RESEARCH & DEVELOPMENT NEWS

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Free Training and PDH Credits via TRB Webinars

NCDOT's Sponsorship of the Transportation Research Board (TRB) provides several benefits for NCDOT employees. These include free registration at the TRB Annual Meeting and free access to electronic and paper versions of most TRB and NCHRP research reports and other documents.

One of the most useful, but least known benefits is free participation in any TRB Webinar. These technical sessions almost always include **1.5 to 2.0 PDH credits at no cost to the participant**.

To receive the documentation for official PDH credits, users must be registered as an individual attendee. To insure that that it is free, users must register with an NCDOT email address and choose NCDOT as a sponsoring agency. Topics are wide ranging and typically very practical. Whether it is planning, pavements, structures maintenance or fiscal matters, there has likely been a recent webinar covering the topic. Completed webinars are archived for later viewing.

NCDOT employees can view past webinars and sign up to receive newsletters and upcoming webinar updates at the following page: http://www.trb.org/ElectronicSessions/ConferenceRecordings.aspx

When a user signs up to receive webinar notifications, they can filter the topics of greatest interest to avoid being inundated with emails. Those options can be changed at any point in the future.

I invite you to explore TRBs website to see all of the resources that are available: http://www.trb.org/Main/Home.aspx. You might even sign up for a myTRB account while you are there to further manage TRB resources or become a friend of a standing committee. The more users of TRB webinars and other resources, the greater the value NCDOT receives for our sponsorship. If you have any questions, please do not hesitate to contact the Research and Development Unit.

Neil Mastin
Research and Development Manager

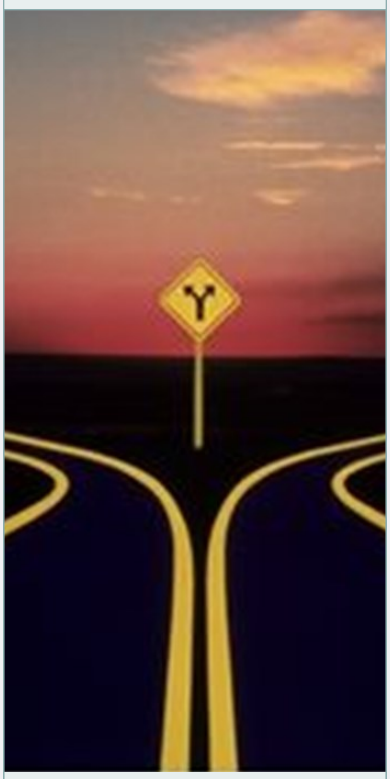


Table of Contents

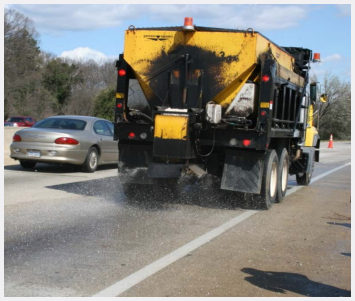
Quantifying Corrosive Potential of De-Icing and Anti-Icing Solutions on Bridge Components

Research Project No. 2012-08. Principal Investigators: Brett Tempest, Ph.D. and Matthew Whelan, Ph.D., UNC-Charlotte Department of Civil and Environmental Engineering

F. Rasay Abadilla, Jr., P.E.

The three predominant anti-icing and deicing strategies used in North Carolina are application of sodium chloride in brine form, granular form or as granules mixed with traction enhancing materials.

Brine application



Granular salt application

Granular salt and sand mix

While each of these has its own unique optimal usage for maintaining road safety, there are undetermined consequences associated with the different applications with respect to chloride initiated corrosion.

This study was undertaken to evaluate the relative impact of each deicing treatment on the ingress of chlorides into concrete surfaces and relative effect on the corrosion rates of both reinforcing steel and exposed structural steel members. The study included investigating how a variety of structural surfaces both above and below the deck, including the slab, girder ends, pier caps, guard rails, and barrier walls are affected by exposure to deicing agents. This was done by evaluating the effectiveness of paints and epoxies used to coat steel components, and the level of exposure experienced by various bridge components. The effectiveness of the deicers was also evaluated by monitoring their concentration on bridge components after application and by measuring their relative thaw rates when applied to ice.

The results showed several important trends that may influence maintenance decisions. After applying the treatments on bridge decks, the average initial surface concentrations associated with the various treatment methods were 14.08% for brine, 11.95% for granular salt, and 5.07% for salt-sand mix. At the application rates often used for ice clearance in NC, the granular salt application showed the greatest ice melting capacity in lab testing. In the field, the granular salt treatment was found to spread to the girders after precipitation events. The brine treatments remained on the deck and did not cause an increase in chlorides on the girder surfaces.

All paint or epoxy coatings tested were effective at protecting steel coupons immersed in chloride solution from corrosion damage and showed negligible weight loss from corrosion during the study. Galvanized coupons underwent some loss of the sacrificial galvanization coating but corrosion did not reach the depth of the substrate material. Coupons that were coated and then damaged by a scratch and exposed to the chloride solution illustrated some differences in the coating performance. Undercutting and progress of

(Continued on page 3)

(Continued from page 2)

corrosion was found to be most significant in epoxy coated specimens. Undercutting was less pronounced in painted specimens and not present in galvanized specimens.

The freezing, thawing and drying cycles simulated in the lab created a transport regimen that was more aggressive than static exposure. Concrete samples having intermittent exposure to salts, water and freezing conditions achieved higher concentrations of chlorides at depth relative to the surface concentration than the control specimens that were continually ponded with 3% solution. Thus, brine treatments applied to dry pavement may lead to increased chloride ingress. The normalized increase (concentration increase per documented treatment) in chloride concentration was greatest in Asheville. This indicates that climate, traffic and other environmental conditions in Asheville have a greater effect on the corrosive potential of road salts to reinforced concrete than the treatment method alone. Statistical analysis of the measured changes in chloride concentration with other external factors, such as bridge age and ADT, revealed that the influence of the treatment type may be statistically less significant than other functional and environmental factors.

Field observations and experimental results indicate that the following scenarios should be used to prioritize corrosion mitigation strategies:

- Bridge condition characteristics: a) Poor joint condition, especially missing joint material, b) Chipped or scratched paint on steel components, c) Chipped or scratched epoxy coating on steel components, and d) Low ADT bridges, where vehicle-driven transport of chlorides from the surface may be low.
- Application characteristics: a) Bridges where brine has been applied to dry pavement, and b) Cases in which deicing or anti-icing materials were applied without the subsequent arrival of significant precipitation.
- Environmental Characteristics: Application of deicers following a long period without precipitation, or warm weather. Although the magnitude of impact of each deicer on corrosion is difficult to quantify without considering other environmental characteristics, the deicers were found to impact bridge elements in different ways. Thus, bridge inspections for regions that make greater use of certain deicers could be focused to detect the onset of damage related to winter maintenance.
- Granular Treatments: a) Joints, b) Pier caps, and c) Lower web and flange of girders.
- Brine: a) Deck surfaces, and b) Above deck weathering steel.

Other Structures/Geotechnical/Construction Research Projects being managed by Rasay Abadilla include:

2015-05 **Improvement of Material Criteria for Highway Embankment Construction**

2015-06 **Unmanned Aircraft Systems: A New Tool for DOT Inspections**

2016-05 **Guidelines for Prioritization of Bridge Replacement, Rehabilitation, and Preservation Projects**

2016-06 **Internal Curing of Concrete Using Lightweight Aggregate**

2016-07 **The Use of Fiber Reinforcement in Latex Modified Concrete Overlay**

2016-21 **Improved Estimation of Embedded Pile Length for Reuse or for Pile Scour Evaluation**

Development of Near Real Time Performance Measurements for Closed-Loop Signal Systems (CLS) Using Historical Traffic Data from Existing Loop Detectors and Signal Timing Data

Research Project No. 2012-12. Principal Investigator: Billy M. Williams, Ph.D., NCSU Department of Civil, Construction, and Environmental Engineering

Ernest Morrison, P.E.

The overarching goal of this research project was to investigate the potential for the NCDOT Central Office Signal Timing (COST) Section to monitor and assess the quality of field deployed closed-loop signal system plans using the data inherent in the systems. The project has produced recommendations and deliverables that should enhance the COST Section's ability to achieve its mission of developing and maintaining quality signal coordination plans across the state.

In reviewing the state of the practice and emerging methodologies, the project team looked closely at the SMART-SIGNAL system and the Purdue University family of signal performance evaluation methods. While the recommendations in the final report do glean some features from these two cutting edge efforts, the project team does not recommend full implementation of either of these systems due to the significant changes in field equipment installation specifications and in turn significant increased costs that such full implementation would entail.

The project team recommends a series of monitoring and assessment elements that can be implemented with the current OASIS detector and split monitor logs. The recommended monitoring and assessment program elements that are based on the OASIS Detector Log are –

- Creating and analyzing the coordinated movements flow plot
- Analyzing the coordinated movements flow plot for assessing time of day plan suitability

The recommend elements that are based on the OASIS Split Monitor Log are –

- Monitoring cycle-by-cycle coordinated movements capacity
- Monitoring early return to green and green extension for coordinated phases
- Monitoring non-coordinated phase displayed green distribution

A final recommended monitoring and assessment program element that is based on both the OASIS Detector Log and the Split Monitor Log is monitoring flow to capacity.

In addition to this Excel-based analysis of OASIS log data, the project team, in recognition of the importance of the dynamic variability of cycle-by-cycle coordinated phase green times, created a tool called the Dynamic Bandwidth Analysis Tool (DBAT). DBAT was developed in as an easy to use, standalone tool and provided as a project deliverable. DBAT reads in OASIS split monitor data and will allow the COST Section to continually monitor dynamic system bandwidth.

Moving beyond dynamic bandwidth monitoring, the project team enhanced DBAT to provide an exhaustive search routine that identifies the set of offsets that would have maximized dynamic bandwidth for the archived cycle-by-cycle signal indication data. This optimization capability is ready to implement for systems with up to four or five intersections. This limit in number of intersection arises from the fact that the number of offset combinations that must be analyzed in the exhaustive search grows exponentially as the number of intersections increases. A linear program formulation was developed and tested that overcomes this limitation. However, creation of an implementation-ready LP tool was beyond the project scope.

Finally, the project team collected high resolution, vehicle activation level detector data at one of the field study sites, and developed methods for analyzing the data alone and conjointly with dynamic bandwidth information. The high resolution data analyses hold the promise of greatly enhancing the information available for COST Section closed-loop system performance assessment. Implementing this recommendation will require additional memory storage at each controller and a modification to the OASIS software to allow archiving of the raw detector inputs. This OASIS software modification is in addition to a list of additional desired OASIS software enhancements detailed in the final report.

New Publications from TRB

Due Diligence for Insurance Coverage in Transportation Construction Contracts : National Cooperative Highway Research Program (NCHRP) Legal Research Digest 66 This digest explores the process of "due diligence," in which a transportation agency acquires objective and accurate information about its insurance companies and contractors in order to evaluate the risks of entering into an agreement and a contractual relationship.

Guidebook on Alternative Quality Management Systems for Highway Construction : National Cooperative Highway Research Program (NCHRP) Report 808 This report provides national guidance on standard approaches relating to quality management systems (QMSs) and stems from a lack of guidance that resulted in significant investment on the part of transportation agencies, contractors, and consultants to develop unique QMSs for different agencies on a project-by-project basis.

Institutionalizing Safety in Transportation Planning Processes: Techniques, Tactics, and Strategies: National Cooperative Highway Research Program (NCHRP) Report 811 This report provides field-tested guidance on institutionalizing the integration of safety into transportation planning and programming processes. The guidebook also provides ways to measure the effectiveness and success of integration efforts.

Renewable Energy as an Airport Revenue Source: Airport Cooperative Research Program (ACRP) Report 141 This guidebook explores challenges airports may anticipate when considering renewable energy as a revenue source. These considerations include the airport's geography and terrain, infrastructure, real estate, energy costs, public policy, regulatory and compliance requirements, tax credits, sponsor assurances, ownership, impacts to navigation and safety, security and staffing issues, Includes an **appendix available online** that provides sample request for proposals.

Economic and Development Implications of Transportation Disinvestment: National Cooperative Highway Research Program (NCHRP) Synthesis 480 This synthesis examines methods available to estimate disinvestment effects on transportation system integrity within and across modes in urban areas, regionally, and in non-metro areas, and the use of those methods by transportation agencies.

Many more publication links can be found on NCDOT's TRB News Feed

Calendar of Events 2015

September 2015

- **NC DOT Board of Transportation Meeting, September 2-3, 2015**

October 2015

- **NC DOT Board of Transportation Meeting, October 7-8, 2015**

Librarian's Corner

By Lamara W. Jones with Chris Mulder

NCDOT Research Library News

We want to introduce you to our new public space in the Library. This area can be used by staff, visitors and researchers who need a space to study and read. This new space is available during Library hours

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NCpedia

A tool you may not be aware of is NCpedia. This an educational website coordinated and managed by the Government & Heritage Library at the State Library of North Carolina, a part of the North Carolina Department of Cultural Resources. Below are two sample entries from a search for "transportation". We encourage you to make use of this free resource.

Transportation, History of | NCpedia

Jan 1, 2006 ... History of **Transportation**. "How Did We Get Here from There?: Advances in North Carolina **Transportation**". by Larry K. Neal Jr. Reprinted with ...

ncpedia.org/**transportation**/history

Transportation improvements in the 1920s | NCpedia

Jan 1, 2004 ... The railroad also operated a large maintenance and repair shop at Spencer (the current site of the North Carolina **Transportation** Museum in ...

ncpedia.org/**transportation**/overview-1920s

Contact the NCDOT Librarian, Lamara Williams-Jones, for assistance: 919-508-1820, Monday through Friday from 8:30 to 4:30. Since there is only one Librarian, customers should call before visiting the Library. Watch this space for future articles about the Library's services and helpful topics. We look forward to serving you!

NCDOT Research and Development Unit General Information

How to find us:

We are located at 104 Fayetteville Street, Raleigh, in the Transportation Technology Center (formerly The Raney Building).

The Research & Development web page contains more information about the Unit and what we do.

The Research Library's catalog is also available on the web.

NCDOT RESEARCH AND DEVELOPMENT

The Research & Development Unit oversees transportation-related research that investigates materials, operations, planning, traffic and safety, structures, human environments, natural environments, and more. Please contact one of our engineers listed on this page if you have questions.

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