January–February 2009

Technology NEWS

Iowa LTAP
Local Technical Assistance Program

Providing transportation technology transfer for Iowa's cities and counties

Inside this issue

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Construction Management & Technology
Earthworks Engineering Research Center
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Iowa Statewide Urban Design and Specifications
Iowa Traffic Safety Data Service
Midwest Transportation Consortium
National Concrete Pavement Technology Center
Program for Roadway Infrastructure Management & Operations
Sustainable Transportation Systems Program
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Cool down with warm-mix asphalt

Warm-mix asphalt is getting the attention of agencies and contractors across the United States. Several contractors in Iowa have used warm-mix asphalt and many more have expressed an interest in the technology.

So what's all the buzz about?

What is warm-mix asphalt?

"Warm-mix asphalt" refers to a group of technologies that reduce the temperature at which asphalt is produced and placed.

Warm-mix asphalt typically uses a chemical additive, wax additive, or foamed asphalt process to reduce the viscosity of the asphalt. This enables the complete coating of aggregates at temperatures 35° to 100° F lower than standard hot-mix asphalt temperatures of 300° to 350° F.

Initially developed in Europe in the late 1990s, warm-mix technologies began to appear in the United States around 2003.

Why warm-mix?

Reducing the temperature of asphalt mixtures has many potential benefits:

- Fuel consumption is reduced by 11 to 30 percent.
- Emissions are reduced by more than 90 percent.
- Cooling time before compaction is eliminated, so paving operations are shorter and roads can be opened sooner.
- The work environment is cooler and freer from smoke, fumes, and odor.
- Paving can occur in cooler temperatures.
- Mixtures can be hauled longer distances.

Warm-mix in Iowa

"Warm-mix is used to a limited extent in Iowa," says Bill Rosener, executive vice president of the Asphalt Paving Association of Iowa (APAI). "It's certainly something that is coming in our industry, and I know that there has been a lot of interest among our [APAI] members."

According to Rosener, several contractors in Iowa have used warm-mix asphalt on paving projects. One contractor—Des Moines Asphalt and Paving Company—received an Innovative Technology Award from APAI in 2008 for a warm-mix project in Polk County.

The Polk County project

"Des Moines Asphalt and Paving Company presented the opportunity for using warm mix," says Polk County Engineer Kurt Bailey. "So we decided to give it a try."

The project involved resurfacing one mile of asphalt pavement on a relatively low-volume road. Warm-mix asphalt was used in the eastbound lane and hot-mix asphalt was used in the westbound lane. "This made it easy to compare the two to see how well they hold up," says Bailey.

A chemical asphalt surfactant was added to the liquid asphalt cement before coating the aggregates, according to Jeff Chapman of Des Moines Asphalt and Paving Company. The mixture was placed at 140° F.

The lower temperature "makes a much more comfortable environment for the workers," says Rosener. "You can visibly see the reduction in fumes." (Check out the accompanying photos on page 2 to see for yourself.)

Bailey says the warm-mix asphalt is performing well so far. "I see no differences between the performance of the warm-mix and hot-mix sections," he says, adding that the long-term performance of the warm-mix asphalt will be the deciding factor.

An advantage Polk County found in the warm-mix project is that it allowed the county to open the road sooner because the cooling time was

Warm-mix asphalt continued on page 2

Acronyms in *Technology News*

AASHTO	American Association of State Highway and Transportation Officials
APWA	American Public Works Association
CTRE	Center for Transportation Research and Education (at ISU)
FHWA	Federal Highway Administration
Iowa DOT	Iowa Department of Transportation
ISU	Iowa State University
LTAP	Local Technical Assistance Program
MUTCD	Manual on Uniform Traffic Control Devices
NACE	National Association of County Engineers
TRB	Transportation Research Board

U.S. Department of Transportation
Federal Highway Administration

Iowa Department of Transportation

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Warm-mix asphalt continued from page 1

eliminated. In addition, the texture of the warm-mix section is more open-graded, so there is more exposed aggregate. "This could provide some benefit in terms of skid resistance," says Bailey.

The future of warm-mix in Iowa

APIA is planning to hold warm-mix asphalt open houses across the state in the coming year. "It's just a matter of an agency agreeing to try it out," says Rosener. "It's a new technology, so right now everyone has cautious optimism."

For more information

For more information about warm-mix asphalt, contact Bill Rosener, APAI, 515-233-0015, billr@apai.net. ■

Conventional hot-mix asphalt placed at 320° F, Yellowstone National Park. (Photo courtesy of Dave Newcomb, National Asphalt Paving Association)

Warm-mix asphalt placed at 245° F, Yellowstone National Park. (Photo courtesy of Dave Newcomb, National Asphalt Paving Association)

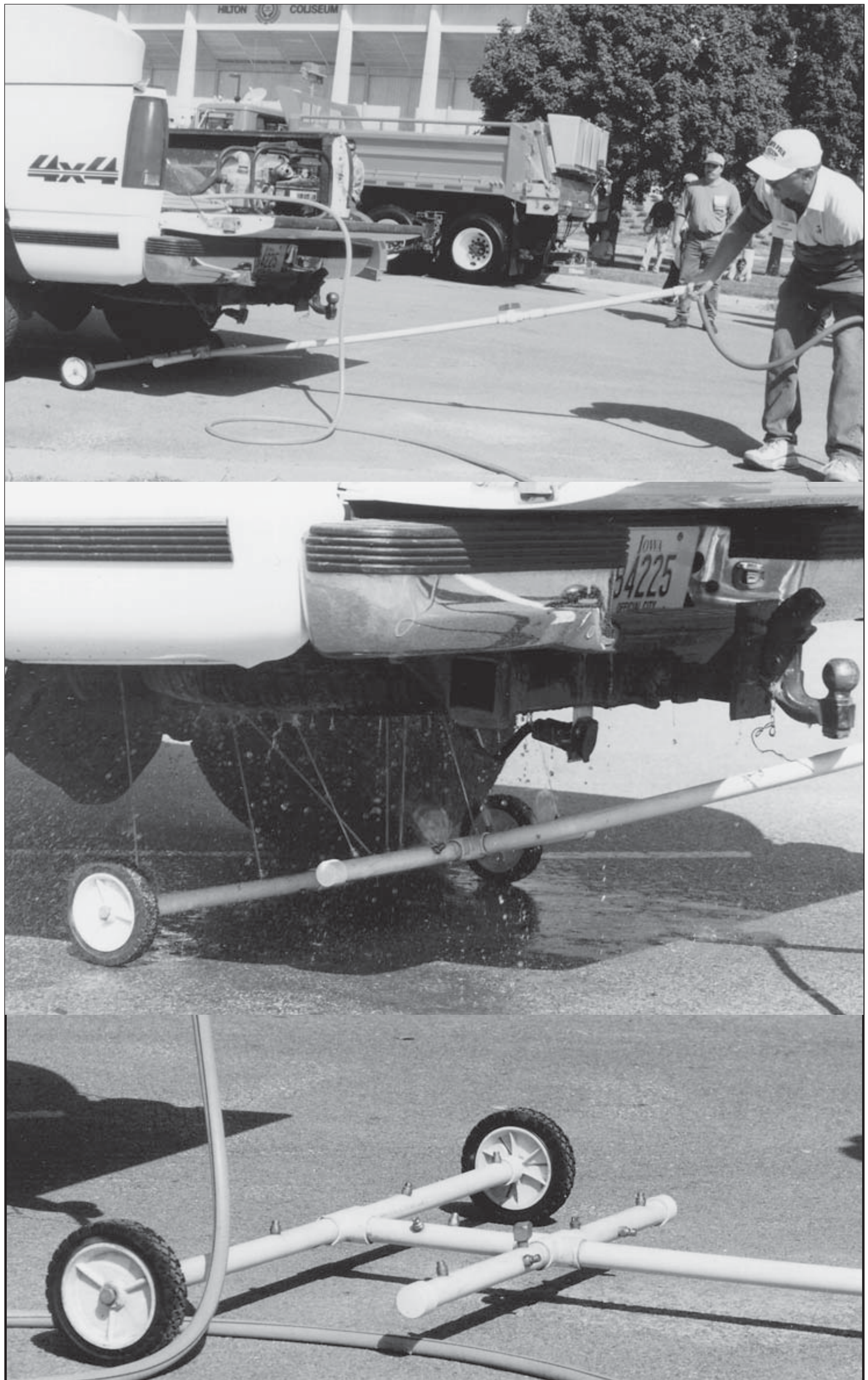
Tip from the field: Remove salt and sand with underbody wash

***Editor's note:** The tip below originally appeared in the Nov-Dec 2002 issue of* Technology News. *Since that time, the City of Ankeny has modified the original design. In place of the PVC pipe, the city now uses one-inch stainless steel tubing. Ten holes are drilled into the tubing, so the nozzles are no longer needed.*

For a quick and easy way to remove salt and sand build-up from beneath snow removal vehicles and equipment, try the underbody wash. It's effective, lightweight, rolls easily under vehicles, and helps prevent corrosion and wear and tear on parts.

The underbody wash was constructed by the City of Ankeny Public Works Department staff. They built it using one-inch PVC pipe, lawnmower wheels, and pressure nozzles. The wash is 105 inches long and 48 inches wide; it has two cross tubes with 15 pressure nozzles. The nozzles are adjusted to spray in various directions. The water pressure is generated by a gas-powered water pump.

For more information about the underbody wash, contact Dennis Guillaume, 515-965-6481. ■



The underbody wash was demonstrated by Dennis Guillaume, City of Ankeny, at the Iowa Maintenance Training Expo in September 2002.

What's your tip?

Do you have a tip for doing your job better, faster, safer, smarter, or cheaper? We want to hear from you!

Write a short description of your innovation. Explain how you use it and how it solves a problem or saves your department time, money, or accidents. Include brief instructions for building any special equipment. Take several photos of your innovation and send them with the tip.

A good tip should be about something easy to do or easy to construct in a shop. Please don't send tips that focus on a commercially available product or that endorse any specific product.

Submit your tips from the field to:

Sabrina Shields-Cook
2711 South Loop Drive, Suite 4700
Ames, Iowa 50011
shieldsc@iastate.edu

Effective clear zones for Iowa's urban roadways

What's the optimum clear zone distance—the space between fixed objects and the roadway edge—on urban (curbed) roadways in Iowa? The Iowa DOT currently recommends a minimum 10-foot wide clear zone as desirable for most situations, while AASHTO design guidance recommends a minimum of 1.5 feet.

Tom Maze, professor of civil engineering at Iowa State University; Christian Sax, master's degree student at Iowa State University; and Neal Hawkins, associate director of traffic operations at CTRE, investigated the benefits and drawbacks of the 10-foot width goal for an urban roadway clear zone in a project sponsored by the Iowa Highway Research Board (TR-560).

Their research suggests that urban communities may find little benefit in rigidly adhering to the Iowa DOT's 10-foot setback recommendation for fixed objects and that a small setback will reduce the majority of fixed object crashes.

Fixed objects and crashes

When fixed objects are located too close to the roadway, they can present hazards to drivers trying to recover from run-off-road incidents. At the same time, fixed objects can provide a protective barrier for pedestrians.

Expanding clear zones in urban areas can be tricky, since urban roadways often have limited amounts of right-of-way available. As a result, urban communities must constantly weigh the cost of purchasing additional clear zone right-of-way against the risk of fixed object crashes.

In Iowa from 2004 to 2006, fixed object collisions made up 15 percent of fatal urban crashes, while only 6 percent of urban crashes were fixed object crashes. This suggests a tendency for fixed object crashes to be more severe than other urban crash types. Table 1 shows the statistical significance of the findings.

Data on urban corridors in Iowa

Researchers evaluated 13 urban corridors, 11 in Des Moines and two in Waterloo, as recommended by their respective city engineers. Some sites met the 10-foot clear zone goal and some did not. For each site, researchers measured the distance from the face of the curb to each fixed object in the right-of-way. They also collected information on the location, the type of fixed object, the roadway name, the roadway speed limit, and the side of the roadway.

Research results and recommendations

Based on the analysis of the data, if the primary goal of clear zone recommendations is to eliminate the majority of fixed object crashes (over 90 percent), a five-foot clear zone is the most effective setback distance. When reducing the cost of fixed object crashes is a primary goal, a three-foot clear zone is the most effective setback distance (90 percent of the economic loss).

According to a cost savings analysis, the greatest benefits accrued when the setback distance was increased to three feet and to five feet from the curb. On roadways with higher speeds or with higher traffic volumes, increasing the setback did not result in large cost savings.

For more information

This research report and a tech transfer summary are available online at www.ctre.iastate.edu/research/detail.cfm?projectID=1914979082. For more information about this project, contact Tom Maze, 515-294-9459, tmaze@iastate.edu. ■

Table 1. Statistical significance of relationship

Within 45 meters of an intersection, the number of fixed object crashes increases.	Setback distances of individual fixed objects to fixed object crashes.
A consistent fixed object offset helps reduce the number of fixed object crashes.	Roadway's posted speed limit and the number of fixed object crashes.
	Fixed object density (the amount of fixed objects along a roadway segment) and the number of fixed object crashes.

Shop focus: Don't get trapped! Safe excavation and trenching

Excavation and trenching are among the most dangerous construction operations. More than twice as many workers are killed in excavation work as compared to general construction work.

Cave-ins are the most common excavation accidents and are more likely to cause death or serious injury than other excavation accidents. About 75 people are killed in cave-ins each year in the United States, and thousands more are injured.

The Occupational Safety and Health Administration (OSHA) outlines several ways that employers and workers can prevent cave-ins.

Planning an excavation

Before starting any job, find out as much as possible about the jobsite and the materials you will need to have on hand to perform the work safely.

Know the site

Conduct observations and tests to gather information about the site, including the following:

- Traffic volumes and proximity to excavation site
- Proximity and physical conditions of nearby structures
- Soil type and condition
- Amount of surface and ground water
- Location of the water table
- Location of overhead and underground utilities
- Weather conditions and forecast

Ensure workers are properly trained

No one should operate equipment unless s/he is properly trained and fully alerted to safety hazards.

In addition, all workers should be trained in the use and fit of protective gear, including the following:

- Hard hats
- Goggles
- Gloves
- Steel-toed safety boots
- Any other special clothing (such as reflective vests if working near traffic)

Excavation and trenching are among the most dangerous construction operations.

Preventing cave-ins

Cave-ins occur when an unsupported trench wall is weakened or undermined by too much weight or pressure. The majority of cave-ins happen in trenches 10–15 feet deep, although collapses can occur in very shallow excavations as well. One or more of the following characteristics is usually present:

- No protective system
- Spoils piled too close to the trench
- Machinery or vehicles parked too close to the trench
- Loose soils
- Accumulating water

Protective systems

Most cave-in fatalities happen because the trench had no protection in place to guard against a cave-in.

Selecting the appropriate protective system for a particular excavation requires knowing the following:

- Classification and water content of the soil
- Depth of the planned excavation
- Weather and climate conditions
- Traffic volumes and proximity to the excavation
- Location of other operations in the vicinity

Protective systems include sloping, shoring, and shielding.

Sloping

To prevent a cave-in, the sides of the trench should be sloped to the steepest angle at which the trench walls will be stable, often called the angle of repose.

A good rule of thumb is to slope the sides of the trench to an angle not steeper than 1.5 horizontal:1 vertical. In other words, for every foot of depth, the trench must be excavated back 1½ feet. However, some soil types may require an even flatter slope for stability, so it is important to know the soil you will be working in.

Shoring

Shoring systems support the sides of a trench to prevent the movement of soil, underground utilities, roadways, and foundations. Shoring is used when the location or depth of the cut makes sloping the sides of the trench to the maximum allowable slope impractical.

Safe excavation continued on page 6

What are the differences between excavation and trenching?

OSHA defines an excavation as any man-made cut, cavity, trench, or depression in the earth's surface formed by earth removal. This can include excavations for anything from cellars to highways.

A trench is defined as a narrow underground excavation that is deeper than it is wide, and no wider than 15 feet. Trenching is generally performed by utility contractors, who construct gas, sewer, and other utility lines.

Safe excavation continued from page 5

Shoring systems may consist of posts, walers, struts, and/or sheeting. Timber and aluminum hydraulic are two common types of shoring.

Shielding

A trench shield (or trench box) is a heavy frame, often made of steel, that can be permanent or portable. Shields are especially useful for sewer and pipeline work.

Be careful not to subject the trench shield to a heavier load than it was designed to withstand.

Materials and equipment storage

Spoils (excavated material) and heavy equipment can exert great pressure on trench walls. Keep spoils, machinery, and vehicles at least two feet from the sides of the trench to prevent a cave-in.

In addition, beware of vibrations from machinery and nearby traffic, which can loosen soil and cause cave-ins.

Soil and weather conditions

Weather conditions can affect the stability of the soil.

Rain can saturate soil and increase the risk of a cave-in. Workers should not be in trenches where water is accumulating.

Very dry weather can also be dangerous because it can loosen some types of soil, which can lead to a cave-in.

Other precautions

A trained, competent person should conduct inspections prior to the start of work and as needed throughout the shift. Surface cracking, overhangs, or bulges can indicate a potential cave-in.

Always use a spotter when excavating near workers in a trench.

Know emergency procedures in case of an accident. Have emergency numbers handy and someone outside the trench ready to help. Workers should know first aid, CPR, and escape routes.

OSHA requires the use of escape routes, such as ladders or steps, within 25 feet of any workers in trenches.

For more information

In addition to cave-ins, other excavation and trenching accidents include

- falls,
- falling loads, and
- mobile equipment accidents.

To learn more about all aspects of excavation safety, consider attending one of the three upcoming Excavation Safety Workshops that will be hosted by LTAP in April. See page 7 for details.

For questions about excavation and trenching, contact Safety Circuit Rider Tom McDonald, 515-294-6384, tmcdonal@iastate.edu. ■

Stanley L. Ring Memorial Library: New acquisitions

Note about delivery of materials: *The library now sends orders through the U.S. Postal Service. This change is resulting in important savings for LTAP, but ordered materials do not arrive as quickly. If you have an urgent need for library materials, let us know when you place your order and we will arrange faster delivery.*

Three ways to order LTAP library materials

- Use the online catalog, www.ctre.iastate.edu/library/search.cfm.
- Contact Jim Hogan, library coordinator, 515-294-9481, hoganj@iastate.edu, fax 515-294-0467.
- Mail or fax the order form on the back cover of *Technology News*.

Publications

P-1734 Design Guide for Improved Quality of Roadway Subgrades and Subbases

This manual has been developed to help Iowa highway engineers improve the design, construction, and testing of a pavement system's subgrade and subbase layers, thereby extending pavement life. It synthesizes current and previous research conducted in Iowa and other states into a practical geotechnical design guide and construction specifications. Topics covered include the important characteristics of Iowa soils, the key parameters and field properties of optimum foundations, embankment construction, geotechnical treatments, drainage systems, and field testing tools.

P-1735 Polyurethane Resin (PUR) Injection for Rock Mass Stabilization

This report describes the application of polyurethane resin (PUR) injection as a rapidly deployed, cost-effective ground and structure stabilization method. Application objectives included the preservation of historic, cultural, and other environmentally sensitive natural and man-made features, while maintaining the original visual characteristics and aesthetic appeal.

P-1736 Road Stabilizer Product Performance: Seedsskadee National Wildlife Refuge

This report describes the application and monitoring of the following roadway stabilization and dust abatement products: water absorbing, organic non-petroleum, electro-mechanical, and synthetic polymer.

P-1737 Velocity Variations in Cross-Hole Sonic Logging Surveys: Causes and Impacts in Drilled Shafts

This study identifies various conditions that affect the load bearing capacity of drilled shafts by modeling various conditions and analyzing them with numerical methods. The study explores many concerns recently raised for drilled shaft design, construction, and maintenance. ■

Conference calendar

March 2009			
24	Work Zone Safety	Storm Lake	Tom McDonald 515-294-6384 tmcdonal@iastate.edu
25	Work Zone Safety	Sioux City	Tom McDonald 515-294-6384 tmcdonal@iastate.edu
26	Work Zone Safety	Council Bluffs	Tom McDonald 515-294-6384 tmcdonal@iastate.edu
30	Work Zone Safety	Ames	Tom McDonald 515-294-6384 tmcdonal@iastate.edu
31	Work Zone Safety	Ames	Tom McDonald 515-294-6384 tmcdonal@iastate.edu

April 2009			
14	Excavation Safety	Carroll	Tom McDonald 515-294-6384 tmcdonal@iastate.edu
15	Excavation Safety	Ames	Tom McDonald 515-294-6384 tmcdonal@iastate.edu
16	Excavation Safety	Iowa City	Tom McDonald 515-294-6384 tmcdonal@iastate.edu

Excavation Safety Workshops

The workshop explains the hazards of excavation and trenching, how accidents happen, and how worker protective measures should be applied. It's a great way to inform new employees of safety protocol or to update more experienced employees on new safety information.

The workshop covers the following:

- Critical definitions and context for excavation safety
- Soils analysis: testing local soils and handling testing equipment
- Shoring options: a walk-through of all the basic systems—sloping, shoring, and shielding

The workshop can also help employers ensure that all employees at an excavation site are competent and knowledgeable to avoid and prevent possible safety problems. The course covers the requirements of 29 CFR Part 1926, Subpart P-Excavations, of the OSHA standards for the construction industry.

The workshop will be offered in three locations:

- April 14, Carrollton Inn on US 71, Carroll
- April 15, Quality Inn at 13th Street and I-35, Ames
- April 16, Quality Inn at Iowa Highway 1 and I-80, Iowa City

Questions?

If you have questions about

- content of the class, contact Tom McDonald, Safety Circuit Rider, 515-294-6384, tmcdonal@iastate.edu.
- registration, contact Georgia Parham, 515-294-2267, gparham@iastate.edu ■

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