Condenser Water Heat Recovery

System Description

Water-cooled chillers reject a significant amount of heat through cooling towers. All of the building heat and the heat generated by the compressor work leaves the building in this manner. Reclaiming this heat and using it to heat the building or the domestic hot water can potentially offer huge energy savings. For example, a 400-ton chiller can provide 500 tons or six million Btu of heat. Unfortunately, the heat is in the form of 85 °F to 95 °F condenser water, which is not very useful. To improve the value of the rejected heat, the water temperature must be increased. There are two main methods to accomplish this: heat recovery chillers and Templifier™ heat pumps.

Heat recovery can only occur when there is a source (a cooling load in the building) and a requirement (a heating load in the building). Different HVAC system types and building uses will dictate the viability of condenser heat recovery. Facilities with high domestic hot water usage, such as health care, hotels, etc., can also benefit from condenser heat recovery.

Heat Recovery Chillers

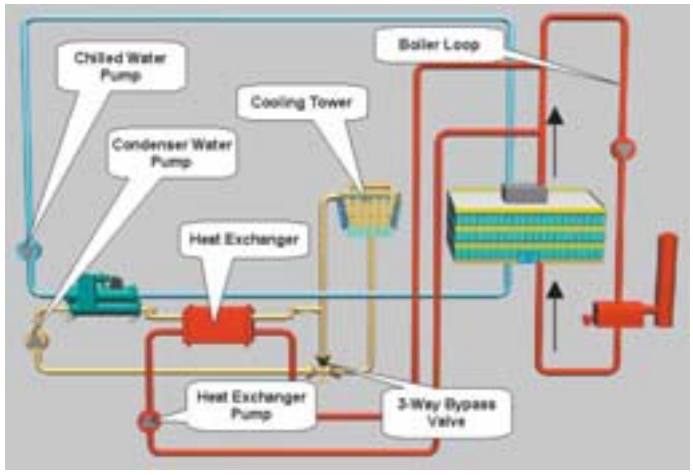

Figure 1 - Single Condenser Heat Recovery Chiller

Heat recovery chillers come in two forms: single condenser and split condenser. Figure 1 shows a single condenser heat recovery chiller. The chiller can produce 105 °F to 110 °F hot water, which can be used for heating the building, or for preheating domestic hot water. Figure 2 shows a split condenser heat recovery chiller, which does not require a heat exchanger. Split condenser chillers are more common than single condenser chillers.

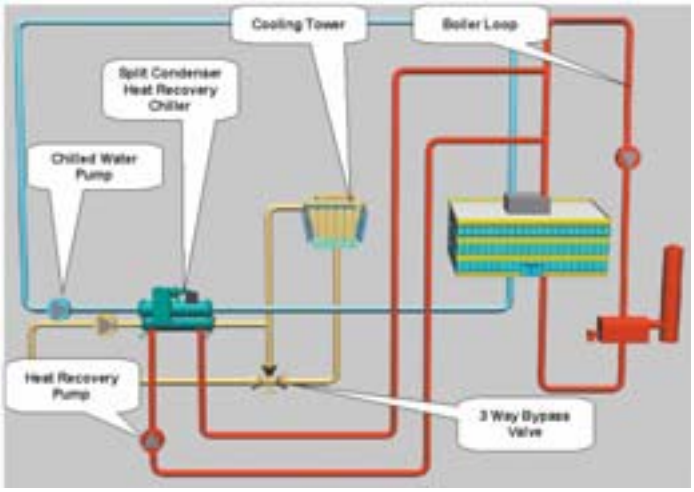

Figure 2 - Split Condenser Heat Recovery Chiller

As the chillers produce hotter condenser water, they work harder and their performance drops when compared to conventional chilled water production. This penalty must be weighed against the value of producing usable hot water. Most heating systems are designed to operate at 180 °F supply water. During heat recovery mode, the heating system must be able to meet the requirements of the building with only 105 °F to 110 °F water. This may require changes to the heating system design that will increase capital cost and operating cost.

Templifiers

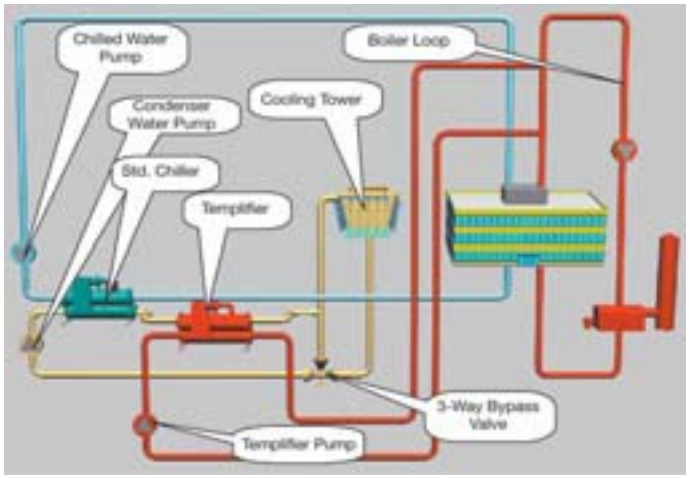

Figure 3 - Templifier Application

Templifiers are heat pumps that can recover low-grade heat and convert it into high-grade heat. They are used in addition to existing chillers. In condenser water applications, they can produce 140 °F to 160°F hot water from condenser water heat. The Coefficient of Performance (COP) ranges from 3.0 to 5.0. The higher water temperature produced by the Templifier

System Pros

- Can recover large amounts of heat that would otherwise be rejected from the building and then use it for either building heat or domestic hot water heating. While airside energy recovery is very effective, it only can recover the heat associated with ventilation air. The chiller plant sees all the heat in the building.
- Can be used with any kind of water-cooled chiller plant and any HVAC system that has simultaneous heating and cooling requirements.
- Templifiers can heat domestic hot water up to 140 °F, even if there is no flow into the storage tank. (Heat recovery chillers can only preheat domestic hot water make-up.)

System Cons

- Can increase chiller plant complexity and cost.
- Heat recovery chillers lower the performance of the chiller in heat recovery mode.
- Heat recovery chillers may require changes to the heating system to work with the cooler hot water. This can increase capital and operating cost.

reduces the impact on the heating system. In addition, Templifiers have a minimal impact on the chilled water plant operation.

Templifiers can also be connected to the domestic hot water load. Most domestic hot water systems are based on 140°F hot water. The Templifier can produce hot enough water to directly heat the storage tank. An isolating heat exchanger is often used to meet local code requirements.

Energy Considerations

Condenser water heat recovery systems are intended to recover waste heat from the building. In the correct applications, the savings can be substantial and the investment can pay for itself in less than two years.

The following are some considerations outlined in ASHRAE Standard 90.1-2001. The numbers in brackets refer to Standard 90.1-2001 sections. It is recommended that Standard 90.1 be reviewed prior to design.

- Air or waterside economizers are not required if condenser side heat recovery is used (6.3.1).
- Simultaneous heating and cooling is allowed if at least 75% of the reheat energy is provided by a site recovered energy source (6.3.2.1).
- Airside energy recovery is not required if 60% or more of outdoor heat energy is provided from site recovered energy (6.3.6.1).
- Condenser heat recovery is required for domestic hot water systems if they operate 24 hours per day, have a cooling load of at least 400 tons and a domestic hot water load of at least 1 million Btu/hr (6.3.6.1).

A thorough explanation of Standard 90.1 is beyond the scope of this document. The designer should have access to the standard and a complete understanding of its contents. The ASHRAE 90.1 Users Manual is also very helpful. ASHRAE considers Standard 90.1 a high-profile standard and continuously updates it.

Typical Applications

Condenser water heat recovery can be used wherever there are simultaneous heating and cooling loads. The heating loads can be either domestic hot water or building heating. Secondary systems such as fan coils, constant volume with reheat, and multizone are prime candidates.

Common applications include:

- Schools
- Health care
- Hotels
- Industrial processes