roads bridges transit
technology news
Local Transportation Information Center
Iowa State University Engineering Extension Service
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December 1984

Winter pothole patching

Repairing potholes during the winter season is extremely difficult. Problems of weather conditions and wet holes are compounded by the unavailability of hot mix asphaltic patching material. Because plants usually close from mid-November until May, street maintenance personnel are faced with patching potholes with less than desirable cold pre-mix asphalt material.

To fill this critical material need, many small communities are turning to commercial pre-mix patching materials sold in 5-gallon containers. These patching products vary greatly in quality and are extremely expensive. Per ton costs can run as high as $300 to $500.

To reduce the cost, small communities can combine their needs for cold mix patch material and order from a single supplier. Cold mix patch material prepared in a conventional hot mix plant markets for approximately $30 per ton, depending on quantities received.

When purchasing cold mix materials, the street maintenance superintendent should look for these key properties:

Workability—The mixture should be sufficiently workable for placement with shovels, rakes, or other hand tools. It should readily compact by hand tamping, hand or power rolling, or under the action of traffic at temperatures as low as 15°F. The mix should remain workable over a period of at least 6 months in a stockpile.

Stability—The mixture should remain in place when used to patch wet or dry pavements and should be stable under normal traffic loads.

Asphalt binder—The asphalt binder used in the aggregate mixture should be formulated with characteristics required to produce a mixture with workability, water resistance, compaction, and stability properties mentioned.

Typically, liquid asphalt binders are used for winter patch materials. These binders are formulated with petroleum distillates to prevent freezing of stockpile mixtures. Asphalt contents of cold mix materials are high, averaging 7 percent. The increase in asphalt content for winter materials aids workability, density, and water resistance for cold weather applications. For cold mix materials, both MC and SC cutback asphalts are used. However, Des Moines has been very successful when using emulsified asphalt CMS-2 conforming to ASTM2397.

Aggregate—The aggregate mix formula should be open graded and low in fines. The open gradation will decrease the structural stability, but will greatly increase the winter workability. A well tested gradation exhibiting the necessary characteristics for winter patch material is as follows:

Sieve Size	Percent passing Min.	Max.
½ in.	100	
⅜ in.	90	100
#4	30	65
#8	14	30
#30	6	18
#200	1	5

For a copy of specifications capable of being let for contract, contact Public Works Department, City of Des Moines, 515/283-4276.

John Bellizzi, P.E., Director of Public Works, Des Moines.

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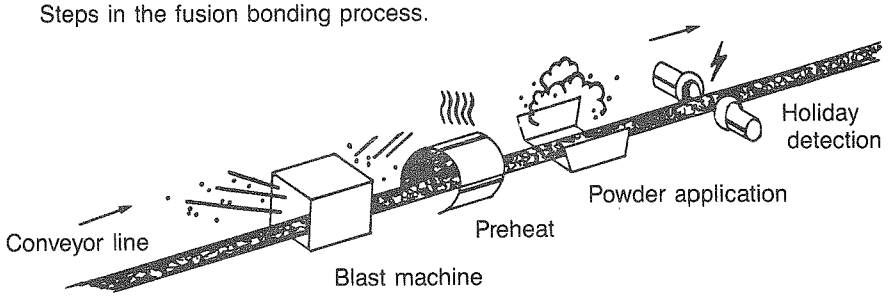
Research pays off with epoxy-coated rebars

One of every four bridge decks in the United States is badly deteriorated (many are less than 20 years old), and the price tag for those needing repair or replacement within the next decade has been estimated as high as 2.5 billion dollars.

Thus, it is crucial, as problems in existing bridge decks are eliminated, to prevent their recurrence. A concerted research effort directed by the Federal Highway Administration's (FHWA) Office of Research and Development has produced enormous payoffs by ensuring improved durability for new decks.

Steps in the fusion bonding process.



Problem

It became evident in the early 1970s that the major cause of bridge deck deterioration was corrosion of reinforcing steel in the concrete due to chloride contamination. The FHWA decided at that time to expand upon one of the conclusions made in NCHRP Report 23, ". . . that for new reinforced concrete construction, a protective coating is the best single means for keeping steel from corroding." They recommended an asphalt-epoxy as the best organic coating to examine.

No specifications concerning barrier coatings for reinforcing steel existed at the time. Although several cases existed in which an epoxy coating had been painted on the surface of an already existing steel structure, widespread application of such technology had not been attempted.

The goal was to develop specifications for an epoxy coating that would: (1) provide a permanent barrier to the transmission of chloride ions to the surface of reinforcing steel, and (2) be durable enough to allow coating the steel prior to the fabrication, bending, and placing processes.

Solution

A comprehensive project exploring a number of alternate approaches was undertaken by the FHWA, with the assistance of the National Bureau of Standards (NBS). Four commercially available powder epoxy coatings were identified as satisfactorily meeting FHWA's criteria. Coatings were evaluated on the basis of their protective qualities. Attention also was given to application methods and necessary surface preparation of the reinforcing steel.

Application

Experimental application was initiated in 1973. This field-evaluation verified the practicality of epoxy-coated rebar and led to rapid implementation on a nationwide basis. In the meantime, FHWA continued research to further verify the long-term durability of the epoxy-coating material and process and to refine the specifications for the product.

Benefit

Analyses of life-cycle costs indicate that the use of epoxy-coated reinforcing steel in both mats of a typical bridge deck results in significant savings compared with any alternative option open to designers. Based on current U.S. construction of approximately 2.5 million square yards of bridge deck per year, the estimated costs over the design life of the bridges for epoxy-coated rebar are approximately $5 million per year below those of any other system. The product is now covered by AASHTO and ASTM standards, and currently epoxy-coated reinforcing steel is being specified by more than 40 of the 50 state highway agencies. Use of epoxy-coated rebar also has spread beyond bridge decks and substructures to the realm of such things as parking garages, marine structures, wastewater treatment plants, cooling towers, and subways.

In 1982, nationwide sales exceeded 100,000 tons, and the market continues to expand.

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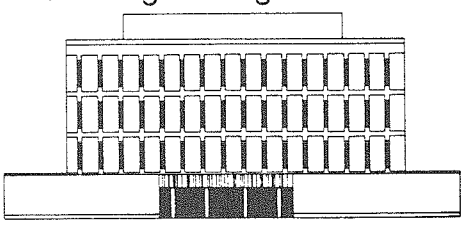
civil engineering extension



Don't waste salt on snow bulk, says Iowa DOT

The Iowa DOT makes the following recommendations for the use of salt. Over the years, the Iowa DOT has developed an effective and economical snow and ice control operation using deicing chemicals. The department has found that the benefits of rock salt can be extended greatly by blending it 50/50 with ice control sand. This is effective in all but urban areas where there is risk of plugging storm sewer systems with the added sand.

A basic rule of thumb is that salt should not be used to melt snow bulk. The use of rock salt to melt snow bulk is wasteful and expensive at current prices. Salt should be used to remove the balance of an ice or snow accumulation after traffic has packed it and after the maximum use of snow plows to remove snow bulk.

Specifically for conditions of temperatures near or below 30°F. and falling, with snow, sleet, or freezing rain and wet or sticky road surfaces, the Iowa DOT recommends a maximum of 300 pounds per two-lane mile rather than the 500 pounds recommended by the Salt Institute. Applications should be repeated if necessary.

Whenever the temperature is below 20°F. the Iowa DOT does not recommend the heavy application of salt in any situation. When the temperature is below 20°F. with snow, sleet, or freezing rain and wet road surfaces, it is excessive to apply rock salt at 600 to 800 pounds per two-lane under any situation. This practice will soon lead to problems of pollution of roadsides and streams if continued. Again, the recommendation is for 300 pounds of sand/salt mix with repeated applications if beneficial. However, rarely is this the case.

Where the temperature is below 10°F. with snow or freezing rain and an accumulation of packed snow or ice, the application of rock salt is not justified in any volume except a minimum amount to freeze proof the abrasive pile in the cold winter conditions.

Charles R. Huisman, Materials Engineer, Iowa DOT

Loss of sign's reflectivity causes fatalities, lawsuit

A collision occurred at night at an intersection of a paved county road and a primary highway when a passenger car failed to stop at a stop sign and struck a semi. The driver of the passenger car was not familiar with the road. Both occupants of the passenger car were fatally injured.

A lawsuit was filed naming both the county and the state as defendants. The plaintiffs alleged that the county was negligent because the intersection was not lighted, there were no rumble strips and flashing beacons, and the stop ahead sign was not sufficiently reflective. The negligence of the state was alleged because of insufficient warning of the presence of the intersection. Both defendants were also alleged to be negligent

because the terrain restricted sight distance in the quadrant of concern such that approaching vehicles were not visible until they were relatively close to the intersection.

There was considerable testimony during the discovery process indicating that the stop ahead sign was severely weathered and essentially retained no reflectivity. This became the principal issue in the case.

In the out-of-court settlement, the county made a substantial payment, with the state adding a token payment to settle the suit.

This case exemplifies a problem that is occurring with increasing frequency—the continuing use of highway signs that have lost their reflective qualities. Signs in place need to be inspected by highway agencies on a regular schedule, at night and during the day.

R. L. Carstens, professor of civil engineering, ISU

tips from the field

Many maintenance crews are increasing their use of diesel powered equipment and trucks because of extended engine life, lower fuel consumption, smaller maintenance costs, greater horsepower, and longer life durability.

It is important to remember that the fuel is the most significant part of the operation and maintenance of a diesel vehicle. When purchasing fuels for use in these vehicles, keep in mind three critical items that can harm a diesel engine: air and water within the system, lubrication and Btu/gallon of the fuel, and fungus and bacterial growth within the fuel.

Air and water must be kept out of any fuel system. However, additional precautions should be taken with diesel vehicles because foaming, freezing, and stalling can occur.

Compared to #2 diesel fuel, #1 is thinner and doesn't gel as easily. Therefore, it often is selected for winter use. However, the engine lubricating quality of #1 diesel fuel is poor. This will have an effect on engine cylinder wear, injection nozzle wearing, injection pump performance, and, in extreme cases, could cause premature engine failure. Also, the Btu rating for #1 diesel fuel is 25,000 less than for #2. That means less work is accomplished for the same amount of fuel, or more fuel is used for the same amount of work.

This reduction in horsepower and lubrication can also happen when a blend of #1 and #2 diesel fuels is used.

Fungus and bacteria growth can shorten engine life immensely. It can create numerous maintenance headaches and be very costly in terms of repairs and downtime of a piece of equipment. It is imperative that fungus and bacteria growth be controlled to ensure the extended life expected of a diesel engine.

Upon investigation into this matter, the City of Spencer found an aftermarket additive, Diesel Fuel Antigel and Fungicide, which is made by E. T. Lubricants. It was found to be cost effective. At less than 1.5¢ a gallon it is much less expensive than 50/50 blend. The additive also is adequate for cold weather operation. Without sacrificing horsepower or lubrication, the vehicles **did not** gel up in −80° F. wind chill. And, it is effective in the control of bacteria and fungus within the storage tank.

One additional tip on fuels: if you suspect your supplier may be giving you Regohol instead of regular gas (because of tax break) try this test. Use a 100 ml graduated cylinder filled with 90 ml of the fuel in question. Add 10 ml of water and shake thoroughly. Because the water will absorb the alcohol you should not be able to read more than 10 ml of water after settling. If you do read more than that, you have regohol rather than regular.

Charles L. Fisher, assistant superintendent of public works, Spencer

Lawsuit's message: maintain low-level roads

A dirt road with a recorded volume of three vehicles per day, was the location of a single-vehicle accident that resulted in a lawsuit against a county. The accident involved a 350 cc motorcycle operated by a frequent traveler on the road.

The accident occurred in May following unusually heavy rains that caused water to flow across the road and erode the dirt surface. One depression was 12 to 15 inches wide and as much as 3 to 4 inches deep across the full width of the road. The depression caused the motorcycle to spill, injuring the operator.

Testimony in trial indicated that the ditches on this road were usually filled and probably had never been cleaned out. The road surface, which was bladed infrequently, probably had not yet been graded for spring since maintenance efforts concentrated on granular-surfaced roads carrying high traffic volumes.

An out-of-state expert testified for the plaintiff, citing that loose-surfaced roads should be bladed to provide a crown of ½ inch per foot. Jurors were made aware of the pronounced differences between the road in question and a road maintained to textbook conditions.

The jury found that the county was 40 percent negligent and returned a judgment in six figures against the county.

This case conveys a clear message to county officials: a portion of each county's roads should be designated as an Area Service Level B system.

R. L. Carstens, professor of civil engineering, ISU.

$250,000 judgment against county: diagnosing what went wrong

When an 18-year-old male driver failed to steer around a sharp turn on a loose surfaced county road, his 1969 Chevrolet crashed into the ditch. Both he and his companion were injured. Fortunately, the injuries were not serious enough to result in any permanent disability to either occupant of the car.

At a subsequent trial the county concerned was alleged to be negligent and was sued for damages. The following facts were brought out at the trial:

- The vehicle driver had failed to notice the reverse turn sign located approximately 1,000 feet before the turn.
- There was no large arrow sign or advisory speed plate in use at this location.
- After leaving a primary highway in traveling to the accident location, the driver had encountered 12 curve or turn signs in 8.7 miles of travel on loose surface roads. Advisory speed plates were in use with two of these signs. A large arrow sign was used at one location in that 8.7 miles, but it faced drivers traveling in the opposite direction.

After hearing the case, a jury awarded the two plaintiffs a total of about $250,000. Although it is not always possible to determine why a jury decides the way it does, this jury probably was telling traffic engineers that consistency in the use of signs is of primary importance. Perhaps not using some types of warning signs is better than inconsistent usage.

R.L. Carstens, professor of civil engineering, ISU.

Update on ETP

Epoxy Thermoplastic (ETP) pavement marking material is a joint development of the Southwest Research Institute and the Federal Highway Administration (FHWA) research staff. It is generic material consisting of two epoxy resins, pigment, filler, and glass beads.

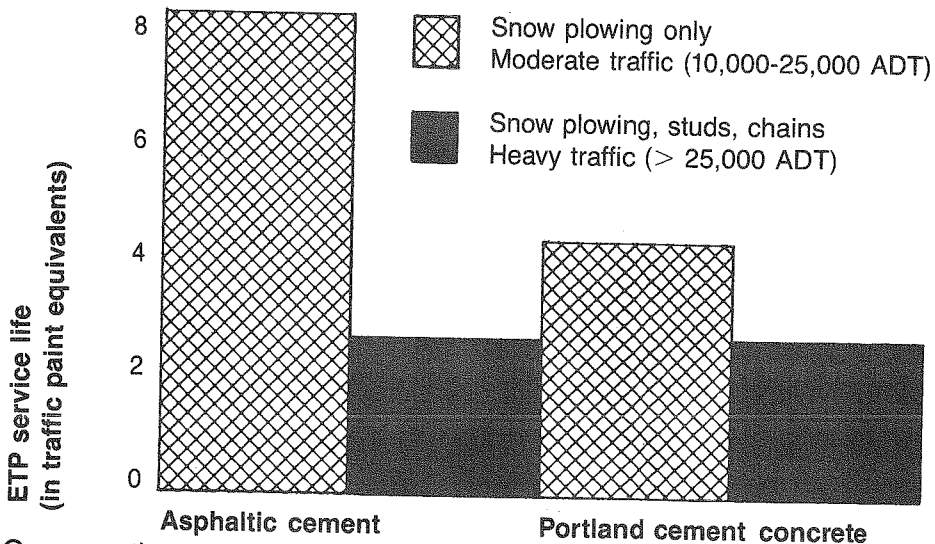
ETP is a 100 percent solids formulation containing no solvents or other volatile components and is applied as a hot spray at 450° F. It requires no primer and can be applied on either asphalt or portland cement concrete surfaces. Existing paint stripes must be substantially removed by sand blasting or other means prior to the application of ETP. The recommended application thickness is 15 to 20 mils with drop on glass beads at a rate of 4 to 6 pounds per gallon. The no-track time is less than 5 seconds so that coning is not necessary during application. When formulated according to specification, ETP has a pot life of at least 4 hours. Durability based on limited field testing indicates a life of from 2 to 10 times longer than normal traffic paint.

An FHWA demonstration project using ETP was scheduled for September 1983. Because of equipment problems this demonstration project was deferred until May 1984. Subsequently, the project was postponed indefinitely because inability to consistently retain the drop on glass beads resulted in very poor night visibility.

Recently, ETP was applied successfully by the Century Fence Company on two Iowa DOT portland cement paving projects. The first project is in Marshall County on Iowa 330 from U.S. 30 south approximately 5 miles.

The second project is in Johnson County on U.S. 218 from the Hills Interchange north approximately 4 miles. Several equipment modifications, including preheating the glass beads, were made to improve bead retention. The high initial reflectivity resulted in excellent night visibility on both projects. The Iowa DOT will monitor both projects to evaluate the long-term durability of the ETP material and reflectivity.

Jim Hogan, area engineer, FHWA Iowa Division.

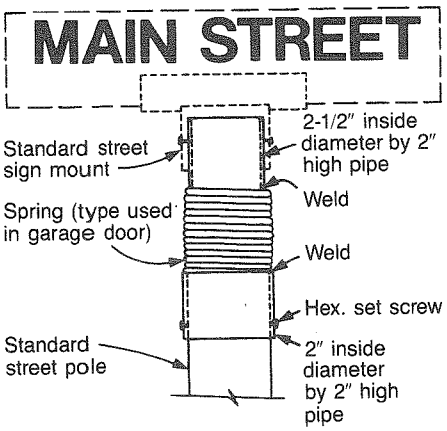


Comparative service life on AC and PCC pavements

Reduce traffic sign vandalism

Each year, 1 out of every 10 traffic signs is defaced, destroyed, or stolen. An article in the November 1983 issue of *Public Works* discusses what municipalities can do to deter such vandalism. Recommendations include enactment and better enforcement of laws, a public information program, and educational techniques that can help reduce vandalism. The article, "Curbing Traffic Sign Vandalism," also offers specific physical alterations such as raising the height of sign blades and using protected sign face materials, hardware, and fasteners.

One idea for a vandal-proof mounting modification was described in the March 1983 issue of *Public Works.* According to Arvin D. Erskine, director of public works in South Portland, Maine, his innovative design has cut down on sign vandalism.



A garage door spring can be used in sign mountings to help combat vandalism.

"Since the street markers were usually pulled from their sockets by a person standing on the end of the marker, it occurred to me that some sort of a spring between the marker and post could be the answer," Erskine wrote.

Locally available, standard materials were used throughout the modified mounting. Broken garage door springs were obtained from an overhead door contractor.

The post and street marker were installed in an area of heavy vandalism. "It was observed that wind had little effect on the marker, but if someone tried to remove it by hanging or pulling on it, the sign would flex and would return to its original position when released. Some of the modified street markers have been in place for over a year and have all but eliminated this problem," Erskine reported.

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