Title: Laboratory and Field Evaluation of a Chloride-free Material for Snow and Ice Control

Authors: Kenji Sato, Akihiro Fujimoto, Makoto Kiriishi, Roberto Tokunaga, Naoto Takahashi, and Noriyuki Nakajima

In cold regions, winter weather poses a significant hazard to road transportation. To provide a safe road surface for the driving public, large amounts of anti-icing and deicing materials are used. The most common materials used for snow and ice control operations are sodium chloride (NaCl), calcium chloride ($CaCl_2$), and other chlorides due to the low costs and effectiveness in melting snow and ice in sub-zero temperatures. However, the use of large amounts of chloride salts may damage the roadside environment, including soil, plants, road structures and vehicles.

To develop an environmentally friendly, chloride-free deicing agent, the performances of-sodium propionate (SP), which has been used as a food additive, were evaluated through a series of laboratory and field tests. In this study, the corrosive effects of SP on metal were compared to those of conventional salts, and the performance of the treatments with SP and conventional salts was evaluated using friction data.

The metal corrosion test was conducted as follows. (i) A 3.0 g of test material is dissolved in 100 ml of distilled water and the test solution was adjusted. (ii) A metal specimen, which was weighed beforehand, was immersed in the solution for 24 hours and then left to dry for 24 hours. (iii) After repeatedly conducting the immersion-and-dry cycle for 7 days, the rust was removed from the specimen, and the remaining metal was weighed. The difference in weight before versus after rusting is regarded as the amount of corrosion. The solutes used for the test were SP, NaCl, $CaCl_2$ and a NaCl-SP mixture. It was found that the amount of corrosion was very small for the SP solution. And even a NaCl-SP mixture with a weight ratio of 8:2 resulted in less corrosion than distilled water, the solution of NaCl or the solution of $CaCl_2$.

To examine the performance of SP applied to a road, we performed a test at the Tomakomai Winter Test Track. 50-meter-long thin-Ice surfaces were artificially created and SP and other chloride salts are applied to the surfaces. The application methods (dry/pre-wet) and test agents were as follows: (1) dry application of NaCl, (2) dry application of a NaCl-SP mixture with weight ratio of 8:2, (3) pre-wet application of a NaCl-SP mixture with a weight ratio of 9:1, and (4) pre-wet application of a NaCl-$CaCl_2$ mixture with a weight ratio of 9:1. Performance was evaluated in terms of friction values. It was found that (2) and (3) were nearly as effective as (1) and (4) in increasing the friction value.

We will further study the performance of the treatments with SP, effective application methods and its possible impacts on soil, plants and roadside structures.