Sample. Monitor. Measure.

SENTRY

Any Application. Anywhere.

TCU - Temperature Control Unit

APPLICATION NOTE

A temperature control unit (TCU) provides controlled temperature water (coolant) to a group of sample coolers in order to ensure closely controlled sample temperatures. These coolers are usually referred to as secondary coolers.

Typically samples over 100° F (38° C) are precooled in "primary" sample coolers using plant cooling water. The secondary coolers are all identical in construction and have a fixed amount of heat transfer area. The coolers are designed so that the sample leaving temperature approaches the coolant temperature very closely (typically less than 0.5°). Therefore, if the temperature of the coolant on the shell side is constant, and the flow rate of coolant through each cooler remains constant, sample temperatures will be very close to the coolant temperature. The heat removed from the samples is picked up by the coolant and circulated back to the TCU where the coolant is again reduced in temperature to the controlled value.

It is possible that one or more samples will come to the secondary coolers at a temperature below that of the coolant (subcooled). In those cases the samples will be warmed by the coolant and approach the coolant temperature from below the set point. If enough samples are subcooled, the temperature of the coolant returning to the TCU will be less than the desired control temperature. In this case, the TCU will add enough heat to bring the coolant to the controlled value.

The basic TCU is a refrigeration system or chiller. It differs from the home refrigerator, drinking fountain chiller or air conditioner in several ways. First, the compressor does not turn on and off (cycle), but runs continuously. A cycling compressor will bring the temperature of a circulating fluid (air or water) down to a certain point, then turn off. When the fluid temperature rises to a set point, it will turn on again. When water is the circulating fluid, the temperature spread is typically about 6° F (-14° C). Since a sample system is typically designed to hold the temperature of all the samples to +1°, a cycling system is not adequate to do the job.

FEATURES

- ***Closed loop pressurized coolant circulating system with ODP centrifugal pump. Water stays clean, no corrosion or fouling of heat transfer surfaces.***
- ***PLC controller with display of all required operational data.***
- ***No extra piping required other than connecting the sample system to the condenser cooling water sources and to the makeup water source. If a city potable water supply line is to be connected for makeup, it is the responsibility of the installer to check and abide by all local codes.***

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Second, a water chiller normally chills water to the range of 40 – 50° F (4 – 10° C). The TCU controls the coolant to 76 – 77° F (24 – 25° C), because the target sample temperature is 77° F (25° C). This requires a different approach in the design of the refrigerant side of the system.

Third, under some conditions the TCU must add heat rather than remove heat from the coolant. The TCU is designed to add heat automatically if the temperature of the returning coolant is below the TCU set point. (This could happen if the primary samples are cooled below 77° F (25° C) by primary cooling water that gets cold in the winter.) The TCU has a built-in heating capability of approximately 30% of its cooling capacity. No operator adjustment is required because the heat comes from the normal losses in the compressor and coolant circulating pump. The three-way hot gas bypass valve diverts all of the hot gas to the evaporator. No gases reach the condenser, so no heat is removed through the condenser.

The TCU is designed for use in a power plant. It is a piece of production equipment that is designed for unattended operation and easy maintenance. A PLC controller, in conjunction with various temperature and pressure sensors, provides ample information to help the maintenance technician easily diagnose problems.

The TCUs are all built in an open frame construction with a NEMA 4X control panel which contains the electrical components. The refrigerant system includes a compressor, condenser, evaporator, thermal expansion valve, and hot gas bypass valve (the source of the close temperature control and non-cycling). The coolant side includes a pump, coolant makeup regulating valve, and relief valve.

The condenser (which removes the heat absorbed by the refrigerant) can be water-cooled or air-cooled. Most power plants use water-cooled systems because high ambient air temperatures limit the capacity of the TCU.