INFRARED SENSOR CONTROL OF AN ICE SHEET - DOES IT WORK?

Controlling Refrigeration Through Ice Surface Temperatures

There has been an effort by some vendors to promote ice temperature control through the use of infrared sensor technology. The theory behind this technology is simple. Since the goal of the refrigeration temperature set point is to produce a specific temperature and texture at the ice surface, why not use an infrared sensor to monitor the true ice sheet temperature and control the refrigeration system accordingly?

Without doubt, maintaining ice surface temperature is the goal of the ice making system. With a stable arena environment, the return secondary fluid temperature has customarily proven to the be the most ideal way to provide a steady and consistent control of ice temperature.

With a typical building load the relationship of ice temperature to return secondary fluid temperature is typically very stable. As ice sheet temperature increase, so does the return secondary fluid temperature.

This relationship, or temperature spread between the return glycol temperature and the ice sheet temperature will vary depending on the type of complex. For example, a properly designed recreational complex will have a much closer spread between the glycol temperature and ice sheet temperature than a major multipurpose complex with an enormity of seating and building ventilation load.

The goal will be to operate with as high of a glycol temperature as possible while still maintaining good comments for the skaters. The higher the temperature maintained, the more efficient the refrigeration cycle with the energy consumed for the cooling effect produced. Also the heat infiltration rate absorbed by the ice sheet is also reduced.

Today's rinks which we design at a very high efficiency rate can maintain a good quality ice sheet with the glycol set at 19 or 20 degrees during most operational functions. For a heavy public skating session, you may wish to reduce this temperature by one or two degrees at the start of the public session. This will have to be gauged by how the ice sheet responds to the load. With your overall building temperature lower, the impact of a large crowd will be substantially less to the ice sheet than experienced in the past.

Once the feel for the building and a benchmark for the glycol temperature settings has been established, the relationship of glycol temperature to ice sheet temperature will remain a constant. The only factor which can effect this relationship is a change in the ice sheet thickness. The thermal conductivity valves of ice is not perfect. Accordingly as the ice gets thicker, the more insulating properties and heat transfer resistance which is created between the surface and the glycol system. The net result of thicker ice is that the operator must operate with a lower glycol set point to achieve the same surface temperatures.

Based upon an average recreational type building and average ice sheet load, every 1/2" of added ice thickness will require the operator to reduce the glycol temperature from 1 to 1-1/2 degrees F to produce the same surface conditions. It is for this reason that ice thickness becomes a very important factor in both ice quality and energy performance of the ice making system. The ice maintenance information we forwarded will address how to monitor and control ice thickness over the entire ice sheet.

Considerable marketing efforts have been launched by companies who profit in the sale of infrared ice temperature controllers. While the concept on the surface seems very attractive, the technology for the given application has significant flaws. These flaws are substantial enough to show a technology which is mean to improve a complexes performance will actually result in a hidden detriment to the operation.

infrared sensors can not overcome three basic problems;

Problem One

infrared sensors read surface temperatures of any and all objects they hit. This works well for an empty ice rink. It may also work relatively well for ice hockey since there are few people on the ice sheet to effect the readings. But, when a large public skating sessions takes place, the accuracy of the readings is significantly compromised. The sensors will average the general area they are aimed at. If this area consists of dozens of skaters, the temperature of these skaters at a level of 6' feet high of which higher temperature body features of exposed arms and head are read, the sensor will automatically assume the ice sheet temperature is warmer by a few degrees when in actuality it is not.

When an ice rink is impacted by a high load condition, the mass of the ice rink acts as a thermal battery providing a flywheel effect through the load. For example when a large capacity public skating session begins, it may take up to 15 or 30 minutes for the ice sheet to begin elevating in temperature. It takes an additional 35 ton load, sustained for approximately 45 minutes to elevate the temperature of the ice sheet one degree. With a glycol return sensor, the refrigeration system will stage up in capacity at this time and likely prevent further elevation in temperature. The unit will operate at this added capacity for an average of 45 minutes past when the public skating load is eliminated. Accordingly, for a 2 hour session, the refrigeration system will operate at a higher capacity for this same 2 hour period but only on a delayed reaction. If the public skating load is light, the system capacity increase (basically starting another compressor) may be delayed even longer than the 45 minute period and then also cycle off faster at the conclusion of the ice event. Using a glycol return sensor assured only the exact amount of refrigeration capacity required will operate.

With an infrared sensor, the moment the skaters step on-to the ice sheet, and additional compressor, or likely two compressors will start. Based upon a large public skating crowd, the sensors will think two more compressors are needed because of the body heat readings distorting the temperature averages. Accordingly, the glycol temperature may likely drop during a public skating session because an over amount of compressors is running. In this model, which is typical of using this technology for an ice rink application with public skating, the energy consumption during a public skating session will be twice as high as required.

The problem with infrared concept, is owners not aware this is happening may actually get enthusiastic about a technology which is actually hurting there systems performance. However without them actually knowing to look for this condition by comparing glycol temperatures and compressor running times, this problem will be hidden to the untrained eye. For the average operator, they see the compressors immediately start when skaters get on the ice sheet, and shut off immediately when the skaters leave, and they may think its because their ice sheet surface temperature changed when it was really 600 bodies at 98.6 degrees which are no longer fooling the sensor in its average ice temperature readings.

Why hasn't this been substantially recognized in past applications? Mainly because, Canadian based companies started promoting infrared sensor control, most of the installations for this technology is located in Canada. Canadian complexes are almost entirely hockey orientated. Canadian rinks have very little public skating and the public skating sessions they do have usually consist of a capacity no greater and 50 to 150 persons. This differs dramatically from the US market where a public skating session of 400 to 600 is very common. Under the US market environment, the problems of this system will become more prevalent as operators collect data on their systems.

Handheld infrared sensors similar to the unit we used is perfect for an operator. They are inexpensive, will not improperly control the compressor starting, yet they will provide the maintenance personnel with a helpful tool to monitor conditions which can be the telltale sign for thick ice conditions or air distribution problems over the ice sheet area.

Problem 2

The second inherent problem of infrared sensors is there inability to provide a true average ice sheet temperature over the entire ice sheet. If they are not aimed directly at a hot spot, they will not control the floor based on the average ice sheet temperatures.

Indirect glycol systems by nature of their design, will attempt to average ice temperatures over the entire floor. Accordingly, measuring the return glycol temperature provides the best accuracy, average, and stability for which to run the refrigeration system at peak efficiency with surface quality maintained.

Problem 3

Comment was already made about the effects of thick ice and its detrimental effect on floor efficiency. When the ice sheet starts becoming thick, with a glycol temperature setting which has been predetermined for the complex, the operator will immediately know that the ice sheet seems soft given the glycol temperature. Upon recognizing this problem, the ice sheet thickness can be adjusted thereby maintaining both the quality of the ice sheet and the energy efficiency of the complex.

With infrared control, no signs of a thickening ice sheet will show itself other then the running hours of the compressor system. As the ice sheet gets thicker, the infrared system will continually try and compensate for the added thickness by running more compressors. In these complexes, its not uncommon for them to have an inch or two more ice than they should because they have no system to bring the matter to their attention. Keep in mind, the extensive resource of information we have with microprocessor is not available in most complexes. The only historical information they have is what they manually log on a daily log sheet. They do not have the detailed graphics and endless comparisons which shows these types of conditions on the microprocessor. Thus, the signs that these conditions are occurring with the infrared sensors are obscured in the inaccurate, insufficient, or totally unavailable historical data.

For the reasons noted above, other than a hand held unit, this is an inappropriately matched technology.

For More Information Contact:

Everything Ice™
www.everything-ice.com
888-543-0921   814-487-6056