Automatic snow melting

Even months after a brutal Canadian winter, the memories of frozen walkways, impassable driveways and ramps, and snow plows working through the night still drive a chill through any building owner or operator—particularly as the next winter is just around the corner.

ICI and residential buildings, as well as individual homes, are all candidates for a properly installed and designed snow melting system. They can increase property value, reduce personal and vehicle mishaps, eliminate corrosive chemicals from expensive walkways and driving surfaces, free up valuable real estate that may have been used for snow storage (or removal equipment), and save owners money when compared to the cost of snow plowing and removal.

Snow melting systems can reduce interior housekeeping duties by keeping snow and slush from foyers, lobbies and loading docks. They also make a building altogether safer by eliminating slippery slush and snow from smooth interior floor surfaces, and make wheelchair ramps and all access points more accessible, cleaner and aesthetically pleasing.

The systems come in three general styles, but the focus of this piece is on electric cables embedded in or under asphalt, concrete or interlock. These cables for snow melting are normally series resistant—that is, they have a continuous heat output along the length of the cable. They are normally sized according to the required amount of heat per meter of cable and the heat required for the application, and are factory-made with non-heated (cold) leads that extend from the area to be warmed to a sensor/controller.

XLPE-coated or mineral insulated?

Series-resistant cables are normally of two types: XLPE-coated and mineral-insulated.

XLPE-coated cables

These cables consist of a copper alloy conductor surrounded by an extruded layer of XLPE (cross-linked polyethylene) with a tinned copper ground wrapped around the inner cable, followed by a layer of metallic armouring and a further layer of XLPE. They have been used in Europe for decades, and are flexible and quickly installed due to ease of handling.

A quality XLPE cable normally includes a minimum 10-year warranty, and can be quite cost effective—as low as $2.00/ft to purchase. Cable can be installed by tying directly onto rebar or by using a galvanized or stainless steel mounting strip to clip the cables in place while the surface is being installed.

Greg Lawrence, chief electrician for Hotmach Electric (Markham, Ont.), says XLPE cables have changed the way he looks at electric heating cables. "The reduced labour, ease of handling and zero failure rate at installation and over tough winters have convinced us this is the future of snow melting," he says.

Mineral-insulated cables

MI (mineral-insulated) cables have been used for years in Canada and, only until a few years ago, were considered the standard product for this application. MI cables normally comprise a seamless die-drawn copper tube or stainless steel alloy sheath that is filled with magnesium oxide and contains one or two alloy elements. The common MI cables are die-drawn copper with an HDPE (high-density polyethylene) jacket to protect the copper from calcium chloride or abrasion.

Great care must be taken to ensure the HDPE is not damaged. Care must also be taken to avoid crimping the copper tube or cracking it in any way. Any water that enters the cable will immediately degrade the insulation value of the magnesium oxide insulation, which is a hygroscopic material causing a short circuit to ground. Copper should also be kept away from all iron or steel bars due to electro-galvanic action on the iron or steel.

Self-regulating cables

Self-regulating cables that are designed to send the heat to where it is needed were popular until a few years ago. They seem to have fallen out of favour with designers, due mainly to the amount of power required to warm the cable to operating temperature. A self-regulating cable, as opposed to a series-resistant cable, normally requires about twice its rated amperage draw to warm up the cable, thereby increasing demand charges, breaker sizes, contactor sizing, wiring, connected load, etc. (They remain popular, though, for freeze prevention on exposed piping systems.)

Controlling the system

Snowmelt controls come in a variety of makes and models. The most popular, current technology is to install a snow sensor on the exterior wall of the building where it can 'see' the prevailing winter winds. Pavement-mounted snow sensors are somewhat expensive, subject to abuse by traffic and may become saturated with water when located in a low area.

Snow sensors normally consist of a precipitation sensor that has an integral heater (heated cup) to melt a sample of the falling snow and a contactor that will send a signal to start the system. Sensors stay wet for the duration of the storm. Once snow or freezing rain has stopped, an adjustable time delay will start and keep the system operating for a selected period to allow the pavement to dry.

The addition of a pavement-sensing, field-adjustable thermostat to control the temperature of the surface at an optimum output will reduce the heat requirement. This also helps reduce energy consumption on days when a light snowfall turns the system on and the surface is warmed soon after by the sun or a warm wind. The temperature sensor will help adjust for the heat of vaporization required to dry the surface. Normally, a surface temperature of just above freezing is adequate.

Remote sensing and connection to building automation systems are standard features, as are remote stations connected to a panel in a mechanical room or building operator's office.

During construction

Proper drainage practices should be observed. Snowmelt systems should be able to drain to a heated trench or to an area below the elevation of the slab.

The most significant and hardest problem to resolve is the failure during the construction process to look at snow melting as a system. When the pavement cracks in shear or moves with expansion and contraction, the system will fail. This may not happen for a number of years, but since modern snow melting cables can last decades when installed properly, the construction industry should endeavor to develop methods to prevent premature failures.

When snowmelt system failures occur, the pavement may still look good and support traffic, suggesting it is doing its job. This is not true, since one of the pavement's jobs is to protect the snowmelt system. A common fault is poor bonding of the top cap of a two-pour slab. If the concrete contractor does not properly prepare the base slab for the new cap, delamination can occur.

systems: those hidden assets

BY GERRY LEMIEUX

Average rate of snowfall during storm	Estimated maximum hourly rate of snowfall	Heat required to melt maximum hourly rate
0.25 in./hr	0.5 – 0.9 in./hr	12 – 20 W/sf
0.5 in./hr	1.1 – 1.8 in./hr	24 – 40 W/sf
1.0 in./hr	2.2 – 3.6 in./hr	48 – 80 W/sf

— NRCan guidelines for snowmelt systems

Another problem occurs when the elevation of the base slab is too high and the cap is poured thin to achieve the correct final elevation. This thin slab containing the cable is subject to cracking and delamination. If a soft membrane is in place between the cap and base slabs the problem worsens, since the cap is subject to increased flexing.

Once the cable is laid it can be damaged by other trades. Communication and understanding are required to minimize problems. Inexperienced installers can make errors in layouts. This is best avoided by having input from the manufacturer readily available. As in most things, it is the details that determine the quality of the job.

Snowmelt system repairs

Most heating systems can be repaired when damaged, but the cost of purchasing and maintaining the specialized equipment and training needed for finding hidden faults is impractical for the average contractor. There are a few specialized companies that deal with these problems. Finding a fault in an electric cable may be as simple as an ohms test and a calculation, or requiring sophisticated equipment.

At first glance it would seem snow/ice melt systems are somewhat expensive to operate and tricky to deal with, but a brief investigation into the heat requirements and actual hours they're operational shows they are a cost-effective alternative to personal injury, snowplowing, damage to garage doors, insurance claims and erosion of concrete by salts and other chemicals. An investigation of your local area conditions and historical weather data will help to ascertain whether a properly constructed and engineered system is right for your application.

The past and future of melting snow

Electric snow melting systems have been in use since 1927 when Alcatel (now Nexans) first introduced series-resistant heating cables to the commercial, industrial and residential sectors in Norway.

The introduction of heating cable technology has changed the way Europeans live. In cities such as Oslo and Stockholm, there is no sound of plows and loaders grinding through the night: heating cables are installed under many city streets, keeping both them and sidewalks clean and safe.

Over time there have been many changes and developments in snow melting and ice control technology. Cost of purchase, maintenance and operation have decreased, efficiencies have risen, and cable technology is continually developing to meet the demands of the market.

With the increase in use there have been changes in cable technology including newer and more sophisticated control systems and developments in the way heating cables should be installed to provide maximum life, effectiveness and energy efficiency.

Notes

1. Special thanks to Len Duke of Emli Cables, Toronto, for his assistance in writing this article.
2. ASHRAE, Applications: Snow Melting Section 45.
3. National Research Council, CBD-160. Design Heat Requirements for Snow Melting Systems. G.P. Williams

For over 30 years, Britech Corp. president Gerry Lemieux has been a recognized author and applications specialist in the heating industry, and his company has been the Canadian representative for Nexans Heating Cables for over seven years.