Tech Brief

Evaluation of Corrosion Inhibitors

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HERE'S THE PROBLEM

Reinforced concrete is one of the most commonly used building material all over the United States (World). Corrosion of steel reinforcement is a major problem for reinforced concrete structural elements. Corrosion of reinforcement leads to unsightly appearance and deterioration load bearing elements and eventually the entire structure. Bridges are one of the most commonly affected structures. Exposures to wet - dry and freeze - thaw conditions that occur in cold regions accelerate the process of corrosion.

AND, HERE'S THE SOLUTION

A research project was initiated to evaluate products that will reduce/eliminate corrosion of steel in concrete. Four new bridge decks were used to evaluate four commercially available corrosion-inhibiting admixtures and a fifth bridge deck was used as a control for comparison. Test samples prepared using field concrete, during the construction of bridge decks, were used for accelerated corrosion testing in the laboratory. The decks were also instrumented to monitor the field performance of actual structures.

THESE ARE OBJECTIVES…

- To determine the effectiveness of four different corrosion inhibitors in reducing corrosion of structural steel reinforcement in a structure.

- To conduct actual field-evaluation of corrosion inhibiting admixtures using new bridge decks.

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HERE IS WHAT WE DID…

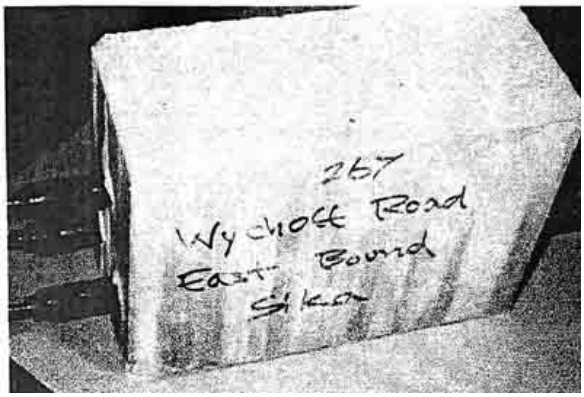
In 1998, five new bridge decks under construction by the New Jersey Department of Transportation (NJDOT) for Route 133 were selected. The concrete used in four bridge decks had one of the following admixtures: DCI-S, XYPEX C-1000, Rheocrete 222+ or Ferrograde901, and had black (un-coated) steel bars. The fifth deck was used as a control for comparison, and had epoxy coated bars and extra black steel bars. This

study was unique in that all of the samples for laboratory testing were prepared using concrete delivered at the construction site and used in the actual structures.

Since corrosion may not initiate for 10 to 15 years, accelerated corrosion tests in the laboratory were also used to evaluate these inhibitors. In addition to the cylinder strength tests, minidecks were prepared for accelerated corrosion testing. The bridge decks were instrumented for long term corrosion monitoring. Field evaluation began with three tests used to determine the physical characters (GECOR 6 Corrosion rate Meter, Concrete Surface Air Flow permeability Indicator, Electrical Resistance Test for Penetrating Slabs), as well as the corrosion protection provided by a particular admixture. The bridges were instrumented for corrosion testing, and monitored periodically for corrosion activity.

Laboratory samples were tested using ASTM G 109 to give early indication of the effectiveness of the admixtures.

Fresh concrete was tested for workability and air content. Compressive strength was obtained at 28 days. Other factors evaluated were corrosion rate, corrosion potential, air permeability, and electrical resistance.



The GECOR 6 Corrosion rate Meter was conducted to establish the kinematics of the corrosion process. The second field test was the Concrete Surface Air Flow permeability Indicator, a non-destructive technique used to determine the relative permeability of concrete surfaces. The third field test was the Electrical Resistance Test for Penetrating Slabs, which was used to establish the effectiveness of the concrete penetrating sealers and the resistance of unsealed concrete surfaces. The fourth was the laboratory testing of the minidecks, where the effects of chemical admixtures on the corrosion of embedded steel reinforcement in concrete exposed to chloride was studied.

CONCLUSION:

The evaluation produced an overall best performing admixture, though the differences in the overall performance of the admixtures were not significant.
The time interval was not enough to initiate corrosion in the steel, thus, a comparison between the admixtures could not be made.
The Air Flow Permeability Indicator can be used for the rapid assessment of the permeability characteristics of concrete slabs. In new concrete, the uniformity can be assessed. In old concrete, damage that causes increase in permeability, which is not visually obvious, can be detected.

WHAT IS THE NEXT STEP?

Continued measurements can be made in the five bridge decks any time in the future. If the field evaluation is continued for another 10 years, the results will provide unique data that will be useful for the entire world.

FOR MORE INFORMATION CONTACT:	
NJDOT PROJECT MANAGER:	**Mr. Carey Younger**
PHONE NO.	**(609) 530-5971**
e-mail	**Carey.Younger@dot.state.nj.us**
UNIVERSITY PRINCIPAL INVESTIGATORS	**Dr. Balaguru**
UNIVERSITY:	**Rutgers University -CAIT**
PHONE NO.	**(732) 445-3537**
e-mail	**balaguru@rci.rutgers.edu**

A final report is available online at http://www.state.nj.us/transportation/research/research.html

If you would like a copy of the full report, please FAX the NJDOT, Bureau of Research, Technology Transfer Group at (609) 530-3722 or send an e-mail to Research.Bureau@dot.state.nj.us and ask for:

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