A bnp PUBLICATION

PROCESS COOLING

July/August 2016

For engineers who specify cooling equipment, components and materials

Vol. 4, No. 6

Cooling with Liquid Nitrogen

Follow Us On:

What Is in Your *Water?*

One critical maintenance issue with process chillers is to recognize what exactly is in your water. Understanding the composition of your process fluid enhances chiller performance.

By Bonnie Martens, Dimplex Thermal Solutions

Many industrial processes utilize a process fluid to cool the equipment by moving heat away from the operation. An industrial chiller is a type of equipment used to accomplish this. The cooling system is designed to remove heat from the process fluid, transfer the heat to another medium such as ambient air or water, and return cool fluid to the process to begin the cycle again.

Process chillers are designed to be air-cooled or water-cooled units. Either type uses a refrigerant at a low temperature to absorb heat from process fluid in the evaporator. Once the refrigerant absorbs the heat, this higher temperature fluid passes to the condenser, where it rejects that absorbed heat. The condenser transfers the heat to the ambient air or to a water source such as a cooling tower.

Air-cooled chillers use a refrigerant that absorbs heat from process fluid at a lower temperature and rejects the heat to the surrounding air through the condenser. Air-cooled chillers have either horizontal or vertical discharge. (The position is indicated by the location of their fans.) Though they require a location where heat can be rejected to air, they also are less complex and require less maintenance than water-cooled units. The need for a cooling tower and pump also is eliminated. Because a wet surface can transfer heat more efficiently than a dry surface, an air-cooled chiller generally consumes approximately 10 percent more power than a water-cooled unit.

Water-cooled chillers are generally used for large-capacity indoor applications where rejecting process heat to the ambient air can be a problem. They also are selected at facilities where a cooling tower is already in place or where the user requires optimum efficiency of power consumption. Water-cooled chillers require condenser water treatment

This evaporator coil corroded because glycol and inhibitor were not used during operation, which resulted in calcium buildup.

The green seen on this evaporator coil is calcium buildup, which prevents the heat transfer from water into the refrigerant.

to eliminate mineral buildup. Mineral deposits create poor heat transfer situations that reduce chiller efficiency.

When it comes to selecting a process cooling fluid, water commonly is used. Knowing the differences among the different types of water helps optimize the overall performance of the chiller and the process being cooled. In some applications —cooling laser equipment, for instance — the water conductivity is vital to the equipment performance. Chillers for cooling laser equipment commonly use deionized (DI) water, which resists the flow of electrical current. In other applications, water glycol is required to protect from freezing and bacterial growth.

Process chillers usually use one of five types of water:

- Tap water or city water.
- Steam-distilled water.
- Water glycol.
- Distilled water.
- Deionized water.

Most equipment manufacturers offer recommendations on the type of water to be used in their equipment. Following those recommendations typically enhances the overall production uptime as well as the service life of the equipment.

Tap Water or City Water

Depending upon the application, some chillers use tap or city water. While using tap or city water may seem like an easy option for manufacturing processes, it is not a recommended one. It is costly and can damage the equipment.

Tap or city water is expensive due to the high demand for the natural resource and the added sewer costs usually associated with disposal. Also, tap or city water contains impurities that can damage components, so it is recommended that an industrial inhibited glycol be added to the water. Tap or city water also is a conductor of electricity.

Steam-Distilled Water

Steam-distilled water is produced by applying the steam distillation process to the water. As a result, some impurities are removed. While water produced by this process has less buildup of scale and minerals, the addition of an industrial inhibited glycol is still recommended. Steam-distilled water also is a conductor of electricity.

Water Glycol

Whether the equipment uses tap, city or steam-distilled water as the cooling water source, using a mixture

Recommended Glycol/Water Mixture*

Application	Glycol Percent	Water Percent	Freeze Point
Indoor Chiller and Process	30	70	5°F/-15°C
Outdoor Chiller/Low Temp.	50	50	-35°F/-37°C

***Figures based on the performance of Koolant Koolers K-Kool-E brand of ethylene glycol.**

of industrial inhibited glycol and water is recommended. Ethylene and propylene are the two standard types of inhibited glycols used.

The main job of glycol is to prevent freezing of the process fluid and ensure consistent flow at the operating temperature. Industrial glycols have inhibitors that also will prevent formation of scale and corrosion while protecting metals such as brass, copper, steel, cast iron and aluminum. Water systems treated with an inhibited glycol also will be protected from algae and bacteria that can grow and degrade the fluid system performance.

There are a few tips to consider when using industrial inhibited glycols:

- Do not mix glycols.
- Do not use automotive-grade antifreeze.
- Check local environmental regulations.
- Consider ethylene glycol for most standard industrial applications.
- Consider propylene glycol for user-contact applications.
- Know the difference between ethylene and propylene glycol.
- Understand that the specific application drives the water/glycol mix percentage used.

Do Not Mix Glycols. Because mixing different types or brand names of glycol can result in some inhibitors precipitating out of the solution, do not mix glycols. Mixing glycols also will gel and clog filters and prevent proper flow rates. If switching glycol types, it will be necessary to run a thorough flush and clean of the fluid system. Once that is done, it is okay to change over.

Do Not Use Automotive-Grade Antifreeze. Glycols used in automotive-grade antifreeze do not have the right type of inhibitors and are not designed for industrial applications. Using automotive-grade antifreeze in the chiller process can cause problems with heat transfer or fluid flow. Also, many automotive glycols contain silicate-based inhibitors that can coat heat exchangers, attack pump seals or form a flow-restricting gel.

Check Local Environmental Regulations. Check state and local codes when selecting the process fluid. Certain areas may have environmental regulations concerning the use and disposal of glycol or other additives.

Consider Ethylene Glycol for Most Standard Industrial Applications. Ethylene glycol is the standard heat transfer fluid for most industrial applications. Ethylene glycol can be used in any application where low toxicity content is not required.

Ethylene glycol has moderately acute oral toxicity. Because of this characteristic, it should not be used in processes where the fluid could come in contact with potable water, food or beverage products.

Consider Propylene Glycol for User-Contact Applications. Propylene glycol provides generally the same freeze protection and corrosion/algae prevention levels as ethylene glycol, but it has a lower level of toxicity. Also, propylene glycol is more readily disposable than ethylene and safer to handle. For these reasons, propylene glycol is commonly used in the food industry and in applications where the user may come in frequent contact with the fluid.

Know the Difference Between Ethylene and Propylene Glycol. At very cold temperatures, propylene glycol becomes more viscous,

A filter strainer is coated with biological growth, better known as slime. Using industrial inhibited glycol will prevent the growth of slime in chillers if the biological deposits have not started before glycol is added.

Contaminated dirty water will plug up the system and cause system failures. Use glycol, filter strainers and a routine preventive maintenance plan to keep your system clean. How often the system should be cleaned depends on the process.

changing the heat exchange rate slightly. Some chillers are designed for that compensation so that either glycol type can be used. Ethylene is more widely used due to its lower purchase price, making it more economically feasible for factories with significant purchasing volumes.

Understand that the Application Drives the Water/Glycol Mix Percentage. The location of the chiller and environmental concerns must be taken into account when selecting the proper mixture of glycol and water for the chiller process. A process located completely indoors, with no chance of freezing, will require less glycol than a system located outdoors where low temperatures can cause the fluid to freeze and piping to burst. Applications with a very low operating temperature (below 20°F [-6°C]) should use a glycol mixture equivalent to an outdoor system.

After selecting the proper glycol and water types, use the data in table 1 to determine the recommended mixture based upon the application and location of the process. The glycol percentage figures in table 1 will apply to any brand of ethylene or propylene glycol.

Deionized Water

Deionized water commonly is used with cooling laser equipment because the mineral ions — cations such as sodium, calcium, iron and copper as well as anions such as chloride and sulfate — have been removed. Each application typically has specific requirements for the allowable conductivity level of the deionized water used.

Deionizing the water can be a costly process, but it cannot be substituted. In applications where the water conductivity is important,

A filter strainer collected copper grindings and dirt to prevent them from entering the system. If the filter is collecting this, there may be more airborne contaminants, which indicate the system should be cleaned more often.

has specific requirements for the allowable conductivity level of the deionized water used.

Deionizing the water can be a costly process, but it cannot be substituted. In applications where the water conductivity is important, deionized water is required. Deionization is a measure of the purity of the water, and it correlates to its conductivity. It indicates the resistance to the flow of electrical current, which is measured in ohms. Conductivity is the inverse of resistance and is measured in siemens (mhos) or micro siemens.

The chiller must be properly designed to operate with the deionized water required. At low deionized water conductivity levels, the water will actually attack certain metals and cause damage to some components. Not to be confused with demineralized water, deionized water is corrosive because it pulls any impurities from the metal piping and atmosphere into it. In its purest form, it is not safe to drink because this can cause internal bleeding.

The purity of deionized water can vary and should be measured against the conductivity scale. Pure deionized water is a poor conductor of electricity. If it is pure enough, inhibitors are not necessary in the chiller.

In conclusion, the proper selection of water for process chillers is important. Using the wrong type of water can affect the performance as well as the life of the chiller components. The chiller manufacturer should be informed of the application and the equipment manufacturer's specifications so the proper components and design are selected for the water or cooling fluid being used. **PC**

Bonnie Martens is a marketing specialist with Dimplex Thermal Solutions. The Kalamazoo, Mich.-based company can be reached at 800-968-5665 or visit the website at www.dimplexthermal.com.