Remote Refrigeration Takes the Heat Out of Your Kitchen

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All refrigerated fixtures, regardless of whether they are walk-ins, icemakers or reach-ins, require specific mechanical components to perform the task of removing heat from that fixture. A basic refrigeration system consists of a compressor, condenser, receiver, evaporator, various controls, valves and piping. These components are arranged in varying degrees of complexity depending on the size and demands of the specific fixture and ambient conditions where the device is located.

A refrigeration system operates by changing the state of the refrigerant in the system from a liquid to a gas and back again. During this process, heat is removed from the refrigerated fixture and dispersed to air or water through the condenser. The evaporator is the fan coil unit located inside the fixture and the compressor serves as a pump that circulates the refrigerant through the system. The compressor also provides the pressure differential necessary to make the system work. The compressor, condenser and receiver–a holding tank for the refrigerant–are typically mounted together on a common metal base and called a condensing unit.

The operator has the option of purchasing most refrigerated fixtures with either self-contained or remote condensers. On self-contained undercounter units, the condensing unit consumes space that could provide additional dry or refrigerated storage capacity. Condensers for walk-in coolers and freezers are often set on top of the walk-in where ventilation is limited or absent.

Many walk-ins and self-contained units are starved for proper ventilation. Without proper airflow to remove the heat, the unit can't maintain proper temperature under full loads. Solving this problem requires increasing the size of air conditioning and ventilation systems to pull more heat out of the kitchen or storage areas. Adding additional air conditioning increases energy costs, adds noise and may require larger ductwork, which can lower the ceiling and head room.

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Self-contained refrigeration requires that all maintenance be performed inside the restaurant, often in the busy cooking and preparation areas. Cleaning and general maintenance cost is increased on condensers located in greasy, often wet environments. Electric controls on the condensers are often subject to damage or shortened life when hoses and pressure washers are used to clean the fixture.

Water-cooled Compressors

Heat rejection to the kitchen can be reduced using water-cooled condensers. Cool or chilled water is piped through the condensing unit to absorb and carry away the rejected heat. Historically, this often meant piping municipal water through the unit and then dumping the water down the drain. Increasing cost of water and stringent conservation measures have all but eliminated this option in many areas.

Modern water-cooled systems use a closed piping loop where water is piped from a cooling tower or mechanical chilling system through the condenser and back. Heat is rejected from the cooling tower into the outside air. Unfortunately the cost of installing a separate chilled water system with piping, pumps, valves and controls, etc. can be very expensive, particularly in urban areas where the piping is installed by union steam fitters.

Cooling towers or chillers are commonly used in large buildings to provide air conditioning. Older main frame or mini-computer systems were also water-cooled. Since the newer computers are air-cooled, or they have self-contained cooling systems, many cooling towers in commercial buildings now only operate during warm periods. Running a large cooling tower year-round just to cool foodservice refrigeration is very expensive. In a building with a single cooler tower, if the tower or piping system is out of service, all of the refrigeration connected to that system may need to be shut down. Some water-cooled systems include a service connection to allow domestic

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water to be piped through the system in case of a cooling tower shutdown, but some municipalities will not permit this connection or require a special set of check valves to assure that no contaminated cooling water will ever seep back into the public water piping.

Another concern with water-cooled compressors is that they are more expensive to purchase than air-cooled models of the same capacity. This extra cost is partially offset by the potentially lower operating life of water-cooled compressors. Since they represent a small percentage of all the compressors sold, water-cooled compressors are often special ordered by refrigeration manufacturers and often add six to eight weeks to the delivery time of the fixture.

Air-cooled Condensers

One of the simplest and cost-effective methods of removing heat from refrigeration fixtures and the kitchens where they are located is to place an air-cooled condensing unit outdoors or in a cool remote area. Although the initial costs for a remote package are more than self-contained systems, the remote package more than pays for itself in long-term operation. Refrigeration piping is less expensive to install than chilled water, and there is no requirement for a cooling tower. Since the compressors run cooler they can often be used to service two or more similar fixtures.

In many remote systems, individual remote condensing units are typically supplied by walk-in manufacturers or local refrigeration contractors and are set at various locations on the roof or throughout the building. They require individual roof pads and penetrations for each set of refrigeration lines and electrical connections have to be made at each unit's location. This requires building trades to spend additional hours for hook-ups, increasing construction time and delays in opening the facility. Maintenance time is also increased because of multiple rack locations. Locally assembled individual condenser racks are not UL listed, which is a requirement in most urban areas.

A better solution to having a row of individual remote units is to purchase an engineered refrigeration system or rack. With all the condensers located in one housing and a single receiver tank in one central location, the equipment is shipped from the factory pre-wired and pre-piped to a single point connection. One single roof pad can be utilized, with a single penetration for all the refrigeration lines and one for the electrical service.

Typically, detailed drawings showing job site coordination require pipe sleeves, clearances, etc. but are not provided when individual condenser units are specified. If a complete rack system is used, "Refrigeration

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Schedules" with detailed drawings and schematics are included as part of the standard package. These "shop" drawings reduce installation time and errors and are extremely helpful in troubleshooting problems during the life of the facility.

In larger systems, multiple fixtures operating at the same temperature can be tied together in a refrigeration network serviced by a single remote rack. These systems are referred to as "multiplex" or "parallel" systems. Typically a system includes three compressors tied to a common manifold. During periods of low use, only one compressor operates. As demand increases, a second compressor is started. A third compressor provides backup. Most retail food markets and many hotels and casinos use these types of systems.

New Concepts in Refrigeration

The newest and most innovative concepts in refrigeration are only available from manufacturers of engineered racks. For example the Hussmann Protocol systems allow installation of a rack capable of handling a large restaurant kitchen that fits inside a 30x84 work counter. A 24x20 high rack shown at the 1999 NAFEM show will accommodate up to 15 HP of compressor capacity in a package that can be mounted vertically on a wall or set horizontally the top of a cooler.

These systems utilize scroll compressors that are much quieter, smaller and lighter in weight than the traditional reciprocating compressors. Since the smallest scroll compressor currently on the market is 2 HP, a multiplex or parallel system is typically required to allow the use of this technology to combine 1/2 to 1 HP loads typical of individual foodservice fixtures.

Any engineered rack system should provide the option to include the ability to segregate ice machine condensers in a separate compartment utilizing its own fans. This assures that the ice machine will operate at maximum capacity at all times. Fan cycling switches are the preferred design. The fans will only run on demand, rather than continuously.

If you follow the direction set by many restaurant and hotel chains who have done detailed analysis of various options, remote air-cooled racks systems are common choices because they have lots to offer in both installation and life cycle savings. These same savings on energy, installation, space and maintenance can benefit your facility. □

About The Author

Since 1983, Foster Frable, Jr., has been a principal with the White Plains, N.Y., foodservice consulting firm Clevenger Frable LaVallee, one of the nation's 10 largest foodservice consulting firms.