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COMMERCIAL AND INDUSTRIAL HEAT RECOVERY CHILLERS

A 105-ton heat recovery chiller for a pharmaceutical storage facility in Malaysia. Photo courtesy of ACMV Pte. Ltd., Singapore.

DID YOU KNOW?

When multiple chillers are arranged in series to accomplish heating or cooling needs, it is a good engineering practice for the heat recovery chiller to be base-loaded, that is, be the first chiller in line to be used for producing chilled water. The more loaded the chiller is, the greater its energy efficiency.

A heat recovery chiller is a heat pump that is employed to recover building heat that would otherwise be rejected. It can simultaneously provide heating and cooling with excellent efficiency and economy of scale in large commercial and industrial facilities with central heating, ventilation, and air conditioning (HVAC) systems.

HOW IT WORKS

A standard chiller produces cold water and dissipates heat absorbed by the refrigerant into the atmosphere through the primary condenser. A heat recovery chiller has a second condenser or condenser circuit added on to a conventional chiller where the energy contained in the refrigerant is transferred to an incoming hot water loop. This hot water, which is typically around 105°F, can be used to heat the building's space or to preheat the return water from the building's water heating loop. The lower temperature lift that the boiler must create as a result of preheating the water means that it has to do less work and consequently the overall heating efficiency improves.

The presence of simultaneous heating and cooling loads year-round is a requirement for using the heat recovery feature in a chiller.

APPLICATIONS

Heat recovery chillers can be used for hot water production, space heating, process heating, boiler water preheating, and dehumidification in industrial and commercial buildings. Specific applications are listed below.

- Hospitals: laundry, boiler preheating
- Universities: dormitories, boiler preheating
- Manufacturing: process water heating, boiler preheating
  - Food processing
  - Chemical
  - Primary metals
  - Automotive
  - Wineries
- Large hotels, resorts and casinos: laundry, showers, swimming pools
- Office buildings: perimeter reheating, domestic hot water preheating
- Schools: cooking/dishwashing, hot water preheating
- Military bases: barracks, boiler preheating, domestic hot water preheating, laundry

BENEFITS

Energy efficiency. The process of recovering otherwise wasted heat energy from the chilled water loop results in improved overall thermal efficiency. Heating with electrical motor-driven refrigerant compression instead of a fossil fuel boiler makes the process even more energy efficient.

Humidity control. In institutional settings the recovered heat can be used to control humidity in sensitive areas like laboratories and operating rooms.

Peak demand savings. In cooler climates, heat rejected by the chiller cooling towers or air-cooled chillers can be recovered by the chiller and used for space heating in lieu of electric strip backup. This can help to eliminate peak demand for the utilities.

Efficient hot water preheating. In multiunit facilities like hotels, barracks and educational facilities, hot water preheating can reduce natural gas water heating for pools, hot tubs, showers, laundry, food services cleaning, dishwashing, and cooking.

Recovery of process heat. Manufacturing facilities can upgrade low-quality waste process heat and reinject it into various process applications thereby reducing fossil fuel demand through a heat recovery chiller that simultaneously serves a portion of the chilled water demand.

LIMITATIONS

High capital cost. Initial investment is a barrier for heat recovery chillers, however, the high capital cost can be largely offset by low operating costs. Typical payback can range from one to three years depending on fuel prices and usage.

Limited use of heat recovery feature in warm climates. In warm climates, where cooling needs predominate, the heat recovery feature doesn't yield significant benefits because the need for simultaneous cooling and heating is limited or doesn't exist.

More cooling energy requirement. Studies have shown that a heat recovery chiller consumes a greater amount of cooling energy than a standard chiller because it operates at a higher condensing pressure and temperature. As a rule, heat energy should be recovered at the lowest possible temperature that can practically meet the heating needs.

Changes to the heating system. The temperature of hot water obtained from the heat recovery chiller is generally around 105°F to 110°F. Manufacturing facilities that use water hotter than 105°F to 110°F for their current processes may need to modify the heating system design using customized solutions to obtain water with the right amount of heat.

Lack of awareness about the latest technology. Customers' limited understanding of energy recovery and its advantages prevent them from adopting the technology. Sometimes they have a general preconceived idea of a chiller but fail to note heat recovery possibilities.

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