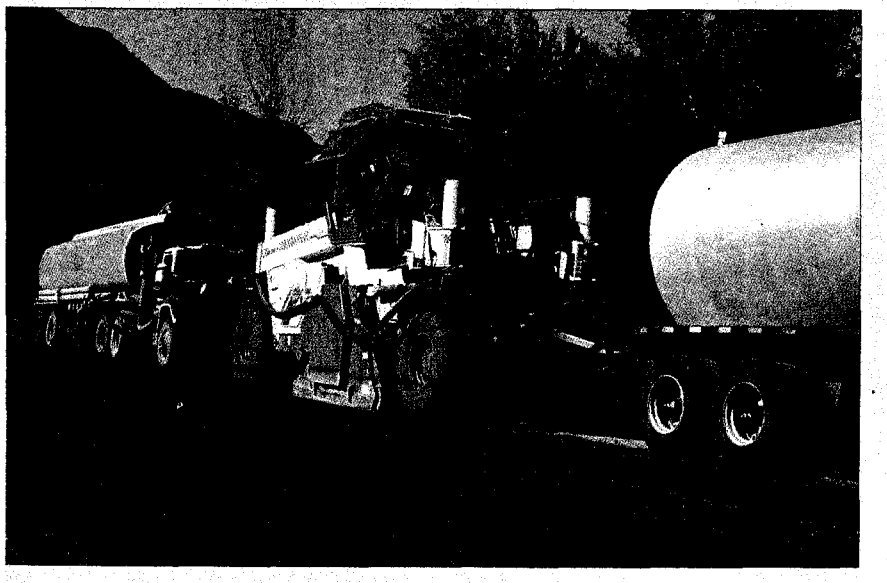
"It's a process used on roads that have failed structurally," said Ed Kearney, director of engineering for Wirtgen America. "You're upgrading a road for which just placing an asphalt overlay won't do."

Kearney reports applications of foamed asphalt in Illinois, Ohio, Georgia, New Jersey, New York, California, and Maine—and several in Canada. "The state of Maine did 100 centerline miles of foamed asphalt in the summer of 2004," said Kearney. "That's double the miles they did in 2003. The number of foamed asphalt machines has been increasing steadily. Most of the reclaimers that we sell now have the foam package on them."

Foamed asphalt has been used in Iowa as well. "We started using foamed asphalt four or five years ago," said Mike Heitzman, state bituminous materials engineer, Iowa DOT. "We rewrote our cold-in-place recycling specification to allow either the use of foam or emulsion. But we only allow foam with full-depth recycling. Our projects have run from 7 to 11 inches deep." One recent foam project involved 5 miles of full-depth reclamation on S.R. 48 in southwest Iowa.

Pavements treated with foamed asphalt can be opened almost immediately to traffic, including trucks. "It greatly increases the strength of a pavement," said Kearney.

Advocates point out that the foamed asphalt process rebuilds a pavement without mining new aggregates, which are in ever-shorter supply. And the process saves money because it spares the expense of milling and trucking reclaimed pavement to the plant, then back to the road.



Foam stabilized base is in the foreground as a Wirtgen WR 2500 S foams the other side of the rural road. Liquid asphalt from the tanker at right is mixed with water from the tanker at left in the mixing chamber of the reclaimer. Photo: Wirtgen America Inc.

Cold recycling
using existing resources

Cold recycling is not a new method of rehabbing deteriorated roadways. For the past 50 years or more, cold recycling, often called stabilization, has been practiced with equipment including rippers, scarifiers, and pulvimixers that have mixed stabilizing agents into the underlying materials.

Today's methods of cold-in-place recycling (CIR) are far more sophisticated, and involve a train of machines that pulverize the asphalt, mix it with emulsion and a bit of water, and spread the reclaimed material down for compaction. CIR is sometimes called partial depth recycling, because some of the pavement is left intact. The cutter does not penetrate through the pavement into the base; that is a different process called full-depth reclamation.

E.J. Breneman's cold-in-place recycling train is led by a 4500-gallon tanker carrying emulsified asphalt. Next is a down-cutting Caterpillar 750C milling machine, which creates a 2-inch-minus material and mixes it with 2% emulsion by weight. The material is conveyed into a windrow elevator, which lifts it into the paver in the rear. Compaction and an overlay follow. Photo: E.J. Breneman

CIR is slowly gaining popularity, said Mike Polak, a partner with cold recycling contractor E.J. Breneman LP, Reading, Pa. Polak is a past president of the Asphalt Recycling and Reclaiming Association. Last year he performed 25 different CIR projects in four states—most were in Pennsylvania while the others were in Maryland, Delaware, and Florida. In size, the projects ranged from 5000 square yards to 30,000 square yards.

"I would say, confidently, that cold-in-place recycling has grown at about 10% a year for the past five or six years," said Polak. "In the state of Pennsylvania there are now three companies that do CIR; when we started back in 1984, we were one of two companies."

Polak said CIR can slash between 20% and 50% from the cost of conventional removal and replacement of pavement materials. The process involves no trucking of aggregates or hot mix. "The best aggregates we have are in place already; why not reuse them," said Polak.

"The process is growing, but you've got to educate people, and it's not an easy sell," said Polak. He reports three satisfied customers in Maryland:

- Harford County has been doing CIR for 10 years
- Frederick County started CIR four years ago
- Howard County did its first CIR project in 1998.

All three Maryland counties are very happy with cold-in-place recycling," said Polak.

The use of RAP is economical and can help offset the increased initial costs sometimes associated with Superpave binders and mixtures.

fact, when any amount of RAP is used, a sample comes into our laboratory in Ames, and we run an extraction test to quantify the binder content in the RAP. Then the mix designer accounts for that quantity of binder in his final mix design."

Just as Iowa did, many states have begun allowing the use of 20% RAP with no change in binder grade, said Brian Prowell, P.E., assistant director of the National Center for Asphalt Technology at Auburn University. Fractionation of RAP, said Prowell, will allow producers to increase the percentages they can run. "We've seen percentages of 20% to 35% RAP without failing the required PG grade and without dropping back to a softer binder," said Prowell. Fractionation refers to the practice of separating RAP into component sizes, just like aggregates. "Fractionation is where the market is headed because that way, producers can save more money and compete more effectively," said Prowell. **PW**

— Brown is a freelance writer based in Des Plaines, Ill.