Winter Deicing Operations for Permeable Interlocking Concrete Pavements

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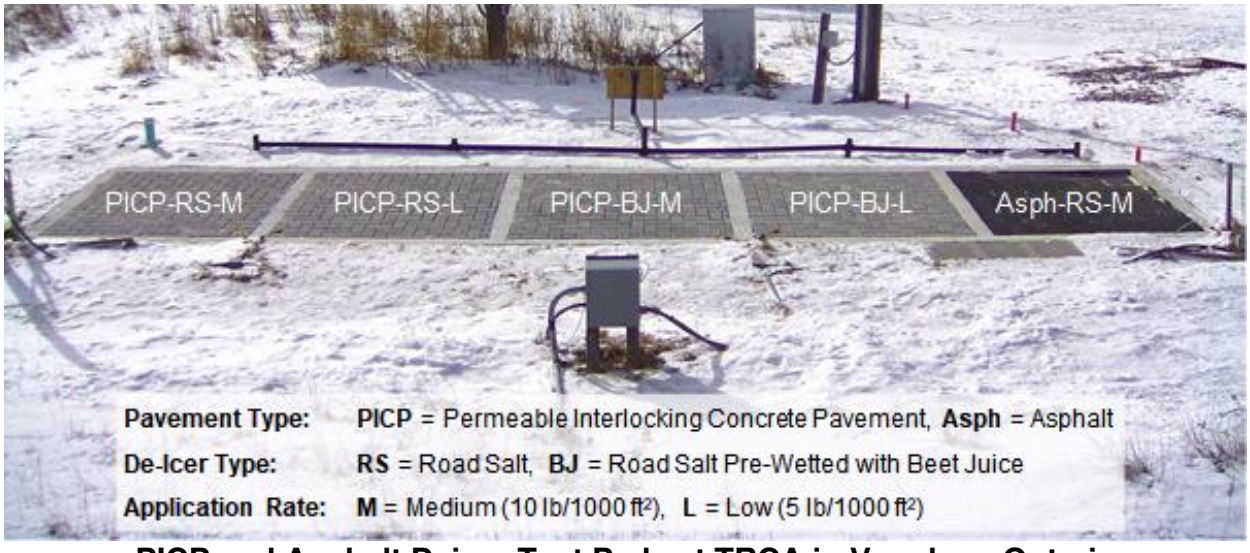
Background and Need

With increasing liability from winter slips and falls plus loss of vehicular control on snow and ice comes an increasing use of deicers. Their increase in snowmelt and stormwater runoff results in environmental damage to lakes, streams and rivers. This results in economic damage to communities, i.e. lost revenue from recreational activities such as swimming, boating and fishing. Additionally, there is the cost of deicers and their application.

Empirical/anecdotal information from PICP owners in cold climates have consistently noted snow melting faster compared to that on conventional impervious pavements especially after plowing. Other permeable pavements provide this benefit as well, and deicer reductions have been established through research. Quantifying reductions in deicer use for PICP was needed to add to existing maintenance guidelines promulgated by industry, public agencies and designers. Moreover, there is a pressing need among municipalities to require use of more permeable pavement systems concomitant with lower deicer use as a means to preserve water-based recreation plus surface drinking and groundwater resources. In addition, reduced deicer use can extend pavement life.

Objectives

This project compared winter performance of impervious and permeable pavements, specifically slip and skid resistance, time to melt/bare pavement, and re-freezing characteristics under various deicer loads and timing. In addition, deicer concentrations were measured in surface runoff from impervious and PICP and in underdrains exiting the latter. From this data, recommended best practices for snow and ice management were provided for PICP.



PICP and Asphalt Deicer Test Pads at TRCA in Vaughan, Ontario

To conduct this investigation, an outdoor pavement test pad was constructed in August 2017 at the Toronto and Region Conservation Authority's (TRCA) Kortright Centre for Conservation located in Vaughan, Ontario. The test pad shown above consisted of four 2 m (6.6 ft) square PICP cells (level) with underdrains and an asphalt control cell (2% slope to a catch basin). Each pavement cell was enclosed with concrete to prevent lateral subsurface flows between them. Installed in an open field, the cells received no pedestrian or vehicular traffic throughout the two-year study. Deicer types were sodium chloride (rock salt) and sodium chloride mixed with beet juice.

Outcomes

- PICP provides equivalent or higher levels of friction compared to asphalt when treated with 50% less deicers. While using less deicers, PICP can have a lower risk of slips and falls for pedestrians and lower risk of skidding for vehicles throughout the winter. Reduced deicer use has positive implications for reduced life cycle costs, a subject for future investigation.

- Under icy conditions, the PICP and asphalt surfaces had similar levels of surface friction prior to salting. Asphalt and pavement surfaces receiving a medium application rate of road salt (0.049 kg/m^2 or 10 lb/1000 ft^2) provide similar levels of safety soon after snow begins to melt. Melting and drying of the PICP surfaces occurred more rapidly with the medium application rate or when using road salt pre-wetted with beet juice.

- However, PICP treated with a low application rate of road salt (0.024 kg/m^2 or 5 lb/1000 ft^2) provided similar levels of safety as PICP treated with a medium application rate of road salt (0.049 kg/m^2 or 10 lb/1000 ft^2). Pre-wetting road salt with beet juice did not provide any additional benefits under the tested conditions.

- Re-freezing of melted snow and ice after sunset was observed on the asphalt surface but could not occur on the PICP surface. The meltwater infiltrated into the PICP leaving the surface dry.

- Conductivity measurements demonstrated that the PICP attenuated and buffered the release of deicing materials in stormwater discharge. Peak conductivity levels were reduced by over 85% by the PICP. Chloride concentrations in sampled asphalt runoff exceeded US EPA chronic concentration limit of 230 mg/L and an acute concentration limit of 860 mg/L (needed to sustain aquatic life) by several magnitudes. Sampled PICP effluent from underdrains never exceeded the acute concentration limit due to infiltration of some water into clayey subgrade soils.

While not specifically studied, reduction of deicers as well as their infiltration into the pavement base likely supports long-term winter durability of the concrete pavers.

The complete research report can be downloaded here.