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MATES

MATERIALS AND TECHNOLOGY ENGINEERING AND SCIENCE

Published by the Materials and Technology Division of the Michigan Department of Transportation

Issue No. 13 **November 1987**

ICE DETECTION ON BRIDGE DECKS

Winter brings the task of keeping our roads and bridges clear and safe for the motoring public. Dealing with the phenomenon known as 'preferential bridge deck icing' is one of the most difficult parts of this task. Winter drivers in Michigan, and other northern states, have come to expect clear, dry pavements most of the time. However, they know that upon approaching bridges they will see signs advising "Bridge May Be Icy" and that they should proceed with caution. They have learned that under certain weather conditions, especially on fall or spring mornings, a thin layer of ice may form on bridge decks. They also know that it is best to delay any passing or other maneuvering until they are off the deck, and to refrain from braking or accelerating while on the bridge. Such knowledge and experience have enabled Michigan drivers to become 'winter sophisticated.' Despite the ability of our driving population to deal with this problem we continue to seek a permanent solution.

Why Ice on the Deck, But Not the Road?

The reason for this condition is that the bridge has cold air circulating beneath it, causing the deck to cool more rapidly than the approach roadways where the earthen base acts as a heat source and insulator. High humidity can cause a heavy frost to form on the cold surface while the warmer roadways are still clear, or a thin icy layer can form from a light snow or rain, or even from melting snow running across the bridge deck. These conditions are extremely difficult to accurately predict or prevent.

Detecting or Predicting Icy Decks

Predicting the occurrence of icy decks has been a long-standing problem for many states and other jurisdictions. Traditionally, it has largely been left to maintenance foremen who, knowing when conditions for preferential icing exist, drive over bridges, to subjectively decide when sand or salt spreading is needed. Recently, several companies have marketed sensors that they claim can be installed in a bridge deck and, in combination with atmospheric sensors, can detect when ice or frost has formed on the deck; or more importantly, when it is highly probable that it will form. By using microcomputers, and telephone or radio for transmission, this information can be sent to a remote location, such as a maintenance garage, alerting personnel there that the spreading of deicing chemicals is, or soon will be, necessary.

In 1983, the M&T Division installed one of these sytems on the I 496 bridge over Cedar St in Lansing and began its evaluation. Funding for this installation came from the Federal Highway Administration who are very interested in its performance. Over two winters, MDOT maintenance personnel made frequent random visual observations of the bridge surface and recorded what they saw. These observations were compared with printouts from the system, enabling us to determine system accuracy (i.e., accuracy for detecting when decks are icy, not predicting when icing will occur). Our initial experience has been that in 80 percent of the comparisons, the condition reported by visual observation agreed with that reported by the system's computer printouts.

Improvements in the system and a greater understanding of it by the users have improved this to near 90 percent. When an error did occur, it was on the 'safe' side; that is, the sensor would indicate ice when none had formed. When ice actually did form, it was almost always indicated by the sensor (one case in each winter the system failed to record existing ice).

In 1985, a system from a competing company was installed on two of the bridges in the I 696/I 275 interchange. Personnel from Oakland County, the agency maintaining this part of the state trunkline, are still monitoring these installations.

Kalamazoo Area Weather Monitoring System

The above systems measure conditions at individual bridge sites, but it would be useful to have information on conditions over a larger area. Therefore, in District 7, a cooperative effort between MDOT, the Kalamazoo County Airport, the Kalamazoo County Road Commission, and the City of Kalamazoo, will attempt to monitor conditions over a fairly large area. This system, to be partly in use this winter (1987/88), will include a number of roadway monitoring sites, installation of an X-band radar (to differentiate snow storms from thunderstorms), and subscription to a weather projection model. This combination should permit accurate tracking of storms entering Michigan from the southwest. It should also aid in keeping track of 'lake-effect' snows. Other parts of Michigan have more snowfall than Kalamazoo County, but this area was deemed particularly appropriate because it contains the heavily traveled I 94 corridor. It appears that we can now, with a high degree of confidence, detect the presence of ice on bridge decks. However, the time elapsing between notification of ice formation and getting a salt truck to the scene can be too long. Our goal is to use these systems to predict when ice will form, and to treat the deck before icing occurs. So far, that goal has not been achieved.

While these systems appear to be promising tools for use in winter maintenance activities, their relatively high installation costs may limit their use.

-Frank Spica

PERFORMANCE TESTING OF PAVEMENT MARKING PAINTS

Reflectorized pavement marking has long been recognized as an essential highway safety feature. New pavement marking products continue to be developed in the search for greater durability, superior night visibility, convenience of application, rapid drying time, and cost effectiveness.

Field Performance Testing

M&T Field performance tests determine the useful life of a paint manufacturer's submitted material before it is allowed to be placed on a qualified product list (i.e., a list of those products eligible for competitive bidding). Such tests are conducted every two years, since approximately one year is required to evaluate and report on them. The best performing three to five paint products must then go through the bidding and procurement process. A section of M 43, east of Grand Ledge, serves as MDOT's paint test area. It is near the M&T laboratories and has sections of both bituminous and portland cement concrete in the traffic lane. This year, 40 different formulations of white and yellow paints were submitted by manufacturers for performance testing. Two stripes of each paint sample were applied transversely across both types of pavement.

Rating the paint's useful life is largely based on durability and nighttime visibility in the wheel tracks where the paint is exposed to most severe traffic wear. Durability and nighttime visibility are interdependent; however, nighttime visibility is considered to be the critical criterion for selecting the best performing paints. Visibility is measured at six-week intervals using a 'retroreflectometer' (a device for measuring the amount of reflected light), designed and built by our Division. This instrument is placed over the paint stripe and an internal light source is reflected off the stripe, picked-up by a photo-cell, and converted into a number representing the brightness of the stripe. The paint stripe and light path shielding permit these measurements in full daylight. Prior to the Division's development of this device, a panel would visit the site at night to rate the stripes. The retroreflectometer saves the cost of overtime pay, exposure of raters to nighttime traffic, and removes the subjectivity from the ratings.

Required Paint Properties

In addition to performance testing, the paint sample has to meet certain specified basic properties such as color, viscosity, settling, drying time, etc., although the paint composition is left entirely to the manufacturer. After one year of field evaluation, nighttime visibility data are graphically analyzed in combination with laboratory test results to determine which products will be categorized as approved pavement marking paints, and therefore be eligible for purchase through competitive bidding the next year.

Michigan's Experience

Based on the results of years of testing, Michigan has basically been using two types of traffic paints: fast-dry and polyester. The fast-dry type, also called hot-applied one-component paint, has become the standard paint for Michigan's highways. The advantages of this type include good night visibility, ease of application, low cost, and relatively safe handling, although the most obvious advantage is its short drying time. The specified two-minute cure time requires only back-up vehicles, straddling the stripe behind the paint machine, so traffic is not unduly disrupted. Cones are eliminated, and vehicle tracking over uncured markings is minimized. This paint provides about one year of service life. For certain areas with heavy traffic wear (e.g., urban freeways) or requiring complex traffic control and operations to apply the paint (such as intersections) the more durable polyester paint has been used. Although it is more expensive, its service life of three or more years justifies its use in such situations.

This year, we are evaluating some regular dry (cold-applied) paint. It is expected to provide better service than the fast-dry type but its 25-minute cure time requires the use of cones to prevent tracking. Use of this cold-applied paint will be limited to yellow edge-lines on freeways.

These three paint types (fast-drying, polyester, and regular-drying) require reflective beads (very tiny glass spheres) to be applied on freshly painted stripes. The beads are cemented into place by the drying paint and brightly reflect the light from headlamps to improve nighttime visibility. One of the biggest advantages of using these three paint types is that they can be applied over existing markings. The yellow edge-lines on freeways are repainted every two years and the lane stripes, annually. In many urban areas with heavy traffic volumes, however, lane stripes are repainted twice a year to maintain adequate guidance for drivers.

Future Directions

In an effort to develop high performance marking materials, many manufacturers have been using their best technology to formulate new products. Although most of these products exhibit overall satisfactory performance, none of them exhibits all the advantages of good durability, excellent reflectivity, ease of application, safe handling, short cure time, year-round delineation, and good adhesion to both bituminous and portland cement concrete pavements. Thus, research and development still goes on and new paints must be tested prior to system-wide use. To facilitate this testing, MDOT has accepted an invitation to participate in a federally sponsored pilot-testing program for pavement marking materials being conducted by the Pennsylvania Department of Transportation. If this project is successful, Michigan will regularly receive test results for a wider range of traffic paints, while retaining the option of continuing in-house testing. Using either method, or both, as necessary, we will continue to provide Michigan's motorists with the best available pavement marking paints.

-Thao Nguyen

TECHADVISORIES

The brief information items that follow here are intended to aid MDOT technologists by advising or clarifying, for them, current technical developments, changes or other activities that may affect their technical duties or responsibilities.

NEW MATERIALS ACTION

The New Materials Committee recently:

Approved the following products for trial installations:

Soil Seal Concentrate Mulch Tackifier

Approved the following products:

Generation III One Piece Channelizer
Generation IV Two Piece Breakaway Channelizer
Poly-Carb Mark-198 Poly-Anchor System
Anchor-It Solid Bond 200 Fastening System
Poly-All Epoxy Anchoring System
Snap-Tite Plastic Pipe Coupling
Product Code 87-7, Pipe Joint Seal

For details contact Don Malott at (517) 322-5687.

PERSONNEL CHANGES

Gary Tinklenberg retired from the Research Laboratory's Materials Unit on October 30, after 10 years service. Gary was our paint technology expert, and has now gone into private practice as a consultant where we wish him great success. **Wayne Frederick** has been appointed as head of the Chemistry and Photometry Unit, replacing Marv Janson who retired last spring. Wayne has been a chemist with the Research Laboratory since 1957.

This document is disseminated as an element of MDOT's technical transfer program. It is intended primarily as a means for timely transfer of technical information to those MDOT technologists engaged in transportation design, construction, maintenance, operation, and program development. Suggestions or questions from district or central office technologists concerning MATES subjects are invited and should be directed to M&T's Technology Transfer Unit.

Technology Transfer Unit
Materials and Technology Division
Michigan DOT
P.O. Box 30049
Lansing, Michigan 48909
Telephone (517) 322-1637