

## Executive Summary, Research Readiness Level Assessment, and Technology Transfer

# Utilizing Kryton KIM Technology in Bridge Deck and Rail Construction to Protect Against Chloride Ion Penetration

### Research Objectives

The purpose of this investigation was to determine if KIM is a suitable admixture for protecting bridge decks and rails against chloride penetration.

### Research Benefits

Based on product demonstrations and research studies presented to NDOT researchers, the KIM product showed potential for use in Nebraska's concrete mix designs for new bridge railings.

### Principal Investigators

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**Wally Heyen, PCC Engineer (Co P.I.)**

**Lieska Halsey, Assistant Materials Engineer (Co P.I.)**

**David Hansen, Chemical Engineer (Co P.I.)**

### PCC Laboratory

**Tim Krason, Hwy Materials & Test Manager**

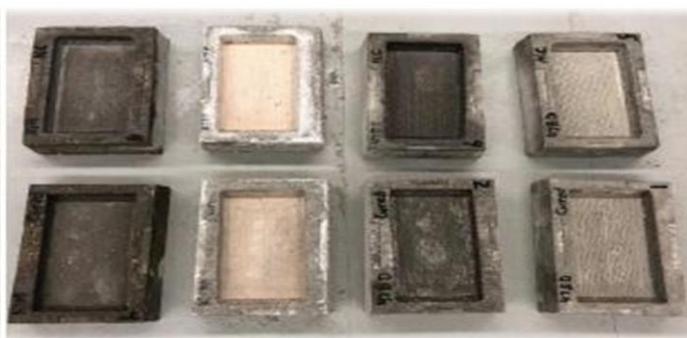
Nebraska Department of Transportation

### Background

In the summer of 2019, representatives from Kryton presented their product, Krystol Internal Membrane (KIM), to researchers at the Nebraska Department of Transportation (NDOT). According to Kryton, "KIM is a hydraulic crystalline admixture used to create permanently waterproof concrete." The KIM reacts with water and unhydrated cement and forms crystals that seal micro-cracks and prevent water and chloride penetration.

### Conclusion

NDOT engineers conclude that ASTM C672 is not the most suitable test for determining KIM's performance, as KIM's intended use is to seal micro-cracks in concrete more than it is to prevent scaling. Furthermore, ASTM C672 testing in a laboratory is not necessarily representative of a product's field performance. Ponding blocks made of 47BD and ponding blocks made of KIM performed identically when ponded with the same material. Considering these factors, researchers cannot draw a conclusion as to whether KIM enhances concrete from the results of ASTM C672 testing. During ASTM C672 testing, researchers made two notable observations; that properly cured concrete is vital to the long-term health of the structure, and that currently approved Portland Concrete Sealer (PCS) provided the best, and the most immediate protection against scaling caused by deicing chlorides. Researchers recommend the continued use of PCS according to NDOT best management practices. Expansion of KIM samples in AASHTO T380 testing slowed near the end of the testing period and indicate that KIM may be useful in sealing micro-cracks and limiting expansion due to ASR. Further investigation into the durability of KIM enhanced concrete is recommended.



The ponding blocks before (left) and after testing.

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### Recommendations

Based on the results of testing and after further discussion with industry professionals, the researchers conclude that further study of KIM is necessary to determine if KIM can enhance the performance of NDOT mix designs.

### Future Evaluations

Continued interest in KIM warrants further investigation in a second project phase to determine if it can enhance the performance of NDOT mix designs. Materials and Research engineers propose testing samples according to AASHTO T380 and NDOT Wet & Dry (W&D) testing.

- AASHTO T380 testing - mini-prisms using Type I/II cement with KIM to determine feasibility for KIM to be used in rapid repair projects.
- W&D testing - cylinders using Type I/II cement with KIM. W&D testing will reveal KIM's ability to mitigate micro-cracking.

### Research Readiness Level (RRL) Assessment

**RRL 2**

#### Level 2: Applied Research/Proof Concept – Lab Level

Research/Technology developed in a laboratory environment. Integration of components

Note: TAC lead member met in 20225; recommended pushing evaluation to 2026.

**This brief summarizes of In-House Research Project**

**“Utilizing Kryton KIM Technology in Bridge Deck and Rail Construction to Protect Against Chloride Ion Penetration”**

**Nebraska Department of Transportation Research Program**