

Deicers and Concrete

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SUMMARY

Deicing is a critical part of a winter maintenance program, helping to prevent slips, trips, and falls on sidewalks and in parking lots. However, when concrete has been damaged, the use of deicers or the type of deicer used are often blamed for the damage. Are deicers really to blame?

As concrete experts Bernard Erlin and Dipayan Jana have stated: "When scaling due to cyclic freezing occurs, often the cause is judged to be de-icing chemicals....In our experience, though, concrete that has attained maturity (or near maturity), that has an air-void system that meets industry standards, and that is properly made, cured, and finished, will be resistant to the damaging effects of cyclic freezing and deicing chemicals."¹

HOW CAN CONCRETE BE DAMAGED USING DEICERS?

When a deicer melts ice, water is created on the surface of the thawed concrete. When the concrete absorbs that water, it can lead to an increased level of saturation. The concrete, now with an increased level of saturation and having been thawed, can freeze again when the temperature falls, causing the water to expand. This expansion put pressure on the concrete - and if the concrete is not strong enough to withstand this pressure, the concrete could fatigue, possibly crack, or spall.

WHAT CAN YOU DO TO PROTECT YOUR CONCRETE?

As Jim Mack, PE, has stated, “By air-entraining our concrete, we create a tiny air void structure – acting as a pressure relief valve – into which the water expands during a freeze cycle.”² Without this air-void space, the freezing water can expand and exert pressure on the inside of the concrete. If more pressure is exerted than what the concrete can withstand, the cement mortar can “pop,” causing scaling.

However, a proper air-void space alone will not prevent deicer scaling. The concrete must be properly made, placed, and cured. Properly made concrete can decrease the amount of water the concrete absorbs. For conventional cement mixtures, this is achieved by minimizing the water to cementitious material (w/cm) ratio.

The American Concrete Institute recommends a maximum w/cm of 0.50 for moderate winter exposures and 0.45 for severe and very severe winter exposures.³ This must be used in combination with proper curing to a minimum compressive strength of 3500 psi (25 MPa). A low w/cm will reduce the amount of freezable water available initially, and proper curing helps ensure the concrete has adequate strength to withstand this first freeze.

Further, care must be taken to avoid exposure of the concrete to deicers during this first year of service. As concrete cures and matures, its strength increases to better withstand the increased freeze cycles.

How do we know these design considerations will protect concrete from winter weather and deicer use? In 2002, the Portland Cement Association published “Performance of Concrete Specimens in the PCA Outdoor Test Facility,”⁴ summarizing 36 years of concrete damage studies conducted at their outdoor testing facility in Skokie, Illinois. Each winter for 36 years, sodium chloride and calcium chloride deicer were applied to concrete on-grade slabs. After 36+ years, sodium chloride and calcium chloride showed similar results of minimal scaling on concrete which was properly formulated, finished, and cured with enough time to mature (e.g., cast in summer) prior to its first winter season.

For more information regarding OxyChem’s calcium chloride products, please visit our website at www.OxyChemCalciumChloride.com.

¹ Bernard Erlin and Dipayan Jana, *Some Truth and Fantasy About Chloride Deicing Chemicals*, Concrete Construction Online Magazine, September 2004.

² Jim Mack, *Air Entrainment Is key to Halting Deicer Scaling*, Roads & Bridges Magazine, page 63, July 1994.

³ *Guide to Durable Concrete, Reported by ACI Committee 201*, American Concrete Institute, ACI 201.2R-16, 2016.

⁴ David C. Stark, Steven H. Kosmatka, James A. Farny, and Paul D. Tennis, *Performance of Concrete Specimens in the PCA Outdoor Test Facility*, Portland Cement Association, Research and Development Bulletin RD124, 2002.

ABOUT THE EXPERTS

Dipayan Jana

President, Petrographer,
Materials Scientist, & Professional Geologist

For more than two decades, Dipayan Jana, the founder and CEO of CMC has been actively involved in characterization, testing, evaluation, and forensic investigation of a wide range of materials, including their short and long-term performance. Dipayan has worked on more than three-thousand projects on quality assurance, characterization, and forensic investigations of various kinds of geological, building, and construction materials e.g., terrestrial and extra-terrestrial rocks, minerals, gemstones, ceramics, building stones, lime, gypsum, hydraulic cements, natural and manufactured aggregates, concretes, and masonries from modern to historic structures. Dipayan has an extensive list of publications on applications of petrography and associated techniques in a wide variety of geological and construction materials that can be viewed under the 'publications' page. Click [here](#) for more information.

Bernard Erlin

Petrographer at TEC

Erlin was the President of The Erlin Company, Latrobe, PA, and ACI member for more than 50 years. He served as Chair of ACI Committee 116, Terminology and Notation, and was a member of ACI Committees 201, Durability of Concrete; 222, Corrosion of Metals in Concrete; and 362, Parking Structures. In 2018, he was recognized as a 50-year member of ACI. During the ACI Concrete Convention – Fall 2012 in Toronto, ON, Canada, Erlin gave the Katharine and Bryant Mather Lecture, in which he talked about Bryant's interest in lepidopterology and told a story about collecting moths and butterflies with him.

Erlin organized, chaired, or co-chaired many ACI sessions, and authored or co-authored over 120 papers dealing with petrographic examinations and other aspects of construction materials. He was a co-editor of several books that are compilations of papers from ACI and ASTM International sessions.

In 2003, he received the ACI Pittsburgh Chapter Tink Bryan Award for exemplary contributions to the industry. Erlin was bestowed honorary membership at the ACI Concrete Convention – Spring 2007 in Atlanta, GA, USA, "For his contributions to ACI and the concrete industry; his pioneering work in the development and application of petrography for the characterization of concrete." Click [here](#) to for more information.

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