



Frost Heaves and Ice Rinks

Remediating frost heaves below the refrigerated slab of an ice rink can be the **most expensive repair** an arena owner may ever face. If the ice rink operates a long-enough season without any way of keeping the sub-soil warm, ice will eventually form. As the ice lens grows and expands -- often to 5 feet and occasionally to over 20 feet below the ice surface. As it expands, it exerts a tremendous force, putting pressure against everything it encounters. Frost heaves can buckle the floor, crack concrete, displace the boards -- and even jeopardize the stability of the **entire building itself**.

A heaved floor can have disastrous consequences.

Dew Point and Frost Heaves

If you've ever lived in a cold climate, you've probably seen condensation develop on the inside of the windows of a house in the wintertime. This results from the dew point of the window being below the temperature at which humidity will condense out of the air.

A similar thing happens below an ice rink. Over a prolonged operating period, the temperature under the insulation will fall below the dew point, causing whatever moisture there is in the ground to condense. Since vapor pressure acts as a moisture magnet, it can travel from great distances to add to the accumulation below the ice rink.

Water can also come from underground sources or run-off from rain and snow -- especially if the facility was not constructed with drainage in mind. Before starting construction on a new facility, a geotechnical engineer must be consulted who can provide advice on the proper drainage underneath and around your facility.



Prevention

If the refrigerated ice surface is in operation for more than seven months of the year, a subfloor heating system is generally required. The heating floor will maintain the sub-floor at a high enough temperature (generally around 38°F) to eliminate the potential to build up an ice lens below the cooling floor.

Water-impermeable insulation must also be installed beneath the cooling floor to minimize the amount of heat loss from the soil below. It is considered good practice to install a double layer of 2" high-density Styrofoam. Finally, a high-quality vapor barrier must be installed beneath the insulation to minimize the potential for the insulation becoming saturated over time.

Installing a heating floor at the start is prudent – even if you plan on operating your facility for just seven months a year, as demand that comes with the popularity of ice sports may make you change your mind later. The cost of heating floor typically runs from 7% to 15% of the refrigeration installation.

Frost Heave Indicators

Discovering your ice floor is out of level is one of the first indications of frost heaves. The differences can be small or large – some as much as 10" out of level. Unless you take out the ice and carry out immediate remedial actions, the only way to you'll be able to level the playing surface is with the application of more ice on the low spots. That results in an inconsistent surface temperature over the entire rink -- and an ice plant operating overtime to accommodate the thick spots.



Of greater consequence than the higher costs due to increased run time of the ice plant is the structural damage that takes place due to the frost heaves. The concrete floor can buckle and crack. Doors and gates can become very hard to open and glass can fall out of their supports, causing bodily harm to players and spectators. In some instances, the whole building can shift and sustain damage.

For many facilities with severe heaving problems, the only recourse is to totally remove the damaged floor and excavate the frozen material. The costs can be tremendous. For this reason, we always recommend a heating floor on all new installations.

Heating Floors

The most common style of heating floor is one that harvests waste heat from the refrigeration plant. This style of system is very effective and efficient to operate.

There have been a few facilities that have used electric resistance heaters, but they are expensive to operate and prone to failure as it can be difficult to detect the failure of one or a few circuits.

A few ice rinks have used forced air to heat below the ice surface. Caution must be taken to ensure the heat source is reliable -- and to ensure there is proper drainage. Otherwise the pipes can become plugged with water which will eventually turn into ice.

If a heating floor system fails, there is no early indicator as it does not immediately affect your ice surface and revenue stream and it can be years before you will see the physical problems listed above. For this reason, you must be diligent to ensure that your heating floor is operating properly. We recommend you carry out the following checks:



Daily

Check the level in your balance tank to ensure you have heat transfer fluid.

Monthly

Turn your heating floor on the HAND position.

Verify that the pump is operating and the pressure rises on the pump gauge.

Feel the heat exchanger to ensure it is transferring heat.

Let the pump circulate for an hour and verify if the return fluid temperature is close to the temperature registered on your thermostat.

Turn the pump back to Auto and verify that when the pump is off the pressure gauge goes back to zero.