Cooling Towers, Chillers, Heat Exchangers

Flow Meters and Controls

Cooling System Basics

The purpose of a cooling system is to transfer heat from the cooling water generated from various industrial equipment and production processes.

Cooling systems are composed of a heat exchanger and cooling unit (chiller). The heat exchanger allows cooling water to remove heat from production processes and plant equipment. The cooling unit removes the heat gained from contact with cooling water with hot equipment and fluids in the heat exchanger. The heat is removed by transferring the heat to air through evaporation to the atmosphere thru towers.

Cooling systems are used in many industrial applications:

- Petrochemical
- Pharmaceutical
- Manufacturing
- Power Generation
- Refineries – Ethanol / Biodiesel / Gasoline
- Food and Beverage

Evaporation Rate

A general rule is for each 10°F circulated water needs to be cooled, 1% of the cooling water is evaporated in the cooling tower. The following equation provides an estimate of the evaporation rate for various circulated cooling water temperature reduction.

Evaporation Rate = Recirculated Flow Rate x (Warm Water Temp. – Desired Cool Water Temp.) x (1% Evaporation per 10°F Temp. Reduction)

Example: If a cooling tower circulates water at a rate of 1,000 gpm and the cooling tower needs to cool the warmed water exiting the heat exchanger from 90°F to 80°F use the following formula to determine the evaporation rate:

Evaporation Rate = 1,000 gpm x (90°F - 80°F) x 0.01/10°F = 10 gpm

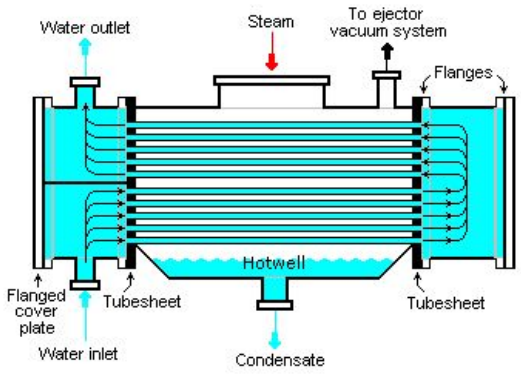

Figure 1 - Heat Exchanger

Blow-Down Water

The water that drains from the cooling equipment is called the "blow-down" water. This water has a higher mineral content then potable water algae, bacteria or pathogen may also be present. This make potable water or treated water using additives to maintain proper pH levels more favorable. Reusing untreated blow down water is not suitable for irrigation of any kind due to high levels of TDS (Total Dissolved Solids).

Make Up Water - Filtration and Treatment

Most industrial cooling towers use river water or well water as their source for fresh cooling water called make up water. Make up water is recirculated back to the heat exchanger replacing cooling water lost through evaporation, blowdown and other losses.

Adding raw make up water before filtration or treatment can complicate the efficiency and add cost in maintaining the entire cooling system. Any water source has various levels of dissolved or suspended solids that are left behind causing the remaining cooling water to become concentrated. This concentration of solids decreases the efficiency of the cooling system while increasing the chance for a catastrophic failure and damage to critical equipment and production processes.

Scaling and Biofouling can also deprive the cooling system from operating properly. Water treatment can reduce the amount of biological growth in the cooling system.

Chlorine is the most widely used chemical for controlling biofouling in a cooling system. Chlorine does have its disadvantages in that it reacts with water to form hydrochloric acid and hypochlorous acid causing environmental issues. Chlorine dioxide is a better alternative when treating the water. Chlorine dioxide does not react with water nor does its chemical form or biocidal activity change with changes in pH. Combining corrosion and scaling inhibitors can also improve the water quality and avoid premature fouling.

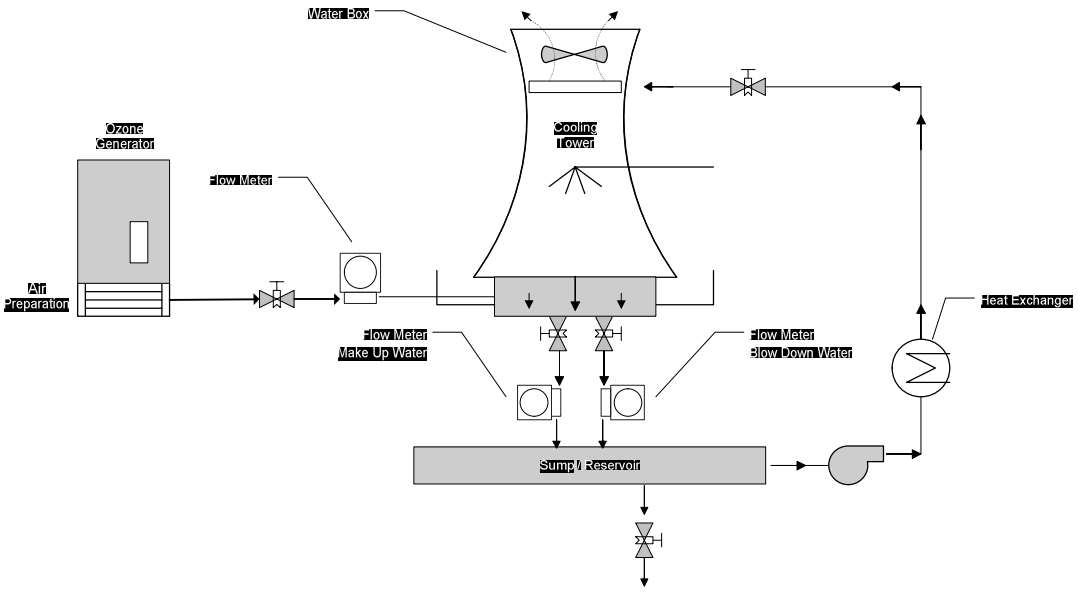

Figure 2 - Cooling Tower Schematic

Cooling System Basics – Modular Chillers

Industrial chillers typically come as complete packaged closed-loop systems, including the chiller unit, condenser, and pump station with recirculating pump, expansion valve, flow meter with low-flow alarm, internal cold water tank, and temperature control. The modular design of many chillers provides reliable and economical temperature control.

The process fluid being cooled is contained in a "closed" circuit and is not directly exposed to the atmosphere or the recirculated external water. The process fluid that flows through the closed circuit can be water, a glycol mixture or a refrigerant.

Industrial chillers are used for controlled cooling of products, mechanisms and factory machinery in a wide range of industries. They are often used in the plastic industry in injection and blow molding, metal working cutting oils, welding equipment, die-castings and machine tooling, chemical processing, pharmaceutical formulation, food and beverage processing, paper and cement processing, vacuum systems, X-ray diffraction, power supplies and power generation stations, analytical equipment, semiconductors, compressed air and gas cooling.

Chillers provide advanced thermal management solutions in various processes.

RCM has been providing flow meters for many industrial applications requiring cooling of their equipment and processes. Our reed switch option -1S2 or -2S2 General Purpose switches or our -1S2-IS-LED one switch or -2S2-IS-LED two switches is added to provide an alarm when flow rates fall below normal operating conditions then supplied for control room reporting. Our reed switch option is now approved for use in Hazardous Locations.

General Purpose:

Contact Rating	10 watts
Voltage	175Vdc max.
	125Vac max.
Current	350mA max switching
Hysteresis	13% F.S.

Hazardous Location Approvals:

CSA / NRTL/c:

AEx ia IIC: Class I, Division I, Groups A, B, C, and D
Class II, Division I, Groups E, F, and G

KEMA: Ex ia IIC: Zone 0, II 1G T4 0° ≤ Ta ≤ 50°C ATEX EC Type Examination

Reed switches are an economical solution for equipment protection and automation for critical processes in a variety of industrial and commercial applications. LED’s provide viewing at a glance and easy field calibration, LED operating voltage 24Vdc, 20mA. Each switch is independently adjustable from 30% to 90% of full scale. The switches can be configured to your factory set points at a lower set point.

Figure 3 – Chiller Cabinets

RCM Industries, **Inc.** provides flow meters to major chiller manufacturers these flow meters come equipped with a stainless steel connection (NPT) 1/4”-3” or brass solder connection in 1” 1 ½” and 2”, and broad range of flow rates to choose from they can be equipped with transmitters with 4-20mA output or dry contact reed switches to monitor flow rate conditions directly or to a remote control room. The above chillers incorporate 4 RCM flow meters with the reed switch option to monitor low conditions.

Conclusion

Designing the optimum cooling system requires a thorough evaluation of the cooling water equipment and cooling system operation primarily the water velocity and water temperature. Low water velocity (flow) causes deposits to form and high temperatures affects water quality requiring treatment to maintain proper pH levels, and minimize biological growth.

Many industrial applications utilize both cooling towers and closed loop portable chillers for point of use cooling, flow meters provide proper management of the flow rate of the cooling water optimizing the systems integrity and efficiency and improve manufacturing process yields.

With the high cost of fuel, construction, operating and energy, large users of cooling water are forced to maximize thermal and mechanical efficiency. An unrestricted cooling water flow requires careful control of deposit, corrosion, scaling, and biofouling saving thousands of dollars in maintenance and energy cost.