

Observations on Overseas Use of Deicing Chemicals

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In March 1994 a winter maintenance panel conducted a study tour of Japan, Germany, and Austria. The tour was sponsored by the Federal Highway Administration and the American Association of State Highway and Transportation Officials, through the National Cooperative Highway Research Program administered by the Transportation Research Board. The panel of U.S. maintenance engineers reviewed winter maintenance equipment; pavement condition policies; and the use, characteristics, and costs of deicing chemicals. Most organizations responsible for winter maintenance in the United States pursue a "bare pavement" policy on all or at least on their major roadways. By contrast, Japan does not advocate that philosophy; the city of Innsbruck, Austria, uses only a minimal amount of chemical deicing; and the state of Bavaria in Germany has progressed to a more environmentally friendly philosophy for deicing chemical use.

Japan was the first country surveyed by the winter maintenance panel in March 1994. Although some individuals in Japan believe that snow removal programs do not address public needs because a "bare pavement" policy is not followed, the general philosophy is that chemicals, notably salt, should be used only in minimal quantities because of their adverse effect on the environment. In the Hokuriku region on Honshu, the main island of Japan, 98 percent of the deicing chemical used is salt (sodium chloride) and 2 percent is calcium chloride. The annual salt use for this area is approximately 700 tons for 1000 km (622 mi) of roadway. Noncorrosive deicing chemicals have not been used in the Hokuriku region. This region has not experienced environmental problems, primarily because of the high amount of precipitation it receives. This dilutes the salt runoff and transfers the salinity to the rivers and seas. The salt application

rate varies from 2 to 40 g/m² (25 to 500 lb per 12-ft-wide lane-mi). When discussing application rates, ranges were identified, but emphasis was placed on rates at the lower end of the range.

The salt used in Japan is of a finer consistency than that normally used in the United States. Japan's salt is imported from Mexico in 1-ton bags at a price of approximately \$300 per ton. Salt applications are normally made with liquid sodium chloride as a prewetting agent (25 to 30 percent by weight of the chemical being liquid). Approximately 70 percent of the sodium chloride used in the Hokuriku region is in solid form. The salt is stored inside, normally on the balconies of buildings, and gravity-loaded through hoppers into the salt spreaders. Because of the high humidity of the region, salt can only be stored for about 10 days before it must be used.

Whereas salt is the primary deicer in Japan, Sapporo, the largest city on the northern island of Hokkaido, uses some calcium magnesium acetate (CMA) imported from the United States. This city of 1.7 million people, with an annual snowfall ranging from 500 to 700 cm (200 to 275 in.), uses about 10,000 tons of CMA per year.

AUSTRIA

The Austrian Highway Authority uses salt as a deicer and prewets it with liquid calcium chloride. The authority purchases calcium chloride in flake form and places it in suspension for use as a wetting agent. The salt has the consistency of table salt. The salt application rate varies from 10 to 70 g/m² (130 to 910 lb per 12-ft-wide lane-mi). All salt is stored inside and costs about \$200 per ton.

The annual salt use in the city of Innsbruck, with a population of 120,000 and 300 km of roadway, is 500

to 600 tons. Salt is used whenever icy conditions exist. Under those circumstances, all streets are treated. The city stores its salt in overhead silos and gravity-loads its trucks. The salt supplier "blows" the salt into the silos. Innsbruck does not prewet its salt applications. The city's salt costs about \$200 per ton and has the consistency of sugar.

GERMANY

The Transportation Administration in the state of Bavaria, Germany, purchases salt primarily from its salt mines at a cost of \$70 per ton. The administration prewets the salt, which has the consistency of sugar, so that 30 percent by total weight is liquid sodium chloride. The fine-graded salt, prewetted, is spread with the consistency of a thick soup. The salt is treated with an anticaking agent and a coloring agent. The purpose of the coloring agent is to distinguish the deicing salt from table salt because the latter is taxed. Bavaria's primary emphasis for snow removal is on plowing, with salt used to prevent the initial snow-and-ice bond to the pavement. Applications are repeated at the operator's discretion.

Several years ago, Bavarian officials evaluated anti-icing, but imprecise forecasting methods used at that time contributed to wasted presalting applications. This raised environmental concerns and led to the abandonment of the effort. With improved road weather information services, further consideration is being given to anti-icing

technologies. Currently, salt applications are made just as roads become slippery.

All of Bavaria's salt was applied in solid form until about 10 years ago. Now approximately 80 percent of its trucks are capable of applying prewetted salt, with the wetting agent applied at the spinner. The objective is to have all trucks capable of applying prewetted salt. Salt used in Bavaria has a nominal top size of 5 to 6 mm and an average size of 2 to 3 mm. In comparison, the standard gradation for deicing salt used in the United States (ASTM D632, Type 1) has 95 to 100 percent passing the 9.5-mm sieve, 20 to 90 percent passing the 4.75-mm sieve, and 10 to 60 percent passing the 2.36-mm sieve.

In maintenance yards, all salt is stored in a wooden building having a capacity of approximately one-half a season's salt demand. The salt is loaded into truck-mounted spreaders by a self-propelled conveyor/loader. They produce their own liquid sodium chloride by mixing granular sodium chloride and water in a tank. Air is injected from the bottom of the tank, thus agitating the mixture and placing the solids into solution.

The adoption of the fine salt gradation and prewetting techniques has led to an impressive reduction in salt use. From the winter of 1978-1979 to the winter of 1990-1991 total salt use in Bavaria was reduced from 361,000 to 174,000 tons. Even more descriptive of the reduction is the fact that the amount of salt applied per kilometer of road was reduced by 54 percent (46.4 to 21.3 kg/km annually) during the period.