

NB West Mixes the Recycle Options for Missouri

NB West Contractors uses a variety of recycling methods in its push for green mix design and paving methods in the asphalt industry.

From warm mix additive to RAP, RAS & PMA, this producer/contractor offers DOT more than smooth pavement results

by Sandy Lender



In the state of Missouri, recycling is a hot topic. The Missouri Department of Transportation (MoDOT) is one of the leading states to perform research and fund projects that will get recycled asphalt shingle (RAS) material into pavements in a sound manner. For Earth Day 2010, MoDOT officials went to the site of NB West Contractors, Sullivan, Mo., to film two videos that educate the general public about the importance of recycling methods in asphalt paving.

One of those methods, the use of RAS, factors into project number J6P2139 that NB West crews performed for MoDOT this summer. Not only did NB West smooth out Route 47 from the Washington City limit to Highway 50 in Franklin County, the contractor saved the state \$42,697.00 on a shoulder mix for the project and provided additional performance information for the use of RAS with polymer modified asphalts (PMAs).

Steve Jackson, manager for NB West, explained the importance of the mix designs used on the project.

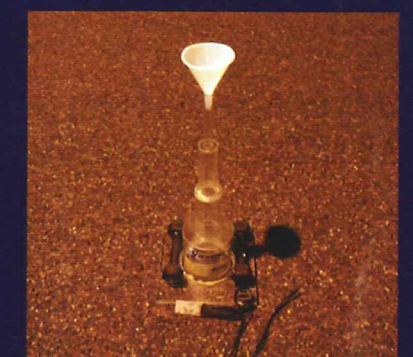
What an Absorptive Rock You Are

A rock's formation, porosity and temperature affect how much liquid asphalt cement or additive it'll take on. MeadWestvaco's Everett Crews gives a summary of how a piece of aggregate's past interplays with Evotherm's present, and how a producer can influence that interaction with a little temperature control.

"A number of benefits arise from the lower mix production and pavement construction temperatures that Evotherm technology enables. One of these benefits is decreased asphalt absorption into the pore structure of the mineral aggregate.

"At normal hot mix temperatures, too much asphalt may be absorbed by the aggregate, and effective binder content may decrease to a point that the mix is rendered susceptible to premature aging problems like embrittlement, cracking and ravelling. By using Evotherm at lower production and construction temperatures, we reduce the degree of absorption.

"This is extremely important because many abundant, readily-available aggregate sources tend to be absorbent. Some limestone seams, for example, may yield stone of high porosity, if the limestone is young in geological terms or if the seam was not subjected to high compressive forces as it formed beneath the Earth's surface. Rhyolitic stones are igneous rocks, but they too can be porous, because they are formed from extrusion of magma above ground where it cools very quickly leaving it more porous than igneous rocks like granite, which form as magma cools very slowly beneath the Earth's surface."



Quality assurance personnel for NB West used the AP-1B falling-head permeameter from Gilson to test the new pavement non-destructively.

The Mixes

NB West's lab and quality assurance team members took extra samples to get plenty of data for the mixes on the Route 47 project.

The first mix that was used was a 9.5 mm nominal maximum aggregate size Superpave mix with PG70-22 PMA. This mix was placed ¾ inch thick as a leveling course. This mix uses 4 percent recycled tear-off shingles and 11 percent RAP.

The second mix was a 12.5 mm nominal maximum aggregate size Superpave mix designated as SP125CLP. This mix contains 5 percent recycled tear-off shingles and 10 percent RAP with PG70-22 PMA and Evotherm 3G warm mix additive.

Also, a revised value-engineering proposal from NB West, approved in March, downgraded the mix on the shoulders from the SP125CLP to a BP-1, saving MoDOT \$42,697.00.

"Currently MoDOT specifications do not allow shingles to be used in mixes with polymer modified asphalt cement," Jackson said. "This job is being done as a research project to gather performance information."



Producing mixes for the Route 47 project took time and effort from the quality control crew.

"This mix is the first time that RAS is being allowed by MoDOT in conjunction with polymer modified asphalt. Up 'til now RAS could only be used with neat asphalts. This project is a trial for RAS and PMA in the state of Missouri. MoDOT and Dr. Chris Williams are doing considerable testing on this mix as part of the evaluation process. This research may be part of the pooled fund study for shingles in asphalt in which MoDOT is the lead state. Joe Schroer from MoDOT approached me about doing a warm mix research study with the FHWA. Unfortunately the FHWA was not able to join us on this project."

Joe Schroer, MoDOT field materials engineer, also worked with Jackson on the video MoDOT produced concerning RAS. In that piece, his remarks show the state's commitment to RAS use. "We use shingles in most of our general asphalt paving mixtures, which comprises about 80 percent of our mixtures right now."

The video reports that MoDOT saved more than \$20 million on resurfacing projects in which recycled asphalt and shingles were used and that more than a dozen Missouri contractors use shingles as a standard part of their business. Out of those contractors, NB West was selected as the spokesman for the method.

"Instead of all these shingles being pushed into a landfill, we're capturing them," Jackson said for the camera. He explained the process in layman's terms for the general public to understand. First, roofing contractors bring the shingles to the contractor; the contractor grinds them to a useable size to get the most oil out of them; and then the contractor puts that product back into the roads.

For the Route 47 project, NB West used 5 percent RAS in the mix. The Missouri limit is 7 percent, but Jackson explained their volume.

"Missouri has a limit of 7 percent RAS that can be used in a mix design. If you have more than 30 percent virgin asphalt cement replacement you have to start developing blending charts and use a softer grade of asphalt. Typically 7 percent shingles is about a 30 percent asphalt cement replacement. Most of our mix designs use 3 percent RAS. We decided to use more shingles on this mix design to learn more about RAS, warm mix, and polymer modified asphalt."

The RAS is only one aspect of the process NB West used on the Route 47 project in late June. The lab techs knew the crew would have a long haul time of approximately one hour for the job and they had an aggregate with a low absorption rate to think about when it came to mix design. So they turned to a known additive for help.

"The aggregate for this project has a very low absorption ~1.0 percent," Jackson said. "The surface mix is a SP 125CLP. The LP stands for Limestone Porphyry. We are using a Rhyolite from Iron Mountain Trap Rock. The other coarse aggregates are Dolomite with very low absorption.

"We are using a warm mix additive to reduce emissions, aid in compaction and maintain workability after a long haul," he continued. "We decided to use Evotherm 3G on this project because of the long haul (approximately 1 hour), as an aid to achieving density, and to achieve a bonus on our tensile strength ratios (TSRs). We have also had more problems with our tires on the drum cracking since we started using RAP and RAS. Our theory is that superheating the aggregate to dry out the RAP and RAS is creating more stress on the drum. By using the Evotherm 3G M1 we are able to reduce our drying temperature and reduce our plant maintenance. The Evotherm product works with any residual moisture in the RAP and RAS to achieve better coating and allow us to drop our mix temperatures."

Everett Crews, the technology development director for MeadWestvaco Asphalt Innovations, North Charleston, S.C., explained the process for readers.

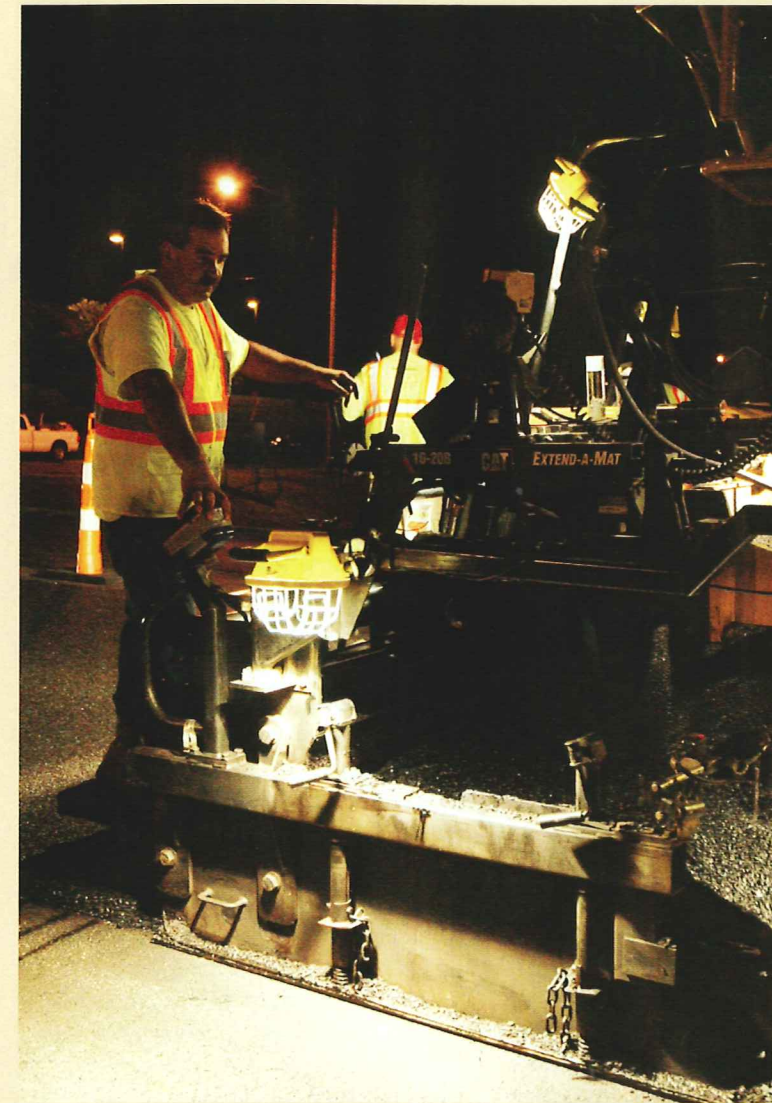
"The Evotherm surfactant package does not act by modifying only the viscosity of the binder. Rather it modifies the overall rheological

response of the binder to high shear events like rolling under a multi-ton vibratory compactor. The specially-formulated surfactants enable the binder to behave as if it were at much higher temperature, so that the Evotherm mix can be discharged from the transport truck, processed through the paver and screed, and finally compacted to target densities, even when the Evotherm mix is 35 to 55 degrees Centigrade below the normal compaction temperature of hot mix."

When adding RAS to the mix, Jackson didn't see any impact to the ratio of additive needed.

"The absorption of the liquid AC does not seem to be impacted. Our AC content testing was very consistent for this project. The Evotherm 3G M1 dosage rate is calculated at 0.5 percent of the total asphalt content, not just the virgin asphalt content. We have to add 0.65 percent Evotherm to the virgin asphalt cement to achieve 0.5 percent dosage in the mix."

Again, Crews agreed with Jackson's assessment. "A number of projects using mixes containing RAP and up to 5 percent RAS have been completed successfully



Steve Jackson explained that the joints on the project were built without a wedge maker due to the changes in mix design. "The joints are being built as a butt joint. The mainline is a Superpave 12.5mm mix and the shoulders are a 35 blow Marshall mix design so we can't use a joint maker. The centerline joint is also a standard joint."



Shingle waste is delivered to the plant site.



After grinding, the waste shingles are stockpiled as RAP would be.



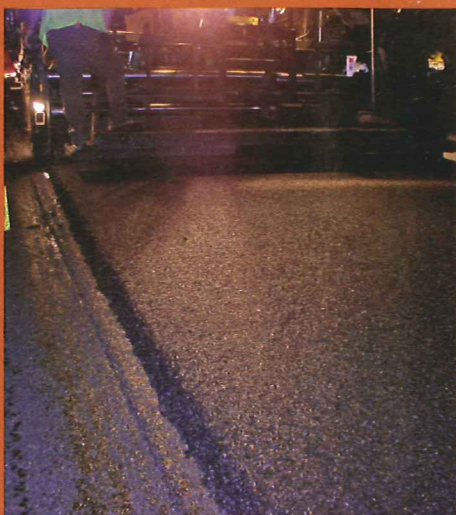
A loader feeds RAS to the bins.



The burner uses #4 recycled fuel oil to heat materials.



The final mix is loaded for its one-hour haul to the Route 47 project site.



The NB West crew uses an SB2500 from Roadtec, Chattanooga, to feed the polymer-modified warm mix asphalt to an AP1055D from Caterpillar Paving Products to produce a smooth, gorgeous mat.



using the standard dosage of 0.5 percent Evotherm by weight of total binder... (D)osage is based on total binder content."

When work started, the NB West crew was only required to mill the transitions and side streets prior to placing the SP095C mix. As Jackson explained, "This mix was used as a leveling course to improve smoothness." The millings have been stockpiled at the NB West plant for use on other projects.

The plant itself is a Stansteel BD400P, rated at 400 tons per hour (TPH). To get smooth and steady production, the crew ran at 200 TPH for the duration of the project.

"200 TPH is our typical production rate for Superpave," Jackson said. "We like to stay at a constant production rate throughout the project to maintain the volumetric properties of the mix."

The weather also influenced the properties of the mix. Jackson explained how.

"The first night on the job we had an excessive amount of dust in the mix," he lamented. "The dust closed in our air voids and caused us problems. We had above average rainfall right before the project started. The aggregate was produced during that time and may not have screened as well as if it was drier. We checked our stockpiles and developed a map of the stockpile based on the gradations that we ran. During mix production we had the loader operator load out of the 'cleaner' part of the pile. Our volumetric properties remained steady for the remainder of the job."

Part of quality control and quality assurance (QC/QA) for NB West involved trying out the mix before taking it to the field. "We ran a test strip at our plant site," Jackson said. "We have been using our test strips to pave our aggregate stockpile area to allow the aggregate to dry quicker and reduce our fuel consumption. We also ran this mix on another maintenance project to give us an opportunity to check plant produced mix."


Another aspect of quality assurance for the NB West crew involved the AP-1B Field Permeameter from Gilson Company, Inc., Lewis Center,

Ohio. This piece of testing equipment allowed the team to take measurements in the field without compromising the integrity of the newly placed mat. For about \$530+, the crew has a tool weighing about 25 pounds that eliminates coring, patching and lab testing.

The falling-head permeameter uses Darcy's Law¹ to determine the rate of water-flow through an asphalt pavement. According to Gilson's website, researchers at the National Center for Asphalt Technology (NCAT) selected this design for its "close correlation with laboratory test results."

The concept is that some Superpave mixes can still be permeable to water, even when crews compact them to their acceptable air void ratio. When QA techs field test permeability on the spot with the AP-1B, pavement destruction is taken out of the picture. As the Gilson website states, "Corrections to mix and placement procedures can be implemented right away. Testing and subsequent calculations can usually be completed in 10 to 15 minutes by one technician. The simple procedure means no extensive training is required."

Management at NB West incorporates environmentally sound practices whenever it can, whether it's for a MoDOT research-heavy project or for a private customer. As Jackson pointed out, the company has paved the aggregate stockpile area to reduce fuel consumption and uses recycled #4 fuel in the plant for burner fuel. For the Route 47 job, they used 10 percent RAP and 5 percent RAS in the main mix design, and used the Evotherm 3G M1 additive to reduce the mix production temperature from 350 degrees F to 270 degrees F, offering fewer emissions and reduced heating resources.

In the end, the recycling efforts NB West exhibits daily, and in MoDOT video productions, offer good lessons for others seeking environmentally friendly ways to reduce costs and natural resource consumption. 

¹ Darcy's Law: $Q = KIA$ (where Q = discharge; K = hydraulic conductivity; I = hydraulic gradient; and A = area of flow) Used to determine the ability of a particular material to allow water to pass through it (Source: Environmental Geology)