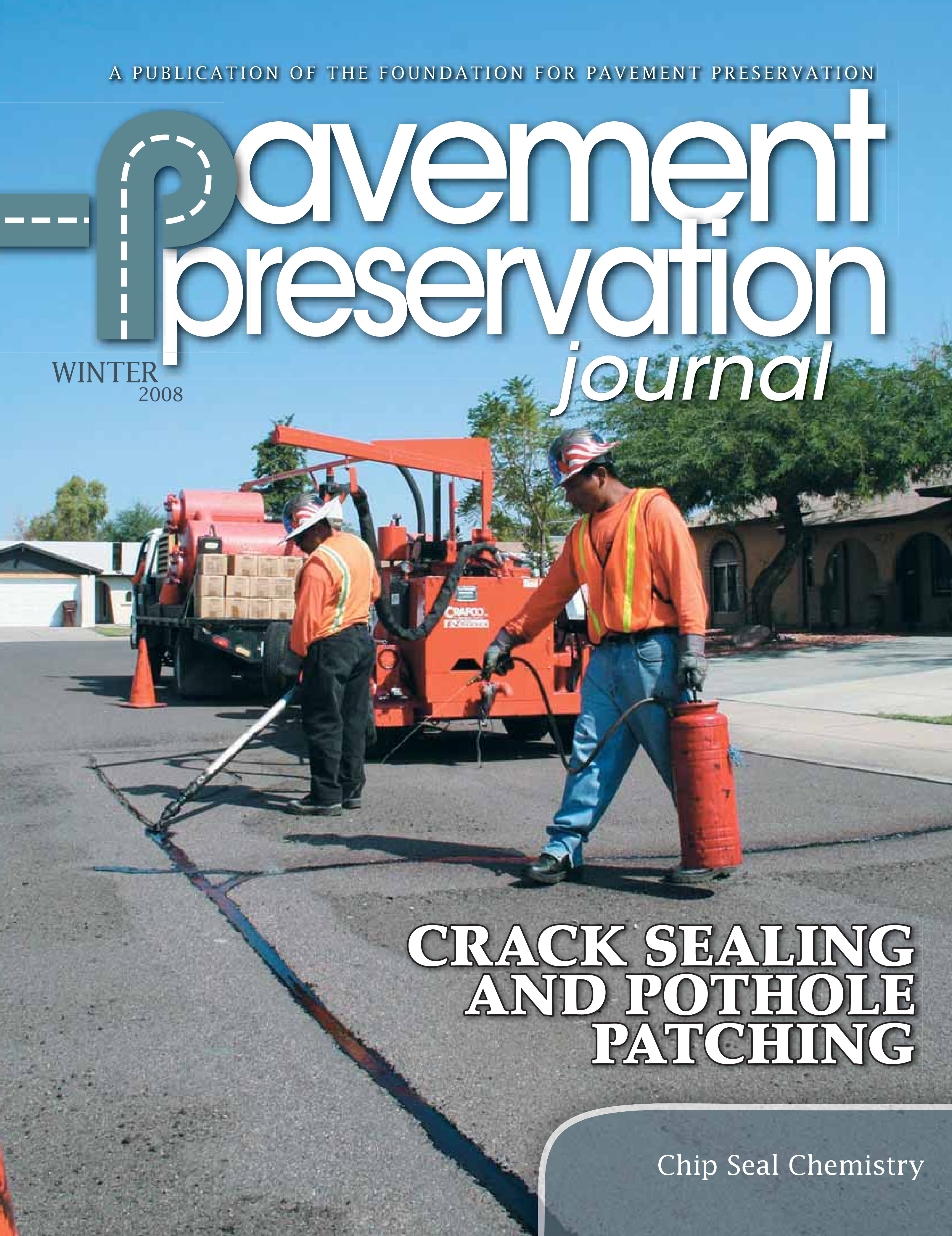

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WINTER 2008

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pavement preservation journal

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Cover: To preserve pavements, staff forces of City of Tempe, Ariz., conduct active crack sealing program. See article Page 11. Photo courtesy of Crafco Mfg. Inc.

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By Bill O'Leary
President
Foundation for Pavement Preservation

International Pavement Preservation Conference Will Set Pace for Future

THIS summer, in advance of the struggle over next year's federal program reauthorization, and in the waning months of the Bush administration, U.S. Transportation Secretary Mary Peters set out a bold strategy to reconfigure the federal surface transportation program.

In Atlanta, in June, in what she said was a "clean break with tradition," Secretary Peters unveiled a plan to "refocus, reform and renew the national approach to highway and transit systems in America."

But what caught our eye was her gambit in outlining a renewed federal focus on maintaining and improving the Interstate highway system. "The federal government [would] take responsibility for maintaining and improving the condition and performance of the Interstate highway system," she said. "While these highways represent just one percent of the nation's roads, they carry over 25 percent of the nation's traffic, and three-quarters of the nation's long-haul trucks. Making sure this network is safe, well maintained, and uncongested must be a key federal priority."

Now anyone who has looked our way in the past decade has seen our efforts in promoting maintenance and preservation of pavements as a way of leveraging tax dollars. In this we are joined by the U.S. DOT through the Federal Highway Administration's (FHWA's) Office of Asset Management and its Construction and System Preservation Team, by the American Association of State Highway & Transportation Officials (AASHTO), and a growing number of state DOTs and forward-looking local governments.

Now, we can look forward to an exciting, world-class event in a year and a half that will throw even more attention on pavement preservation as an agency focus, and bring pavement preservation practitioners from around the world to the same table.

That event will be the **First International Conference on Pavement Preservation**, to be held in Newport Beach, Calif., on April 12-16, 2010.

From around the globe, the First International Conference on Pavement Preservation will bring together researchers and experts working in the field of pavement preservation, to help them exchange ideas and discuss critical issues and concerns.

This conference is being co-organized by the California Department of Transportation (Caltrans), FHWA, and your friends at the Foundation for Pavement Preservation (FP^2), with the participation of the California Pavement Preservation Center (CPPC) and the National Center for Pavement Preservation (NCPP). We expect other agencies to join with us in the months to come. Its main theme will be *pavement preservation and sustainability*. The conference will address an array of issues that are relevant to the pavement preservation community.

Presentations, now being accepted, will focus on these hot topics:

- Benefits of pavement preservation, both economic and environmental;
- Integration of pavement preservation into pavement management;
- Pavement preservation treatments for flexible pavements, including design, materials, constructability, and performance;
- Pavement preservation treatments for rigid pavements, including design, materials, constructability, and performance;
- Pavement preservation strategy selection;
- The funding of pavement preservation; and
- The promotion of pavement preservation to the public and our elected leaders.

I hope you will strongly consider joining all of us at FP^2 in supporting and attending this worthy and exciting event the year after next. More information is available at www.pavementpreservation.org/icpp/index.php. And watch the pages of *Pavement Preservation Journal* for updates as the First International Conference on Pavement Preservation draws near.

Selecting the Right Pothole Materials is Complex Job

The FHWA's June 2003 revised *Distress Identification Manual* for the Long-Term Pavement Performance (LTPP) program describes potholes as bowl-shaped holes of various sizes in the pavement surface, with a minimum width of 150 mm (6 in.). *Low-severity* potholes are less than 25 mm (1 in.) deep, *moderate* from 25 to 50 mm (1 to 2 in.) deep, and *high severity* greater than 50 mm (2 in.) deep.

For the record, LTPP suggests recording the number of potholes and square meters of affected area at each severity level. "Pothole depth is the maximum depth below pavement surface," the manual says. "If pothole occurs within an area of fatigue cracking, the area of fatigue cracking is reduced by the area of the pothole."

Potholes always are associated with HMA fatigue damage and water damage, and the most egregious offenders appear in late winter or early spring, depending on the climate, after a series of freeze-thaw cycles.

Water enters the road base through surface cracks or from the sides of the road, the T2 center points out. "During the winter the water freezes, drawing more water into the base material. The February and March freeze-thaw cycles often cause frost heaves, which let in more water. The ice melts from the top down, leaving a trapped pool of water."

Potholes are the bane of late winter maintenance.

Potholes aren't just a popular nuisance; they constitute a dangerous safety hazard that can cause vehicles to veer suddenly in traffic, lose control after contact, or result in substantial damage to vehicles.

If you use quality, high-performance materials, potholes need not wait until warm weather for patching. New patching products can work superbly in virtually any temperature range. But sophisticated, value-added patch products come at a higher price and may result in costly product being expended on a disintegrating pavement that should be scheduled for reconstruction.

Road agencies now may patch potholes, permanently, as soon as they're discovered, even when the substrate is wet. Self-propelled, near-robotic pothole patching machines can service each step of the pothole patching process, using as few as one operator.

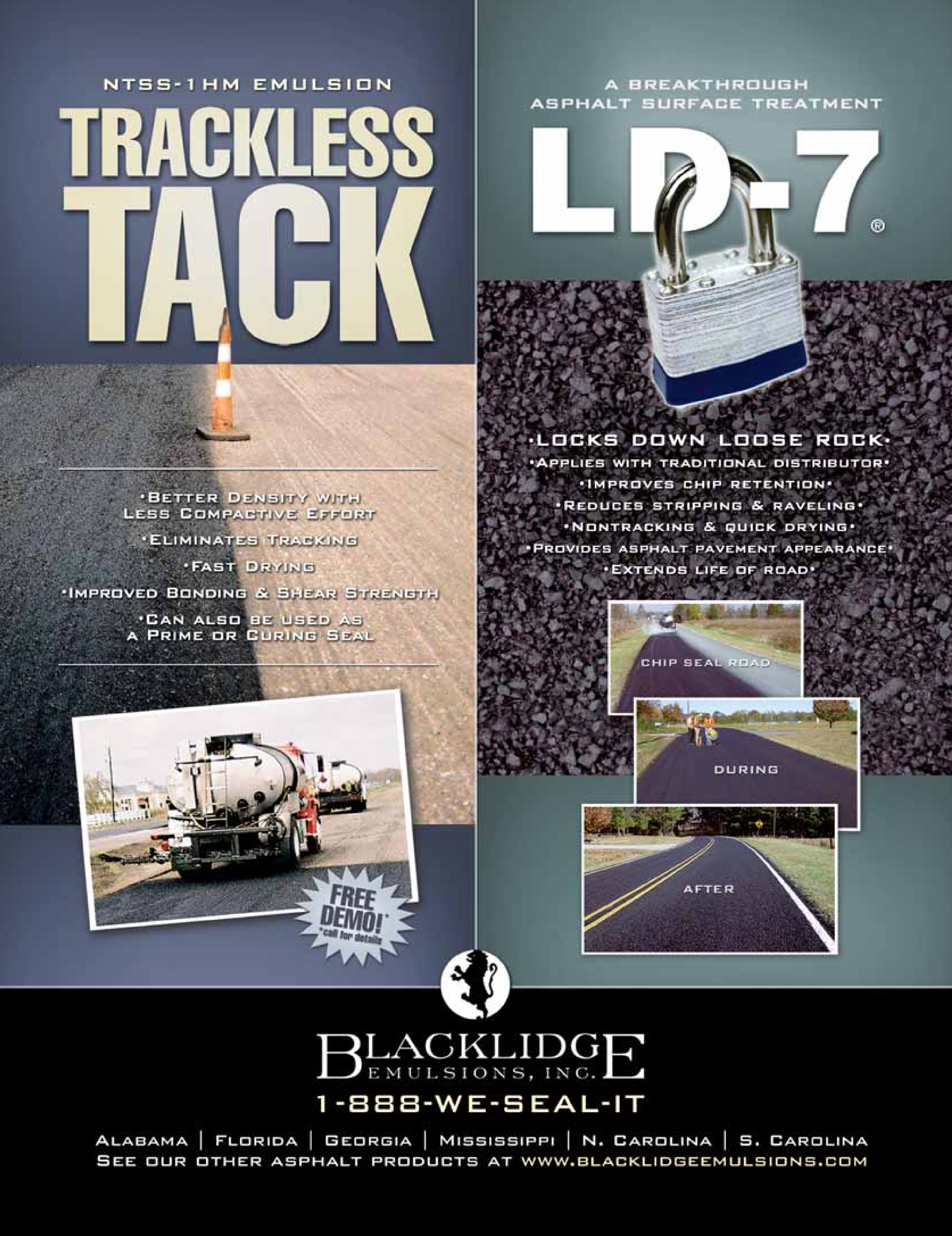
Research from the Strategic Highway Research Program (SHRP), continued under the Federal Highway Administration's (FHWA) Long-Term Pavement Performance program, shows that high quality materials are the most important variable in patch success, and that old-fashioned "throw-and-roll" cold-mix patching was as effective as any other method, so long as quality materials were used.

Nonetheless, experts maintain that the best solution is to spend more money up front and build a well-drained roadway so potholes don't appear in the first place. Potholes will happen because there isn't enough money per section of pavement at the beginning.

Technique and tamping are essential for a quality patch.

"The secret is placing a binder or liquid coating in, packing material in from the bottom, consolidating it, and packing again, just like the dentist does with a filling," said John O'Doherty, project specialist, National Center for Pavement Preservation at Michigan State University, and a former maintenance materials research engineer with Michigan DOT. "You don't want fluids of any sort in there; you want it to be absolutely rock-solid."

Ironically, the time that potholes appear is not the optimum time to be making permanent patches. "Anything put in now is probably going to be a stop-gap until weather improves," O'Doherty said. "It's too cold for the materials to work properly. The ideal time is summer, when things are fluid and sticky. In winter the material congeals and is not easy to work with." Unfortunately, he said, agencies have no choice if they want to keep the lanes safe for drivers.



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Tempe's Crack Sealing Grows as City's Budgets Stay Same

By Cathy Somers

With more than 160,000 residents calling it home, the City of Tempe is the seventh largest city in the state of Arizona.

Part of what makes Tempe such a vibrant, bustling city is the more than 51,000 students who attend the main campus of Arizona State University, which has grown into the largest university in the nation. Tempe also keeps busy with the numerous sporting events it hosts, including a past Super Bowl, the annual Insight Bowl and spring training for the Los Angeles Angels of Anaheim; and, of course, is home to the ASU Sun Devils.

Keeping up with the needs of this community is not a daunting task for the Tempe Public Works Street Maintenance Section, and the proof is evident as you drive the streets of the city.

Tempe has been handling its crack sealing in-house for so long that it predates any of the street department's current employees.

"We are very fortunate because the residents and elected officials value great streets. It's expected," said Denise Brewer, superintendent of streets for Tempe.

Because of the high expectations for quality roadways, the department has not had to face any budget cuts, even under the current economic conditions, but its yearly budget of $6 million is not increasing either. Toby Crooks, civil engineer for the city, has had to modify its pavement preservation program to cope with the non-increase of funds, which is leading to an increase in its crack sealing.

The city has been handling its crack sealing in-house for so long that it predates any of the street department's current employees. "I started working here 23 years ago, and my first job was running a crack sealing machine," said Pat Romer, one of four team leads employed under John Sammons, street supervisor.

City of Tempe staff has 1,241 lane miles to maintain

The team leads rotate every six months, and all employees are cross-trained, required to rotate and able fill in any gaps as needed within the department. Therefore, if the crack sealing crew is short on bodies, somebody can be moved over from milling or sweeping or vice versa.

With 1,241 lane miles to maintain, the city has been employing an engineering firm to do road evaluations and pavement analysis. However, as part of ongoing changes, the city will be moving to a computer-based geographic information systems program.

To execute crack sealing, Tempe owns two EZ Pour 400 melters, two Crack-Vac machines and four routers, all manufactured by Crafco, Inc., located in the neighboring city of Chandler.

Crack sealing teams are rotated to perform cross-platform training with other equipment

With few exceptions, Tempe, Ariz., does all crack sealing with own forces

Tempe's decision to go with 400-gallon capacity melters stems from a preference for the added capacity offered with the larger units. Crews use up to 2,500 lbs. of sealant in residential areas and 5,000 lbs. in arterial roadways every day. The city uses Crafco PolyFlex 3 and PolyFlex 4 sealants, depending on the time of year and temperature. Crafco *Detack* is also applied on the treated cracks immediately after sealant application to remove surface tack and allow quicker opening to traffic.

Having the luxury of mild winters, Tempe is able to run its crack sealing program year-round. During the hot summer months, where the average temperature in July is 104 deg F, the city uses the PolyFlex 4 material to seal cold joints and curb lines. PolyFlex 4 is able to withstand the brutal summer temperatures and still set up, not causing any tracking issues.

A majority of Tempe's cracks are treated during the cooler months of October/November through April/March, when the cracks are opening up. The sealant choice during these months is the PolyFlex 3.

Tempe is a big advocate on routing all thermal (moving) cracks. "Using a router creates a reservoir, gets the material seated and supplies a clean surface to stick to; it bonds better," said Brewer. The city also makes sure to seal all edge joints along the curb and cutter to prevent a source of water penetration.

One to two years after crack sealing, the city will do a cape seal. With this process, Tempe is able to keep the streets in excellent condition and only have to touch the roads every six to seven years.

Tempe prefers doing the crack sealing in-house to control the quality of workmanship, but there are occasions where some of the work still needs to be outsourced. When these instances arise, the city still purchases the sealant and provides it for the contractors and is then able to keep control over the material being used.

In the midst of pavement preservation program changes, Tempe still is proud that it is able to maintain its streets by providing the treatments needed. The city is able to cut back on the frequency of more costly treatments and crack seal now to prevent further damage, then re-evaluate in a couple years to see if further treatment is required.

"The No. 1 easiest thing you can do for your streets is crack sealing," Crooks said. "We are having to be more realistic and spend the money where it needs to go."

With most municipalities facing similar challenges, it's encouraging to know that the City of Tempe has been able to find solutions that work.

Cathy Somers is marketing assistant at Crafco, Inc., Chandler, Ariz.

California PPC Works with Caltrans on Innovative Projects, Database

By Mary Stroup-Gardiner and Ding Cheng

The California Pavement Preservation Center (CP²C) was founded in July 2006, and is actively involved with Caltrans and the Pavement Preservation Task Group (PPTG) on the implementation or evaluation of new and innovative products.

Other tasks include documenting the benefits of pavement preservation, training and staff development, improving pavement preservation performance, providing technical assistance and promoting pavement preservation throughout the state. Caltrans has provided $5 million per year to encourage the use of new technologies.

INNOVATIVE PROJECTS

Innovation, as defined by Caltrans, is any technology not currently used as standard practice by Caltrans. There

Entry portal to California Pavement Preservation Center's Innovation Database


At the Morro Bay warm mix demonstration project along the chilly Pacific Coast between Monterey and Santa Barbara, participants discuss the workability of the warm mix obtained behind paver screed.

Cold in-place recycling is demonstrated in the City of Chino, Calif.

are five innovative projects that have already been indentified for the 2008 and 2009 construction seasons.

Innovative products being evaluated include:

- **Hot in-place recycling** – Two projects in 2008 and one in 2009.
- **Cold in-place recycling** – Two projects in 2008 and two in 2009.
- **Polymer-modified chip seals** – One project in 2008 and none identified for 2009.
- **Warm mix asphalt** – Two projects in 2008 and none identified for 2009.
- **Rubberized Emulsion-Aggregate Slurry** (REAS) – No projects in 2008 and one in 2009.

The hot in-place recycling (HIR) project will demonstrate the Japanese Hitone equipment and process. This technology is comprised of four components: pre-heating, milling, separating and paving.

The RAP is separated into three different gradations, which are then recombined to produce a two-lift pavement. For the project in District 2, in northeastern California, headquarted in Redding, the gradations will be a dense gradation topped with an open-graded surface course, all completed in one pass of the recycling train.

Most recently, cold in-place recycling (CIR) was placed in the City of Chino, in San Bernardino County, east of Los Angeles. Other California projects will be identified in the upcoming months.

Polymer modified asphalt (PMA) chip seals will be placed in District 11 — encompassing San Diego and Imperial counties in the very south of the state — to evaluate the both the 2007 PMA specification, graded as a PG 70-22, and the 2008 PMA revision, graded as a PG 76-22PM or a PG 76-22TR (tire rubber).

A warm mix demonstration project in Morro Bay generated excitement in the California engineering community. As a result of this demonstration, both District 5 (Pacific Coast between Monterey and Santa Barbara) and District 1 (northwest counties, headquarted at Eureka) engineers have elected to try the mix for their long-haul 2008 projects. The hot mix asphalt (HMA) will be mixed at the standard temperature, but the warm mix additive is expected to provide workability even after mix cool down due to the long hauls, estimated to be from two to four hours.

Innovation, as defined by Caltrans, is any technology not currently used as standard practice by Caltrans. There are five innovative projects that have already been indentified for the 2008 and 2009 construction seasons.

REAS blends crumb rubber into asphalt emulsion at ambient temperatures and then are used in a slurry to resurface roadways. It is estimated that this project can reuse 78 tires per lane mile while improving skid resistance and the pavement life expectancy. These benefits will be evaluated in the upcoming project.

Some of the products currently under investigation include:

- **Micro Surfacing.** New specifications for Micro Surfacing have been tested and evaluated in field sections. These products are being used more and more now that some of the construction issues have been resolved.
- **Fog and rejuvenating seals.** Three test sections are being placed this summer to assist in the development of new performance-based specifications. The testing includes skid testing and tests for stiffness of the mix to ensure safety to the users and that the agents are imparting some positive effects to the existing mixes.
- **Interlayers.** Caltrans placed test sections in District 2 to evaluated the use of different interlayers in combination with chips seals or thin asphalt concrete overlays. These included modified-binder asphalt, poly/fiberglass fabric, AR chip seal and polymer modified emulsion chip seal.
- **AR chip seals.** Caltrans is evaluating, using test sections in District 11, asphalt rubber chip seals. The performance of the current designs in hot climates, with high traffic, has resulted in some bleeding. The design variations include changes in the aggregate gradation and the stiffness of the binder.
- **Asphalt rubber hot mix-open graded (RAC-O) and high binder RAC-O-HB.** Projects in place statewide. They are currently under evaluation.
- **European quiet mix**. One project placed in southern California. It is currently under evaluation.
- **Thin bonded wearing course.** Routinely used since the late 1990s. Caltrans is now experimenting with variations in the gradations and materials.
- **Micro Surfacing.** Caltrans evaluated a new specification now routinely used in California.

The findings from the current and proposed test programs will be used to assist Caltrans and the PPTG in the development of improved specifications for tools not normally used in the state. Caltrans, the PPTG and the Center are trying to identify as many of the applicable tools as possible for use in pavement preservation.

INNOVATION DATABASE

The objectives of developing an innovation database are to help streamline the process for implementing innovation and new products in the areas of pavement preservation and to encourage technical transfer through dissemination of information through a web site.

Version One of the innovation database has been developed by the innovation subgroup and the CP2 Center. The web site for accessing the database is www.ecst.csuchico.edu/cp2c/innovation_database.

The Caltrans' new innovation projects, such as RAC-O-HB, interlayer, fog and rejuvenation seal, chip seal, warm mix, CIR and European quiet pavement are being stored into the database.

The database is securely installed at the College of Engineering of California State University-Chico. It is currently maintained by CP^2 Center staff. Users can obtain usernames and passwords from the center to log in to the database. The database is capable of helping submit innovation proposals, storing comments from reviewers and approving innovations by a PPTG Chair.

There are five different groups of users for the database. The following are the basic roles for each group:

- **General public.** This group was created to help dissemination of innovative technologies. Users can login using "guest" for both username and password. After login, they can browse and view innovations and search innovations by keywords, but they cannot comment, edit or submit proposals.
- **Champions or innovators.** This user group can submit new proposals and view others' innovations. They can also submit a file with their proposal. The format of the file can be a picture, Word or PDF document. For security reasons, they can edit their own innovations, but they can not edit proposals submitted by other champions or innovators.
- **Innovation committee or reviewers**. This user group can review and comment on the innovations submitted. They can also see the comments created by themselves or others, but they cannot edit any innovation submitted.
- **CP^2 Center staff.** This user group can add or edit new users to the database in addition to having all the functions of innovation committee members.
- **PPTG Chair.** The chair can approve innovation status to pre-proposal, proposal, and final report, in addition to the functions of innovation committee members.

We hope the innovation database will help streamline the Caltrans' innovation procedure and boost our efforts at disseminating innovation information.

Mary Stroup-Gardiner and Ding Cheng are associated with the California Pavement Preservation Center.

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TERMINAL BLEND RUBBERIZED ASPHALT BINDERS

In the United States and Europe, approximately 300 million used tires are generated each year. Therefore, in many countries this has been a serious problem due to the lack of landfill space, and environmental pollution caused by burning the rubber. There are many applications in civil engineering to solve this problem. One of them is the utilization of the tire rubber by including it in asphalt pavements.

Terminal blend technology has been used since the mid 1980's in many states. In the terminal blend process, tire rubber is blended into the asphalt binder at the asphalt terminal or refinery and shipped to the hot plant as a finished product with no additional handling or processing. The tire rubber is completely digested into the asphalt to provide Styrene, butadiene, carbon black and aromatic oils yielding a homogeneous material that exhibits excellent storage stability and compatibility with the finished binder formulation. Terminal blend could achieve up to 25% tire rubber content, but in this study a minimum of 10% was used.

In 1998, a research project was conducted at the University of Nevada (UNR) to evaluate the performance of the tire rubber modified asphalt concrete (TRMAC) made with terminal blend binder relative to the performance of crumb rubber modified (CRM) mixtures. The wet process used in the CRM mixtures requires the availability of the blending equipment on the job site, and auxiliary equipment at the hot plant, which results in added cost for the CRM binders.

This research effort was divided into two distinct parts:

a. Evaluate the performance of laboratory produced TRMAC and the performance of laboratory produced CRM mixtures. The primary objective, to compare the performance of gap graded TRMAC (TRMAC-GG) mixture and the gap grade CRM (CRM-GG) mixtures. A secondary objective was to compare dense graded (DG) TRMAC mixture with that of the TRMAC-GG mixture.
b. Evaluate the performance of the field produced TRMAC-GG mixture and compare it to the performance of the laboratory mixtures.

The performances of the lab mixed HMA mixtures were evaluated in terms of their resistance to rutting and fatigue. The Superpave shear test (SST) and flexural fatigue test were used to evaluate the rutting and fatigue properties of the mixtures, respectively. In addition, the performance of the field TRMAC-GG mixture was evaluated in terms of its resistance to rutting, fatigue, thermal cracking, and moisture damage. Based on the data generated from the research, the researchers drew the following conclusions:

- No statistical difference in the rutting resistance between the two GG mixtures exists, even though visual inspection of the laboratory curves suggests that the TRMAC-GG mixture is more rut resistant than the CRM-GG mixture. The most probable reason the performance of the two GG mixtures with the two binders was statistically the same is due to the data scatter associated with the test results for the CRM mixtures. CRM mixtures are typically more variable than other mixtures.
- The DG mixtures are more resistant to rutting than the GG mixtures and less resistant to fatigue cracking when using the same terminal blend binder.
- No statistical difference exists in fatigue performance between the TRMAC-GG and CRM-GG mixtures.
- The resistance of the field TRMAC-GG mixtures to moisture damage is high.
- The field TRMAC-GG mixtures withstood a temperature of -28°C without cracking. This indicates that the field TRMAC-GG mixtures have excellent resistance to thermal cracking which is more than adequate for the majority of California's environment.
- The field TRMAC-GG mixtures withstood the entire 10,000 cycles of loading in the SST without drastic failure, an indication of good resistance to rutting.
- The rutting resistance of the field TRMAC-GG mixtures is similar to the rutting resistance of the lab TRMAC-GG and CRM-GG mixtures. Therefore the field produced TRMAC-GG is consistent with the mix design materials.

		Nevada	California
Property	PG 64-28TR	PG 64-28NV	PG 64-28PM
Original Binder			
Flash Point, Min. °C	230	230	230
Solubility, Min %	97.5	N/A	99
Min.% Tire Rubber Content	10.0	-	-
Sieve, Particles Retained	N/A	0	N/A
Max.R.Viscosity at 135°C, Pa*s	3.0	3.0	3.0
DSR at 64°C, Min. G*/sin(δ), kPa	1.00	1.00	1.00
Ductility @ 4°C, 5cm/min, Min.	-	50	-
Toughness, in-lb, Min.	-	110	-
Tenacity, in-lb, Min.	-	75	-
Mass Loss, Maximum, %	1.00	1.00	1.00
RTFO Test Aged Binder			
DSR at 64°C Min. G*/sin(δ), kPa	2.20	2.20	2.20
DSR at 64°C,Max. (δ), °	80	N/A	80
Ductility @ 4°C, 5cm/min, Min.	N/A	25	N/A
Min. Elastic Recovery @ 25°C, %	75	N/A	75
PAV Aged Binder at 100°C			
Max. DSR @ 22°C G*sin(δ), kPa	5000	5000	5000
Max. S-value @ -18°C MPa Min. m-value @ -18°C	300 0.300	300 0.300	300 0.300

"Terminal Blend technology allows the product to be engineered specifically to meet the climatic conditions defined by the Superpave performance graded PG system"

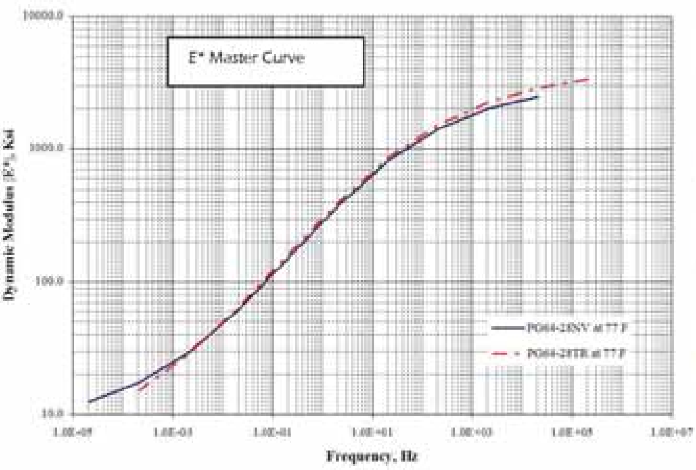
"Terminal blend technology eliminates the need for the blending unit at the job site and reduces the associated costs"

		Nevada	California
Property	PG 76-22TR	PG 76-22NV	PG 76-22PM
Original Binder			
Flash Point, Min. °C	230	230	230
Solubility, Min %	97.5	N/A	99
Min.% Polymer	-	3.0	-
Min.% Tire Rubber Content	10.0	-	-
Sieve, Particles Retained	N/A	0	N/A
Max.R.Viscosity at 135°C, Pa*s	3.0	3.0	3.0
DSR, 76°C, Min. G*/sin(δ), kPa	1.00	1.30	1.00
Ductility @ 4°C, 5cm/min, Min.	-	20	-
Mass Loss, Maximum, %	1.00	1.00	1.00
RTFO Test Aged Binder			
DSR at 76°C Min. G*/sin(δ), kPa	2.20	2.20	2.20
DSR at 76°C,Max. (δ), °	80	N/A	80
Ductility @ 4°C, 5cm/min, Min.	N/A	10	N/A
Min. Elastic Recovery @ 25°C, %	65	N/A	65
PAV Aged Binder at 110°C			
Max. DSR @ 31°C G*sin(δ), kPa	5000	5000	5000
Max. S-value @ -12°C MPa Min. m-value @ -12°C	300 0.300	300 0.300	300 0.300

In 2006, another research project was undertaken at UNR to evaluate the laboratory performance of HMA mixtures designed with terminal blend rubber modified binders (PG64-28TR & PG76-22TR) and polymer modified binders (PG64-28NV & PG76-22NV). These polymer modified binders also meet California PG64-28PM and PG76-22PM specifications. This objective was achieved through a laboratory-based experiment that evaluated the resistance of these mixtures to rutting, fatigue, thermal cracking, and moisture damage. In addition the dynamic modulus was also evaluated. Based on the data generated from the laboratory experiment, the following conclusions were made:

- The moisture sensitivity of the terminal blend (TR) and the polymer modified (NV) binders exhibited good resistance to moisture damage and all were above the 70% criterion for the tensile strength ratio (TSR).

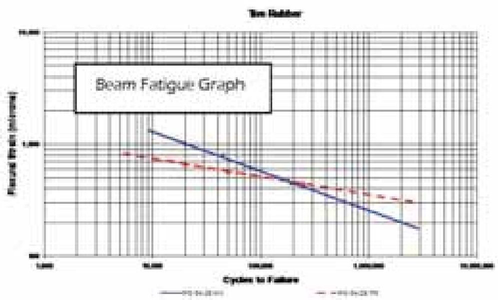
Mix	Air Void,%		Tensile Strength, TS at 77°F, psi				TSR,%
	Ave. %	CV, %	Unconditioned		Conditioned		
			Ave.	CV, %	Ave.	CV, %	
PG64-28NV	6.8	3.4	117	2	111	6	95
PG64-28TR	6.6	2.8	114	10	109	4	95
PG76-22NV	7.2	4.5	132	10	112	8	85
PG76-22TR	7.1	4.6	163	10	139	10	85



- The PG64-28TR & PG64-28NV have approximately equal dynamic modulus. The dynamic modulus of the PG76-22TR mix was higher than the PG76-22NV mix at 70°F.

Temp.	Mix	Mean Rut Depth, @ 8000 cycles (mm)	STD	CV, %
60°C	PG64-28NV	1.7	0.08	4.6
	PG64-28TR	1.2	0.11	9.5
	PG76-22NV	1.5	0.13	8.6
	PG76-22TR	1.2	0.07	5.9
64°C	PG64-28NV	2.1	0.07	4.0
	PG64-28TR	2.0	0.13	6.7
76°C	PG76-22NV	2.7	0.19	7.2
	PG76-22TR	3.4	0.12	3.5

- When the resistance to permanent deformation was compared using the Asphalt Pavement Analyzer (APA), both the NV and TR mixtures showed similar resistance to rutting and were well below the recommended NDOT criterion of 8mm after 8000 cycles.
- When the resistance to permanent deformation of the mixtures was compared based on fundamental testing under the Repeated Load Triaxial (RLT), the PG64-28TR mix showed lower rutting resistance than the PG64-28NV mix while the PG76-22TR mix showed higher rutting resistance than the PG76-22NV mix.
- When the fatigue resistance of the mixtures was compared, the PG64-28TR mix showed lower fatigue resistance than the PG64-28NV mix at strains higher than 500 microns and equal at 500 microns. The PG64-28TR mix showed higher fatigue



resistance than the PG64-28NV mix at strains lower than 500 microns. Additionally, the fatigue resistance of the PG76-22TR mix is lower than the fatigue resistance of the PG76-22NV mix at all strain levels.

Mixture	*Air Voids, %*	*CV, %*	*Fracture Temp. °C*
PG64-28NV	7.0	3.1	-32.8
PG64-28TR	7.0	3.9	-31.0

- The PG64-28TR mix and the PG64-28NV mix showed good resistance to thermal cracking since the fracture temperatures of both mixtures were colder than the low performance temperature of the binders (-28°C).

Phase two of the research, expected to be completed by the end of 2007, will be accomplished using mechanistic analysis to evaluate the combined impacts of mixtures properties and their resistance to the various failure modes along with pavement structure on the responses of HMA pavements to traffic loads. For example, a brief look at the dynamic modulus property of the mixtures shows that the PG76-22TR mix has a higher dynamic modulus than the PG76-22NV mix. This indicates that when both of these mixtures are placed in the same pavement structure under the same traffic load, the TR mix will exhibit a lower tensile strain at the bottom of the HMA layer. Taking this lower strain at the bottom of the TR layer into the fatigue relationships may result in a better fatigue life. This simple comparison shows the significance of mechanistic analysis in understanding the impact of mixtures properties on the performance of HMA pavements.

Both studies showed that the TR blends have excellent performance regardless of whether they are used in dense or gap graded mixtures. Also, it will encourage agencies to use TR binders in their roads as a benefit of recycling tire rubber without jeopardizing performance and quality.

Terminal blend (TR) benefits & advantages:

- *Homogeneous material*
- *No visual residue of tire rubber*
- *Performance graded "PG"*
- *Excellent resistance to weathering*
- *improve cohesion and adhesion bonds*
- *handled like any other binder* (NO SPECIAL EQUIPMENT NEEDED)

Texas Center Studies PMSs as Means to Program Preservation

By Dr. Yetkin Yildirim, P.E

The Texas Pavement Preservation Center is conducting a new study on the best practices of pavement preservation treatment selection. This study examines the current practices of several departments of transportation (DOTs) around the country, as well as the theoretical information that motivate them.

A pavement management system, or PMS, describes an agency's approach to road maintenance. The American Association of State Highway and Transportation Officials (AASHTO) defines a PMS as "a set of tools or methods that assist decision-makers in finding optimum strategies for providing, evaluating and maintaining pavements in a serviceable condition over a period of time."

During the PMS development process, the agency must establish program guidelines, an organized approach to identifying the proper locations and times for PP treatment placement, a method of determining feasible treatments, a logical approach to final treatment selection, implementation procedures and a system for program assessment.

COMPONENTS OF A PMS

Prior to treatment selection or even data collection and analysis, the agency must choose the parameters that will guide its decision process. Some of the most common factors used to select PP treatment include existing pavement conditions; traffic conditions; estimated service life of potential treatments; location, noise requirements; aesthetic preferences; climatic conditions; season during intended construction; financial and construction data; agency policies; drainage issues; and long-term road plans.

Normally, the list of considerations extends well beyond the above, as existing pavement condition is determined by another set of factors: the age of the pavement and its material makeup; structural condition; estimated remaining service life; current distress type and extent, including cracking, raveling, oxidation/weathering, bleeding, flushing, rutting, shoving, patching; loss of friction/polished aggregate; roughness; and poor ride quality.

Traffic conditions are usually classified according to volume, composition and patterns of movement. In order to choose the correct treatment, the agency must decide which factors are the most important to the job at hand and then collect accurate data on each.

Deciding which factors to consider in treatment selection and collecting data are only the first steps in choosing a proper pavement preservation treatment. All the data gathered about a pavement must then be translated into an appropriate treatment option, which may be the most difficult step of the selection process.

SYSTEM POINTS WAY

At this point, agencies usually have a number of considerations that factor into their decisions, and identifying the best treatment just by looking at the data can be nearly impossible, but a well-developed PMS can alleviate many of the difficulties involved. Agencies may be tempted to avoid the complicated process of developing a PMS, but the success of their pavement preservation programs depends upon their doing so. Pavement preservation requires an accuracy of selection and timing that cannot be achieved through arbitrary decisions.

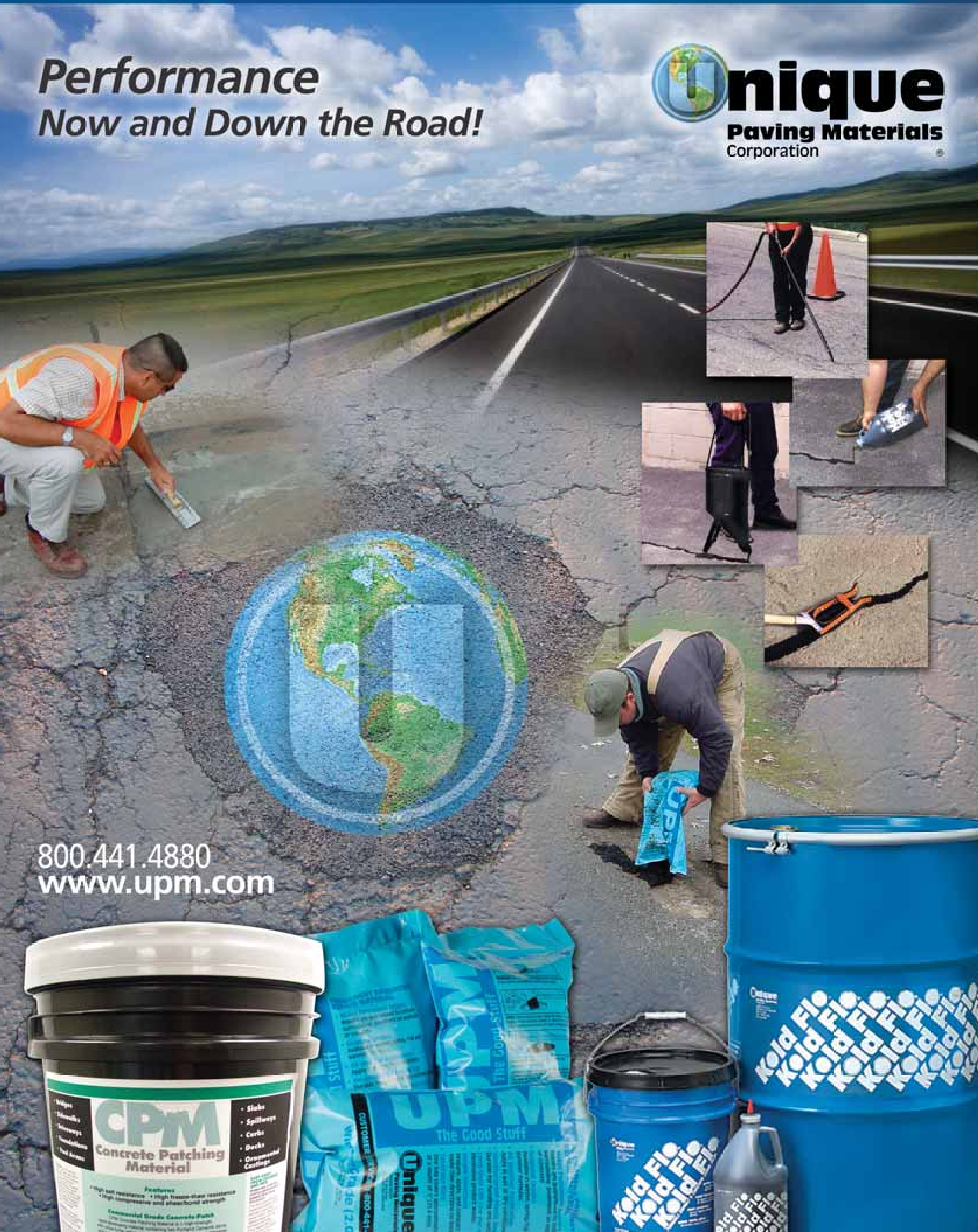
Preservation programs must rely on objective methods and systematic approaches to treatment selection, not on past experience, anecdotal information, or even expert opinion. An effective PMS produces precise treatment selections and makes for a successful pavement preservation program overall. For more information on this and other research conducted by the TPPC, please contact Dr. Yetkin Yildirim at yetkin@mail.utexas.edu.

CHIP SEAL COURSES HELD

TPPC's latest efforts include organizing professional development courses on micro-surfacing and seal coats (also known as chip seals). The first three rounds of seal coat courses were held this spring in Fort Worth on Feb. 27 and 28, in Austin on March 18 and 19 and in Lubbock on April 15 and 16. Additional courses were slated for the fall in Lufkin and San Angelo. Further information on the material covered in these courses can be found in Issue 11 of the Texas Pavement Preservation Center Newsletter at www.utexas.edu/research/tppc/news/newsletter-eleventh-issue.pdf.

The TPPC is developing a second series of courses covering micro-surfacing based on the "*Micro-surfacing: Guidelines for Use and Quality Assurance*" manual released by the Texas Transportation Institute (TTI) in 1996. For more information about the upcoming seal coat and micro-surfacing courses, please contact Dr. Yetkin Yildirim at yetkin@mail.utexas.edu.

Dr. Yetkin Yildirim, P.E., is director, Texas Pavement Preservation Center, at the University of Texas-Austin.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Hot-Pour Sealants Outperform Cold-Pour in Texas Research

Yetkin Yildirim, P.E

The data gathered over three years show a typical service life of one to two years for cold-pour sealants and a three- to five-year service life for hot-pour sealants.

A recent study conducted by the Texas Pavement Preservation Center at the University of Texas at Austin provides data comparing the service lives of hot- and cold-pour crack sealants.

Conducted in cooperation with the Texas DOT and the Federal Highway Administration, this research began in 2001 and was completed in 2005. The study tested seven different types of crack and joint sealants: three cold-pour sealants and four hot-pour rubber sealants.

The sealants were applied to eight different roads in five TxDOT districts between January and April 2001, for a total of 33 test sections. Crack repair consists of crack sealing and crack filling, while crack sealing refers to routing of cracks and placing material on the routed channel. Crack filling, on the other

TREATMENT EFFECTIVENESS (%) Final (6th) Visit (Winter 2004)						
Sealant Material	*Atlanta*	*El Paso*	*Amarillo*	*San Antonio*	*Lufkin*	**AVG.**
C1	0.2	0	0	0.1	N/A	0.07
C2	0	0	N/A	0	N/A	0.00
C3	6	N/A	0	0	N/A	2.00
H1	73.7	N/A	6	67	N/A	48.91
H2	68.2	23.9	N/A	9.5	N/A	33.87
H3	N/A	28.4	13.5	71.2	N/A	37.70
H4	N/A	N/A	47	66.5	N/A	56.75
Date of investigation	2/12/2004	2/27/2004	2/26/2004	2/20/2004	2/13/2004	
AVG. for Cold Pour	2.06	0.00	0.00	0.03	N/A	0.52
AVG. for Hot Pour	70.95	26.15	21.17	53.55	N/A	42.95
Overall AVG.	29.62	13.07	13.30	30.61	N/A	21.65

Treatment effectiveness evaluation results after the final investigation (winter 2004.)

hand, refers to the placement of material on an uncut crack. In this study, crack filling was the preferred measure of repair.

The sections were visited and monitored for performance at regular intervals. The first evaluations were made within three to four months after the crack filling operations. The test sections were inspected once every winter (January and February) and once every summer (July-August) for three years between 2001 and 2004.

A qualitative evaluation was performed by visual examination of cracks. Failure was considered to be in the form of full-depth adhesion or cohesion loss, complete pullout, spalls and secondary cracks, potholes, etc. The length of failure of all cracks was measured and recorded during every visit. The treatment effectiveness was deemed the ratio between the length of the remaining sealed crack and the length of the original treatment, expressed as a percentage. For the purposes of this study, when a sealant's treatment effectiveness fell below 60 percent, it was considered to have reached the end of its service life.

The first evaluations of hot-pour and cold-pour materials in non-covered test sections during summer 2001 indicated that they both performed well. The results indicated an average treatment effectiveness level of approximately 100 percent for hot-pour sealants.

The cold-pour sealants exhibited an overall average treatment effectiveness of greater than 90 percent with one exception. In the first visits to the covered sections, no bleeding was observed. By the second visit in winter 2002, a general decrease in treatment effectiveness for all sealants was observed. At this point, the majority of the cold-pour sealants was approaching or had just fallen below a 60 percent treatment effectiveness level.

The results from the final investigation in winter 2004 reveal that hot-pour sealants generally have longer service lives than cold-pour sealants. The data gathered over three years show a typical service life of one to two years for cold-pour sealants and a three- to five-year service life for hot-pour sealants. The reports from this study are available at: www.utexas.edu/research/tppc/pubs/.

Dr. Yetkin Yildirim, P.E., is director, Texas Pavement Preservation Center, at the University of Texas-Austin.

Contribute Your Technical Paper to *Pavement Preservation Journal*

Prospective authors are invited to present articles on original research on any topic relevant to pavement preservation, such as preservation techniques, materials, construction, testing, performance, recycling, and pavement management to *Pavement Preservation Journal*.

Papers discussing best practices for pavement preservation treatments, including asphalt overlays, scrub and fog seals, crack sealing, chip seal, hot in-place recycling, microsurfacing, and slurry seals, would be welcome as well.

Authors must prepare their manuscripts in accordance with the guidelines outlined by the *Pavement Preservation Journal*. All articles should be submitted as an email attachment to Dr. Yetkin Yildirim, P.E., at yetkin@mail.utexas.edu.

For more information, including style guidelines, please visit the *Pavement Preservation Journal's* home page at www.fp2.org/.

At NCPP, Polymer Modified Emulsion Study Nears Completion

The National Center for Pavement Preservation's (NCPP) work on the FHWA study on the use of polymer modified emulsions (PME) in thin surface treatments is nearing completion.

A draft interim report is currently undergoing peer review by agency, industry and academic practitioners. The report includes the results of a comprehensive literature review; a "Straw Man" report-only specification developed in conjunction with industry; and a PME testing plan.

Efforts are underway to collect samples for testing under the Straw Man from several Federal Lands Highway projects intended for placement this fall. It is planned that these results will be incorporated into the final report, with a final version to be issued by the end of 2008.

A section has been added to the NCPP Bulletin Board System (BBS) to document significant developments in the implementation and testing results related to the study. Information on the PME Study may be viewed at www.pavementpreservation.org/phpBB2/.

NEW FEATURES ON WEB SITE

The NCPP has added several new features to its web site to meet user needs. News items are now updated weekly, and interested persons may subscribe to the NCPP "news feed" from the front page of the NCPP web site. A new section has been added to the web site to accommodate proceedings and information related to FHWA-Asphalt Recycling & Reclaiming Association (ARRA) workshops (visit www.pavementpreservation.org/recyclingworkshop/ for more information).

In addition, the Expert Task Group (ETG) portion of the NCPP web site has also been recently updated. To view and download information on ETG activities, please visit www.pavementpreservation.org/expert/index.php.

Over the 12-month period extending from September 2007 to August 2008, the NCPP web site experienced nearly 2.2 million hits, with more than 403 gigabytes (GB) of information and data downloaded by users.

By Barry Baughman
Technical Manager, Ultrapave Corp.
President, Asphalt Emulsion Manufacturers Association

Technological Advances Key to Controlling Industry Volatility

World events have affected our industry as we see asphalt prices skyrocketing, diesel and gasoline prices in the stratosphere and the supply of liquid asphalt being critically short. We see the rising costs and shortages of raw materials, companies and banks going bankrupt, and available funding going down, both for us personally and as an industry.

Technology is our future. What we see as our vision today will become our future. We must not be satisfied with our past successes, but we must push the limits to reach out and meet the needs through technology and better utilization of our resources.

The Foundation for Pavement Preservation has laid a good foundation for the use of asphalt emulsion in pavement preservation techniques. The FP^2 and the NCPP conducted a study resulting in the January release of the *Transportation System Preservation Research Development, and Implementation Road Map* (see *New "Road Map" Offers Pavement Preservation Path to Progress*, Spring 2008, Page 15).

This road map identified "that there were significant gaps in understanding of pavement preservation, and it will require a comprehensive and broadly supported program of research, development and technology transfer to fill those gaps. A partnership has been developed to determine what the most crucial knowledge gaps in pavement preservation and what research is necessary to fill those gaps … [T]he challenge remains for FHWA, TRB, AASHTO and other partners to commit the resources according to its direction so that agencies have the tools and knowledge to effectively use transportation system preservation to extend the life of the nation's infrastructure."

Roger Hayner, co-chair of the Emulsion Task Force, with **Colin Franco** of Rhode Island DOT, stated in his report to AEMA that "the Emulsion Task Force was formed earlier this year under the Pavement Preservation Expert Task Group."

The Emulsion Task Force members encompass a broad range of industry, suppliers, researchers, the National Center for Pavement Preservation, FHWA and agency representatives. Their mission is to review and refine material- oriented research needs related to pavement preservation.

This includes evaluation of the existing Pavement Preservation Road Map problem statements and the Consortium on Asphalt Research work plans and research. The group is expected to review and make recommendation to integrated related research activities as well as coordinate activities and knowledge sharing with Superpave, other expert task groups, Transportation Research Board and the National Cooperative Highway Research Program, as well as within industry through AEMA, the International Slurry Surfacing Association, Asphalt Recycling & Reclaiming Association and the Asphalt Institute.

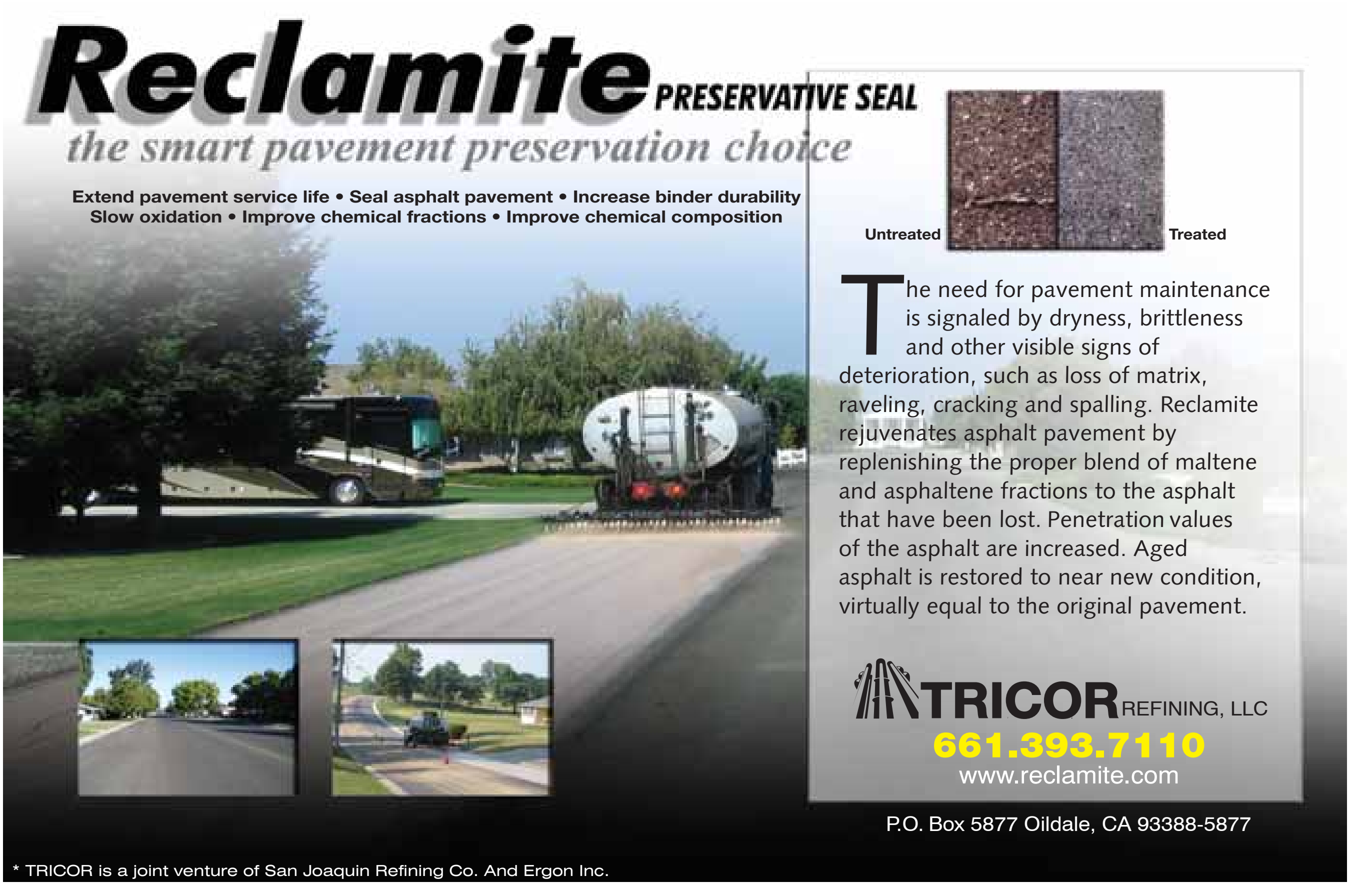
The ETF also is to proactively encourage adoption of uniform national standards for Pavement Preservation technologies through the American Association of State Highway & Transportation Officials and the AASHTO and ASTM International. This would include the promotion of advance performance based methods and specifications as well as material related certification standards.

At this year's International Symposium on Asphalt Emulsion Technology, the progress of the research projects being identified by the road map were presented. We have made substantial progress on identifying a recovery method that gives us product in the lab similar to field material. We are beginning to identify properties needed and the tests to use to give us criteria for successful field applications.

The riding public demands good roads but needs to realize that there are costs associated with good roads. We need to continue the education process of those who are making the decisions on our highway network. We must pay to preserve our roadway system and to build new ones. We all need to focus on preserving our highway assets through pavement preservation and their technologies.

Technology is the key to our future as we manage our highway system with pavement preservation.

Barry Baughman is 2008 president, Asphalt Emulsion Manufacturers Association.



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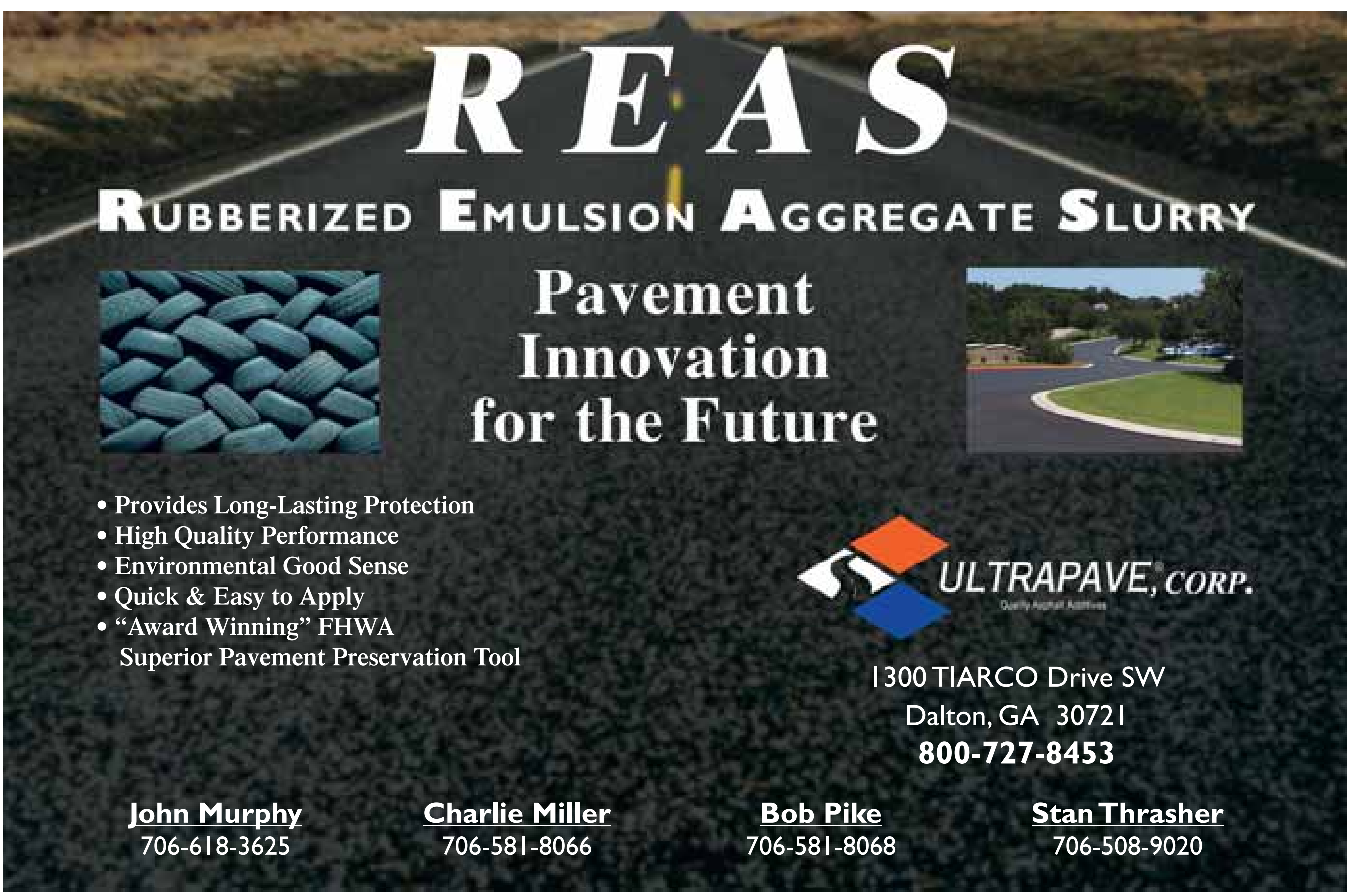

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New Emulsifiers Enhance Performance of Polymer Modified Emulsions

By Everett Crews, Ph.D.

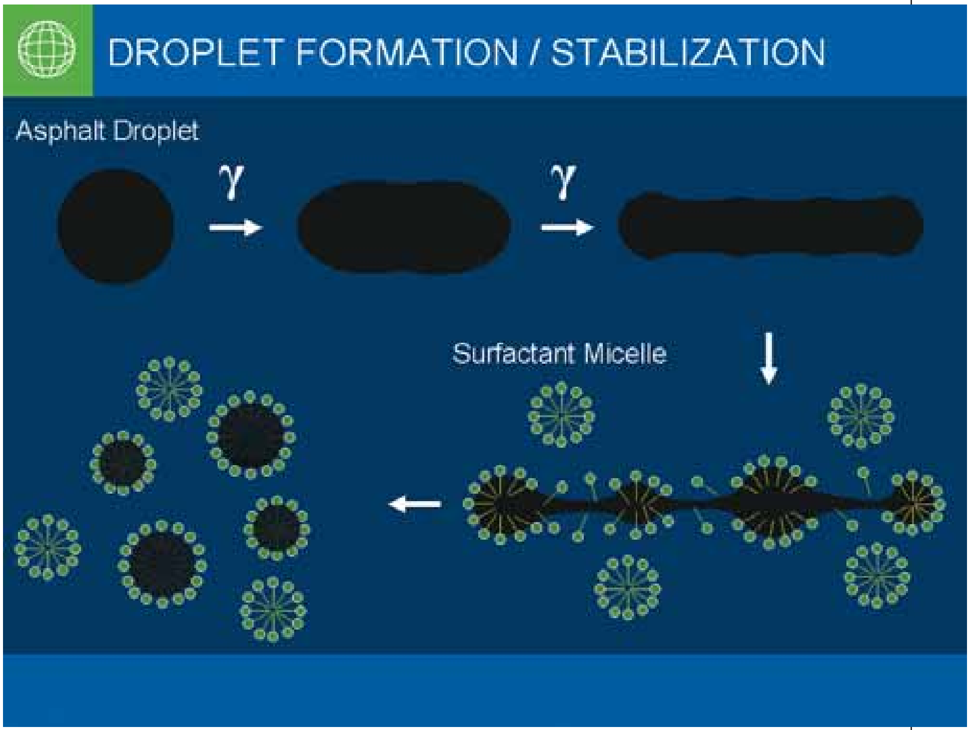
Numerous forces are shaping our chip seal markets and technology today. The industry is undertaking novel development opportunities and delivering chip seals that impart improved early and long-term chip retention, enhanced moisture resistance and more effective reflective crack mitigation. These improved performance capabilities are enhancing chip seal applications as a versatile tool in the maintenance engineers' pavement preservation toolbox.

Emulsion industry members, including business, academia and government, have taken steps in recent years to partner with our transportation agencies to address these challenges. Among many initiatives undertaken by the industry at large was the formation of the Foundation of Pavement Preservation, the work of which has led to a paradigm shift in the approach to managing our highway infrastructure.

Leadership within the foundation has sponsored and guided research and new technology initiatives that have brought together engineers and scientists to accomplish a wide range of important engineering objectives.

An international group has introduced a new recovery method that yields binder residues having properties more realistically matching those of binders in the field. This work applies to all emulsion applications. On another front, researchers have demonstrated the use of dynamic shear rheometry (DSR) measurements as a means to understand the fundamentals of emulsion curing and binder strength development in chip seal applications. Noteworthy also is work guided by the FHWA at places like the Western Research Institute where new techniques using atomic force microscopy are helping us pry into the molecular secrets of binder-aggregate adhesion.

So, where have these industry and R&D activities taken us today with chip seal technology? Clearly, the way the industry can stretch its shrinking dollars is to develop new chip seal technologies with enhanced performance characteristics. Chief among these are 1) early chip retention; 2) moisture resistance; and 3) mitigation of reflective cracking. Delivering these properties extends the service life of the chip seal.



Droplet formation and stabilization in the mill

PME'S SOLVE PROBLEMS

But arguably, the most widespread solution to bringing the industry higher performance chip seals has been the use by formulators and engineers of polymer modified asphalt emulsions. In fact, most high-end chip seal construction innovations, like the two aforementioned technologies, rely in their formulations on the use of polymer modified chip seal emulsions.

Polymers, whether SBS, SB, SBR or others, deliver the targeted chip retention, moisture resistance and crack mitigation properties, which in turn extends the service life of the chip seal significantly. Our limited dollars are thereby extended as well.

A high-quality emulsion also delivers high performance. By quality, we mean emulsions having the targeted viscosity, viscosity stability, particle size distribution, residue and other properties required for storage, transport and use.

Now there are many formulation and process variables that affect viscosity, viscosity stability and particle size distribution (as well as the other qualities of an emulsion). Our focus today, of course, is on the emulsifier type and dosage. But those skilled in the art know the significance of bitumen type and dosage as well as other formulation factors like salt content and pH. Likewise, chip seal emulsion producers are thoroughly aware of how process variables like those listed affect shear mechanisms during the milling operation, and in turn affect our emulsion particle size and viscosity.

By high performance, it is understood that uniform spray properties, rapid cure, high chip retention, moisture resistance and improved reflective crack mitigation are the targets.

IN THE SHEAR ZONES OF A MILL

As an asphalt droplet enters the high shear zones of a mill, the droplet is distorted. At fixed volume, the surface area increases. Due to interfactial tension, pressure and viscosity effects, the droplet distorts like a stream of water flowing from a faucet under the effect of gravity. As surface area increases with concurrent increases in interfacial tensions, the emulsifiers (surfactants) populate the high energy surfaces, stabilizing them and allowing further extension and distortion of the original asphalt droplet. Ultimately, the distorted, stretched droplet ruptures, the emulsifiers stabilize the surface and the finished oil-in-water emulsion is created.

The most widespread solution to bringing the industry higher performance chip seals has been the use of polymer modified asphalt emulsions.

Without the emulsifier, the entire process of shear-induced distortion, stretching and rupture of the asphalt droplet would reverse itself, following essentially the red arrows in the schematic. Absent emulsifier, thermodynamics will force the coalescence of the ruptured oil droplets (more surface area) into a larger droplet (less surface area) to minimize the free-energy of the system, since as we know, the free energy of an oil droplet in an aqueous continuous phase is proportional to the interfacial tension times the interfacial area.

Likewise, it is well known that increasing the emulsifier dosage increases emulsion viscosity, other things being equal. This relationship applies whether the bitumen is modified with polymer or not. Also, increasing emulsifier dosage leads to decreased reactivity, rendering the finished emulsions slow to set (low demulsibility), and lower early chip retention in the field.

And herein lies the challenge with polymer modified emulsions. We need high viscosity emulsions. We need viscosity-stable emulsions. And we need polymer modified emulsions that are highly reactive, to ensure good early chip retention.

For polymer modified binders, which have markedly different visco-elastic properties than unmodified binders, the process of shear-induced distortion and rupture of a droplet is challenging. To meet this challenge and produce a quality emulsion having low particle size distribution, the emulsion formulator and plant production engineer most commonly use higher quantities of emulsifier than used in the production of unmodified bitumen emulsions.

What is needed is an emulsifier that, at high dosage, imparts simultaneously high viscosity and high demulsibility. Other features that are useful in emulsifier handling relate not to their performance, but also to their economy of use. A liquid emulsifier is easier to transfer in the emulsion plant. No heat means no additional fuel cost. One hundred percent activity means no additional charge for transporting inerts from the emulsifier manufacturer to the emulsion plant. Lastly, rapid solubilization in soap tanks saves time and money.

NEW CHEMISTRY PROVIDES ALTERNATIVES

To handle the growing use of polymer modified emulsions for chip seal applications, the industry needed new emulsifier chemistry that would provide high demulsibility (reactivity) with high viscosity.

MWV Asphalt Innovations has developed a suite of new chemistries that meet the challenges of producing high-quality polymer modified emulsions. Two products within that suite, which have proven performance with a host of asphalts, have allowed the polymer modified emulsion manufacturer to achieve highly reactive emulsions while at the same time meeting viscosity specifications.

For performance, the combination of good particle size distribution, high viscosity and high reactivity manifests itself in high early chip retention. Numerous sweep tests have been conducted to compare conventional emulsifiers with these new products, and a variety of asphalts have been used. Polymer modified emulsion formulated with these new products show superior chip retention in lab-made chip seal samples.

The products have been successfully used in the field application of polymer-modified emulsions in many states and Canada. These lab results and field observations demonstrate that the use of these chemistries gives chip seal emulsion formulators the needed tools to use polymer modified bitumens in their production of high-performance chip seals.

However, even without the results of those future studies, it is clear that the introduction of these products stand as a milestone in polymer modified emulsion production for chip seal applications. Heretofore the twin targets of high viscosity and high demulsibility were not within the formulator's capabilities. Today they are.

The pavement preservation engineer—striving to stretch his budget and deliver the longest service life chip seal pavement—now has a reliable means of producing high-performance chip seal emulsions.

Everett Crews, Ph.D., is technical development manager, MWV-Asphalt Innovations. Adapted from a presentation at the 2008 International Symposium on Asphalt Emulsion Technology, September 24-26, Crystal City, Va.

Calendar of Events

2008

Nov. 11-12	AEMA Asphalt Emulsions: User Focus, Indianapolis, Ind.
Nov. 13-14	AEMA Asphalt Emulsions: Producer Group, Indianapolis, Ind.
Nov. 13-14	Road Dust Management Practices and Future Needs Conference, San Antonio, Texas
Nov. 17-20	Southeastern Asphalt User/Producer Group Meeting, Birmingham, Ala.

2009

Jan. 11-15	Transportation Research Board, Washington, D.C.
Jan. 27-30	Slurry Systems Workshop Palace Station Hotel & Casino, Las Vegas, Nev.
Feb. 15-16	AEMA-ARRA-ISSA Annual Meeting, Palm Springs, Calif.
Mar. 9-12	World of Asphalt, Orlando, Fla.
April 19-23	National Association of County Engineers, Peoria, Ill.
May 4-6	Southeastern Pavement Preservation Partnership, Baton Rouge, La.

2010

April 12-16	First International Conference on Pavement Preservation, Newport Beach, Calif.

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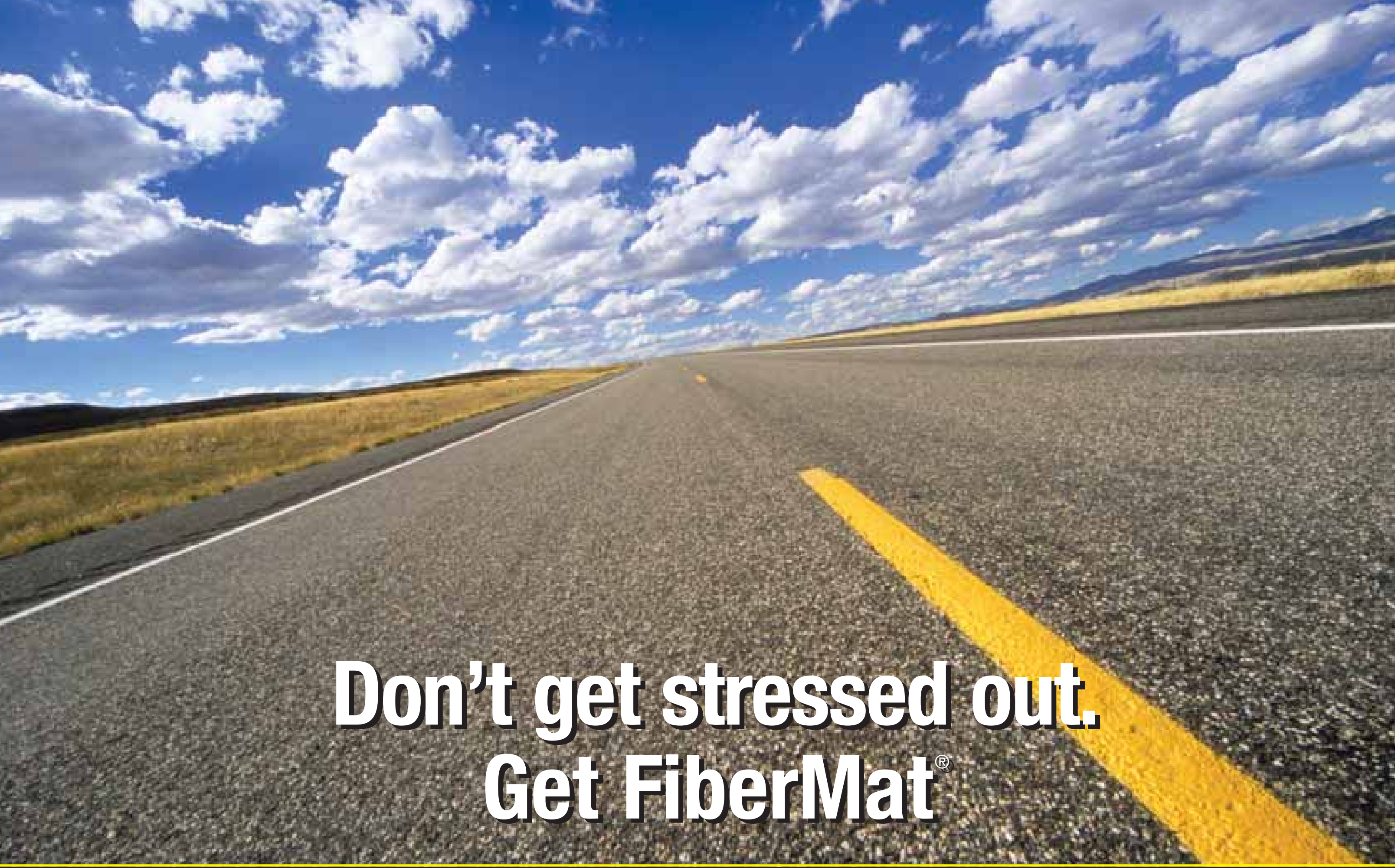

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It’s no wonder FiberMat is making big inroads in the asphalt industry. It’s one of the most exciting processes introduced in years.

Our FibreDec® patented process uses a stress absorbing, fiber-reinforced membrane designed to delay reflective and seal alligator cracks. An in-place spray applied process produces a membrane that not only waterproofs the surface, but also controls the stresses generated in the pavement structure.

The result? FiberMat’s special combination of polymer-modified asphalt emulsion and glass fibers dramatically improves overall surface performance, proven in field and laboratory testing. FiberMat prolongs the life of the pavement, which translates to a lower life cycle cost.

FIBERMAT

Let FiberMat put you on the right road.

For more information, call (877) FIBRMAT (877) 342-7628
or email: fibermat@midlandasphalt.com

Licensing opportunities available in certain parts of the country through Midland Asphalt Materials, Inc.