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Roadway Deicing and the Environment

With winter approaching, millions of tons of deicing and traction control materials will be applied to the nation's roadways to help maintain safe driving conditions. However, since the widespread adoption of salt for snow and ice control in the mid 1960s, there have been concerns related to the effects deicing agents may have on the environment.

Conventional Deicing Agents

In a typical deicing operation, snow is cleared from roadways and a mixture of rock salt, sand, and/or other liquid deicers is spread on any snowpack or ice. After allowing sufficient time for the snow/ice layer to soften, the material is plowed from the road surface. Examples of common roadway deicing salts include sodium chloride (also known as "rock salt," NaCl), magnesium chloride ($MgCl_2$), and calcium chloride ($CaCl_2$). Salt is generally the most economical deicing material. However, the application of salt to roadways can corrode vehicles, bridges, guardrails, and damage concrete. From an environmental perspective, salts are easily transported with runoff water and can contaminate surface and groundwater when applied excessively. Salt can also inhibit the growth of vegetation adjacent to roadways, which can also adversely impact animals that live in roadside habitats. Finally, roadside salt deposits can attract birds, deer, etc. to the roadside, increasing the chance of motor vehicle accidents.

Materials such as sand are also often applied as an additional measure to help maintain traction on slick roads. While sand does not typically impart chemical changes to receiving waters, some environmental impacts can occur. For instance, aquatic habitats can be adversely affected when sand is washed off road surfaces along with snowmelt and deposits in waterways and wetlands. Through the process of sedimentation, host sites for insects, aquatic vegetation, and higher order vertebrates such as fish can be destroyed. Additionally, sand can clog highway drainage structures as well as impede water flow through wetlands. However, many of the concerns related to application of sand and other traction materials can be addressed through the implementation of well designed sediment collection systems and water conveyance structures.

Liquid deicers include a broad array of materials ranging from liquid salts to byproducts generated though agricultural processing. Examples of agricultural byproducts used in liquid deicers include sugar-based byproducts from grain distilling processes and byproducts from the manufacture of corn-based products. Typically, liquid deicers act faster than conventional solid salts, which must first turn into a brine solution before becoming effective. Liquid deicers also work at lower temperatures, are better able to adhere to road surfaces, and are much less likely to be worn away. As a consequence, it may be possible to apply less liquid deicer than salt or sand during a storm. However, liquid deicers can be applied alone or in combination with salt and/or sand.

Since liquid deicers are liquids, they can have the most significant affect on water quality adjacent to roadways. For instance, agricultural byproducts typically used in deicers are known to contain soluble organic carbon as well as nutrients such as nitrogen and phosphorus. As a result, it is possible for deicing operations to have an adverse impact on regional waterways, by adding to nutrient and organic carbon loading. This is important in light of total maximum daily loading (TMDL) requirements and/or stream anti-degradation legislation and must be accounted for in areas sensitive to elevated nutrients. To meet new and special requirements, the industry has responded with a variety of low nutrient liquid deicing products.

Alternative Deicing Agents

Calcium magnesium acetate (CMA), a biodegradable material made from limestone and acetic acid, is considered a viable alternative to conventional salt and liquid deicers, due to its low environmental impact. In the environment, the degradation of CMA results in the release of calcium, magnesium, and acetate. The further degradation of acetate yields carbon dioxide and water. Consequently, CMA can be used in areas where roadside vegetation and surface waters are environmentally vulnerable. CMA is also less corrosive than conventional deicers and can be applied to corrosion-sensitive structures such as bridges and concrete surfaces. However, CMA melts at a slower rate than conventional salts and is more expensive. It is estimated that CMA costs from 15 to 30 times more than conventional salt. The true costs and benefits of CMA use can only be determined when infrastructure maintenance and replacement costs associated with chloride-related corrosion are taken into account. From a practical point of view, maintenance engineers report a 13 percent lower average mass application of CMA per lane-mile, when compared with traditional salts. Reports of less frequent reapplication and better traction have also been attributed to CMA treated road surfaces.

Final Perspective

As the demand for effective and environmentally friendly roadway deicers continues to grow, effort has also been placed on adopting materials from other industries. For example, urea is often used in airports to prevent ice from bonding to pavement. However, urea contains high concentrations of nutrients, which makes its application near waterways questionable.

Regardless of the materials and methods used to fight winter weather on our nation's roadways, human safety must remain the central goal of any winter road maintenance program. However, through careful evaluation of new materials and the use of best management practices when applying deicers in the field, it is possible to maintain safe roads and minimize environmental impacts. GE

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City Cuts Wastewater Flow by Over 550,000 gpd While Population Doubles

Many booming communities struggle with expanding their wastewater infrastructure and treatment capacity to keep up with growing demand. But not Wentzville, MO. To the contrary, Wentzville has managed to decrease the flow to its wastewater treatment plant by more than 555,500 gpd—even as its population more than doubled over the past two decades—by rehabilitating more than 2.5 miles of city sewers and performing other system maintenance.

Between 1998 and 2002 alone, Wentzville, which is located about 40 miles west of St. Louis, added 2,627 new sewer connections. But by that time, the city had already embarked on a program to identify the causes of unidentified flows and then implemented a multi-pronged attack to reduce them.

Wentzville's Water and Wastewater Department first recognized it had a problem when it started keeping detailed records of flows to the city's wastewater treatment plant in the late 1980s, according to Gary Miller, Wentzville's Water/Wastewater Superintendent.

"The amount of wastewater accounted for in residents' paid water bills was far less than the metered influent that flowed to the city's wastewater treatment plant," Miller says. "Water was infiltrating the pipes along the way."

The seven-year program, which ultimately cost the city about $925,000, included a mix of small, spot repairs, manhole lining, and water meter change-out. Perhaps most significantly, it included the rehabilitation of more than 2.5 miles of city sewers using Insituform Technologies, Inc.'s (www.insituform.com) cured-in-place pipe technology.

The city began with the least costly improvements first. Water and wastewater department crews started by making simple repairs on improperly capped laterals. They also conducted drive-by inspections of roof drain down spouts that were not discharging to the open air, and repaired low-lying manholes that needed to be raised to proper grade.

"While making these repairs, we noticed that many homeowners were contributing to the city's problems by piping their sump pump discharges through their basement or laundry drains directly into the sewer system," notes Miller.

To combat this problem, the department divided the city into five sections, which it addressed at a rate of one per year. City workers inspected the homes of sump pump owners to ensure their discharge was properly connected and did not enter the sewer system. Violators were given 90 days to comply.

Water Meter Change-Out Program

Next, the department realized it needed a better and more accurate accounting of the amount of water its customers used. "We knew the cost of replacing the old water meters would be expensive," says Miller. "But we believed the return on our investment would be substantial, and it was."

Over 48 months, new, more accurate water meters were installed in more than 2,200 homes, resulting in a 15 percent revenue increase for the water department. Because the city's sewer bills are tied to water usage, the wastewater department benefited similarly. Within 15 months, the new meters had paid for themselves.

In 1998, officials again divided the city into five sections and, using a 1980 sewer study, prioritized sewer mains for repair. Virtually all of the deteriorated lines were located beneath existing streets, in back yards, or in rough terrain.

After reviewing its options, the city chose to rehabilitate the mains using a cured in-place liner that did not require excavation. It awarded Insituform a contract valued at $100,000 per budget year to make the repairs. Each year for the next five years, the sewers in a given section of the city were video-taped so the company and city officials could assess their condition.

"The televising process revealed a significant portion of the city's infiltration problems could be traced to the original poor installation of sewer mains, laterals, and manholes," says Gary Penrod of Insituform. So crews went to work on the sewers, rehabilitating about 13,704 ft of sewers over five years using the company's cured-in-place process (CIPP).

"Working from manholes, our workers used water pressure to insert a flexible liner inside the sewers," says Penrod. "Once in place, the liner was then heated and cured into a structurally sound pipe-within-a-pipe with a life span comparable to that of a new sewer." Between 1993 and 2001, Wentzville invested more than $700,000 in its infiltration reduction program and reduced the amount of unaccounted for wastewater from 911,387 gpd to 113,200 gpd.

Manholes were the last piece of the city's plan to minimize infiltration. Back in the 1980s, the city had installed new tight seals on faulty manholes. But that was only a small part of the problem. In 1998, the city faced the choice of replacing its manholes or relining them in place. It chose to reline them, keeping the disruption to streets and residents to a minimum. The department's annual budget now includes a $30,000 line item for manhole relining, as prioritized by the wastewater staff.

Lessons Learned

Is there a lesson to be learned from Wentzville's experience? "Yes," says Miller. "First, a community can learn a lot just by keeping detailed records of the flow into its treatment plants. Second, a community can save itself significant cost by taking a proactive approach to its sewer maintenance program. And finally, a community can grow without demanding more capacity at its wastewater treatment plant." GE