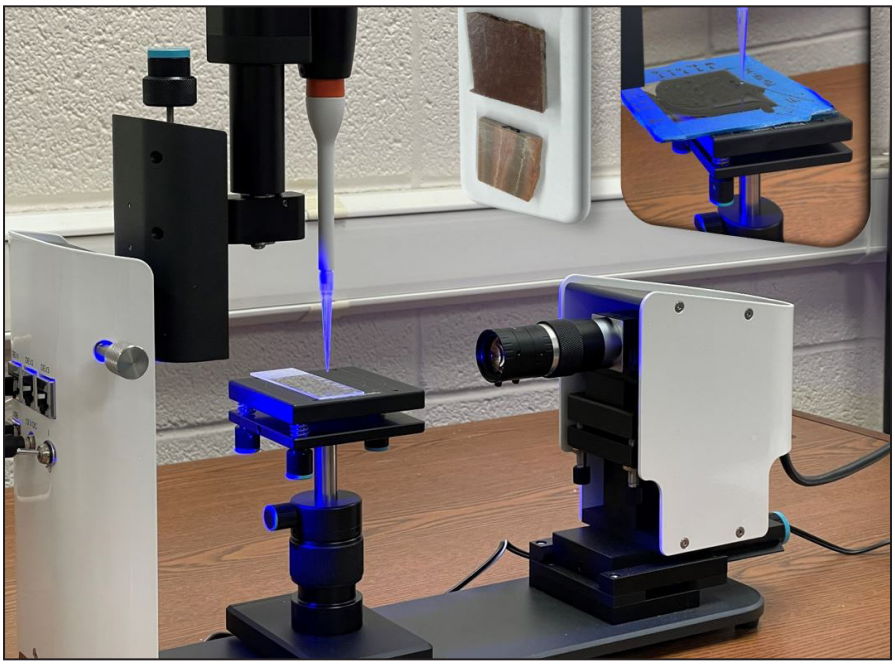
MOUNTAIN-PLAINS CONSORTIUM

RESEARCH BRIEF | MPC 24-542 (project 625) | August 2024

Effect of Deicing Agents and Environmental Conditions on the Performance of Asphalt Pavements in Cold Regions



the ISSUE

Chloride-based deicers such as NaCl, CaCl2, and MgCl2 are essential for ensuring road safety in cold seasons. These chemicals adversely affect asphalt pavement durability and may negatively impact its structural integrity. This study explored the damage mechanisms caused by the application of deicing chemicals in cold regions.

the RESEARCH

Researchers examined the effects of these deicers on adhesion evolution and moisture-induced damage mechanisms in asphalt binder-aggregate systems. They evaluated the performance characteristics of the hot mix asphalt specimens, including rutting, moisture-induced damage, and cracking resistance, when the specimens were subjected to different deicer solutions and freeze-thaw cycles. At the component level, the effects of deicer type (NaCl, CaCl2, and MgCl2) and freeze-thaw cycles on adhesion and damage mechanisms responsible for moisture-induced damage were assessed. At the microscale, a thermodynamic-based surface free energy method was pursued to characterize the adhesion and debonding energies, as well as the moisture-induced damage potential of the binder-aggregate systems for different aggregates and asphalt binders in contact with various deicer solutions.

MOUNTAIN-PLAINS CONSORTIUM REGION 8

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South Dakota State University
University of Colorado Denver
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Project Title

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the **FINDINGS**

The researchers found that elevated salt concentrations in deicer solutions led to a deterioration of adhesive and cohesive bonds between asphalt binder and aggregate systems in different scales. However, lower concentrations had an even more damaging effect due to their high ion mobility, allowing them to penetrate the asphalt mix and binder's internal structure. This infiltration induced chemical aging and altered the asphalt binder's microstructure via salt erosion. The effects of this phenomenon were observed on multiple testing scales, and the results from the various testing scales corroborated one another, supporting the findings.

the **IMPACT**

Many deicing chemicals may have a deteriorating effect on asphalt pavement durability. This study will provide pavement engineers and transportation agency decision-makers with laboratory data that show the extent of any negative effect of using deicing agents on pavement performance and durability. This will help minimize the undesirable effects of deicing agents and freeze-thaw cycles on pavement longevity by selecting a winter maintenance plan that suits the condition of the local asphalt pavements. The work is also a major step toward developing materials and methods to combat moisture and deicer-accelerated pavement distresses. Therefore, the economic impacts of the proposed study are expected to be significant.

For more information on this project, download the Main report at https://www.ugpti.org/resources/reports/details.php?id=1192

For more information or additional copies, visit the Web site at www.mountain-plains.org, call (701) 231-7767 or write to Mountain-Plains Consortium, Upper Great Plains Transportation Institute, North Dakota State University, Dept. 2880, PO Box 6050, Fargo, ND 58108-6050.