Technical Note
TNTCCHILLER1210

Optimizing the selection of a re-circulating chiller

Scott Pratt, Thermo Fisher Scientific, Newington, NH, USA

Key Words:

- Site heat
- Ambient temperature
- Relative humidity
- Altitude
- Tubing size and distance
- Vertical pumping
- Insulation
- Air cleanliness
- Electrical
- Control System
- Refrigeration System
- Recirculation System
- Ease of maintenance
- Fluids
- Filters

Abstract

A re-circulating chiller is used to supply a steady flow of temperature-controlled fluid to an application. The fluid temperature coming from the chiller could be used to cool, maintain or even increase the temperature of the application. Five criteria must be defined in order to select the correct refrigeration, circulation, and control systems for your re-circulating chiller.

Introduction

The first four criteria - heat load, setpoint temperature, flow rate, and pressure loss - are well known and typically used to select a re-circulating chiller. To optimize your re-circulating chiller selection, you must determine one or several unique requirements (the fifth criteria) such as site conditions, controller options, or required accessories will make certain all of your application requirements are met.

How to optimize the selection of a re-circulating chiller

A simple re-circulating chiller can be defined by the first four requirements: heat load, set point temperature, flow rate, and pressure loss. However, to optimize the selection of a re-circulating chiller, a thorough application review is recommended. It is not unusual for re-circulating chiller requirements to include a need for sophisticated electronic and mechanical options and accessories, as well as demanding installation conditions.

Heat Load

While heat energy needs to be removed in order to maintain or lower the application temperature, there are some applications, such as reaction vessels, that may require both heating and cooling. It is common for heat load to be expressed in watts or BTU's, although tons or kcal are also seen in some specifications.

While a particular application may include a known heat load from the manufacturer, often it will need to be determined by you. In these cases, you will need to identify the source of the heat energy. The heat load is comprised of one or more of the following types of energy:

Electrical

This type of heat load is created when some or all of the electrical energy being used is converted to excess heat. In these cases, the manufacturer of the instrument used in the application should be able to provide cooling specifications. If that information is not available, there are two methods to determine this type of heat load.

Method #1 – standard heat load calculation. For an application that is currently installed and running on tap water or building Process Cooled Water (PCW), the heat load can easily be easily calculated by measuring the inlet temperature, outlet temperature, and flow rate

$$\text{GPH} \times 8.33\,\text{lbs/gallon} \times \Delta T(°\text{F}) = \text{BTU}$$

$$\text{BTU}/3.41 = \text{watts}$$

Or for metric units of measure

$$\text{LPH} \times \Delta T(°\text{C}) = \text{Kcal}$$

$$\text{Kcal} \times 1.16\,\text{watts/Kcal} = \text{watts}$$

Method #2 – Kva (Kilo-Volt-Amps) calculation. This is used if the measurements in Method #1 are not available (e.g., an application that is new or is not in running condition), the total power consumption is calculated by:

$$\text{Kva} = \text{Amp} \times \text{Voltage} \times \sqrt{\text{phase}}$$

This method determines the maximum possible heat load generated by an electrical device, but the actual heat load is usually smaller. As a result, this method may lead to buying a larger re-circulating chiller than is necessary, so it should only be considered when heat load cannot be determined another way.

Mechanical Energy (friction)

When surfaces that are in contact move relative to each other, the friction between the two surfaces converts kinetic energy into heat. The heat load can be calculated by using one of the methods above.

Pump Heat Generated by the Chiller

Friction created between the fluid and the moving parts of a pump heats the re-circulation fluid. When looking at the rated cooling capacity of a chiller, the specified conditions should state whether pump heat has been included. The quantity of pump heat is based on pump horsepower, efficiency, and the flow rate. When pump heat has not been included, or has been included but is for a pump with less horsepower, pump heat should be ascertained considering the worst case, and subtracted from the cooling capacity. This is especially critical when the cooling capacity is very close to the heat load requirement of the application. Use Method #1 above if the application is currently being cooled to calculate the heat load. Otherwise, use Method #2 above by tracing the friction back to the component responsible for the movement (e.g., a motor) and use the electrical current draw to calculate the heat load.

Chemical Energy

The breaking or making of chemical bonds involves energy, which may be either absorbed (endothermic) or evolved (exothermic) from a chemical system. Determining the heat load will require using prior experience, calculations, or testing.

Internal Energy

Energy associated with a change of temperature of a given mass. This type of application is often the most difficult to size a re-circulating chiller correctly without actual testing or data from the manufacturer of the application instrument. The heat load from internal energy can be calculated when the mass, specific heat, temperature change, and time to temperature are known for each solid, liquid, and gas that will change temperature. This includes the fluid in the circulation loop and re-circulating chiller. This calculation often is not enough information to size a re-circuiting chiller. Other factors may need to be considered, including:

- How far above or below ambient may cause a gain or loss of heat energy and may require additional heating or cooling capacity, especially if the application is not insulated.
- Efficiencies of heat transfer (e.g., stirring, physical properties).

Setpoint Temperature

The heat load and setpoint temperature are used together to determine the compressor size for a re-circulating chiller. The higher the heat load and/or the lower the setpoint temperature the larger the compressor needs to be to do the required work.

In all evaporative refrigeration systems that utilize a phase change from a liquid to a gas, the cooling capacity decreases at lower circulation temperatures. The control system compensates by allowing less refrigerant to flow into the evaporator. Because it is the evaporation or phase change from a liquid to a gas that removes heat energy from the recirculating liquid, slower evaporation of less refrigerant means less heat removal.

Flow Rate

The flow rate is the volume of fluid which passes through a given surface per unit time (e.g., liters per minute or gallons per minute). The flow rate, along with pressure loss, is used to determine the type and size of pump needed to meet the flow rate requirement. There are three ways to determine the flow rate:

1. Use the published manufacturer's specifications. Plot the actual requirement onto the pump curve.
2. If the application is currently being cooled, it is per the known flow rate. Plot the actual requirement onto the pump curve.
3. If the flow rate is not known, select the largest flow pump available for the selected re-circulating chiller.

Note: Some applications may have intricate passages with larger surface area per kW (kilo-Watt) of required heat transfer. These types of applications would typically have smaller flow requirements per kW of heat removal than other applications with less surface area per kW of heat. This variation in heat transfer efficiency explains why two applications can have the same heat load at the same temperature but have different flow requirements

Pressure Loss

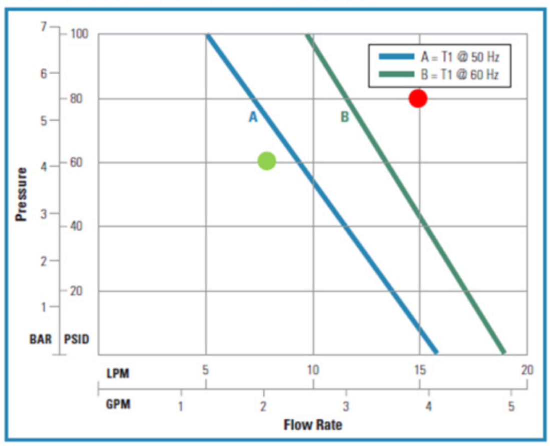
Pressure loss is the difference in pressure between two points in a flow system. A reduction in the pressure of a fluid between these two points is caused by its motion against an enclosed surface (such as a pipe or passage). As the fluid moves through the pipe or passage, friction between the fluid and the walls, and within the fluid itself, creates a pressure loss. The faster the fluid moves, the greater the losses.

For applications where the flow rate and pressure loss specification is supplied, the pressure difference is typically measured between the inlet and outlet at the required flow rate. Make sure that it is for the actual pressure loss and not the maximum safe pressure specification. It is often assumed that a margin of safety can be added to the specification by using the maximum safe pressure, but this strategy leads to a larger pump than necessary or can appear that no pump is available to meet the specification. Also keep in mind that when the chiller and the application are not next to each other, the additional pressure loss of the supply and return plumbing must also be added to the supplied pressure loss specification because small passages, tight turns, and long distances increase the frictional losses, while larger, straight passages over shorter distances lowers frictional losses and results in lower pressure loss.

Through any given application or flow system, the pressure loss will increase exponentially with flow rate. Many applications do not have a particular requirement for flow. In these cases, it is best to select a larger pump and a means to bypass any excess flow to maintain safe pressure.

The flow rate and pressure loss are used to determine the type and size of pump needed to meet the requirement. This is done by plotting the applications requirement onto the pump curve. If the plotted point is on or below the given pump curve then that pump may be utilized. See illustration below.

Pumping Capacity for Turbine Pump Option (T1)*



● 8 lpm @ 4 Bar is under the curve and the pump meets the requirement
● 15 lpm @ 5.5 Bar is over the curve and the pump does not meet the requirement

Unique Requirements

To optimize the selection process, and avoid the pitfalls of sizing an incorrect chiller, it is critical to uncover the variables that enhance or affect the refrigeration, control, or re-circulating systems. A unique requirement can be defined as any option, accessory, ancillary equipment, or setting needed for the operation of the application or the chiller (before, during, or after operation of the application).

Unique requirements fall under three areas: site considerations, special application requirements, and preventative maintenance. Each of these is explored below, but keep in mind that the list is not inclusive.

Site Considerations

Site heat

In some cases, an air-cooled condenser adds heat to the room and may present a problem for the HVAC system or the personnel. In other instances, high ambient temperature conditions de-rate the cooling capacity to an undesirable level (see Ambient temperature).

In these cases, it may be advantageous to have a condenser that uses water rather than air to remove the process heat. This water could be municipal or well, but in most cases will be recycled building process water that is cooled via a water tower or roof mounted refrigeration system. Additional advantages of a water-cooled condenser include lower power usage because there is no fan motor, lower noise, and HVAC electrical savings as the process heat is not dumped into the air conditioned space. Additionally, water cooled units do not de-rate under high ambient temperatures for those areas that are not temperature controlled.

Ambient temperature

As the temperature of the air in the room increases, the ability of an air-cooled condenser to shed heat decreases. The cooling capacity is reduced in accordance with the chiller manufacturer's specifications for high ambient cooling capacity de-ration. This may require selecting a chiller with a larger compressor/condenser assembly to offset the cooling capacity de-ration in high ambient. Low ambient conditions can cause poor evaporation of the refrigerant or other issues and should be avoided by checking the chiller manufacturer's specifications.

Relative humidity

While this does not directly influence cooling capacity, the setpoint temperature and relative humidity level can cause condensation and dripping from internal and external plumbing lines. Insulation is an option, but is not a guarantee against condensation. Instead choose a chiller with a drip pan to catch the condensation that is caused by setpoint temperatures below the dewpoint.

Altitude

As altitude is increased, the density of the air decreases. The fan that moves the air across the air-cooled condenser is specified by its airflow of cubic feet per minute (CFM). At lower air densities the mass of a cubic foot of air is reduced, and as a result, there are fewer molecules to absorb the heat that the condenser is trying to reject. Because of the decrease in air density, maximum temperature for the air entering an air-cooled re-circulating chiller is reduced by 1°C per 1,000 feet above sea level. In addition, cooling capacity is reduced 1.2% per 1,000 feet above sea level and a unit with a larger compressor/condenser assembly may have to be specified for high altitude installations.

Tubing size and distance

The size of tubing and distance to and from the application has a direct impact on the pump performance. The plumbing internal diameter (ID) must be selected based on the required flow rate and the distance from the chiller to the application. For example, when the chiller and application are not in the same room and/or the application already has a high pressure requirement (high pressure loss), consideration of the chiller pump selection and tubing ID is critical. A variety of charts and calculators are available, or an engineering firm can be consulted, to insure the proper selection. When making this selection, remember that every 90° bend is the equivalent of about 5 feet of straight tubing and if the application has smaller fittings than the chiller, the larger size should be maintained and reduced only at the inlet and outlet of the application.

Vertical pumping and drainback

When a re-circulating chiller is located one or more floors below the application, vertical pumping is required. Typical pumps available in re-circulating chillers can raise the water level a substantial distance vertically. Therefore, pumping vertically is not as challenging as is often believed. For installations up to 27 feet, once the water has crested the highest point, gravity pulling down on the return side will create a siphon that will offset the added pressure required to initially reach the high point. At heights above 27 feet, only the additional distance above 27 feet needs to be considered as an extra pressure loss.

To verify that the pump can supply the initial lift required to pump water to the highest point, follow this calculation:

(Vertical feet) x (0.434psi /ft) = psi

Example:

(25 ft) x (0.434psi/ft) = 10.85 psi

required for the initial lift of the fluid to 25 ft. After the fluid has crested the high point and returned to the chiller, the additional pressure required to pump to 25 ft returns to zero.

Or:

(Vertical meters) x (0.098bar/meter) = bar

Example:

(8 m) x (0.098bar/m) = 0.784 bar (784 millibar)

required for the initial lift of the fluid to 25 ft. After the fluid has crested the high point and returned to the chiller, the additional pressure required to pump to 8 m returns to zero.

To calculate the additional pressure loss for vertical pumping above 27 feet or 8 meters, subtract 27 feet or 8 meters from the total vertical height and add that to the total pressure loss (pressure loss of the application and associated plumbing).

Example:

40 ft – 27 ft = 13 ft

13 ft x 0.434 psi/ft = 5.64 psi

Add 5.64 psi to the total pressure loss.

Or:

15 m – 8 m = 7 m

7 m x 0.098 bar/m = 0.686 bar (686 millibar)

Add 0.686 bar to the total pressure loss.

Drainback into the chiller may occur in installations that pump vertically when the chiller is off or the pump stops pumping. After the pump has been shut off, the fluid in circulation has momentum and continues to move within the tubing until it empties into the reservoir, which could cause an overflow. Additionally, air entrapment can further aggravate this issue. Air entrapped within the fluid or at the high point of the application could collect and break the vacuum, while even a small leak in the circulation loop would allow air into the loop again breaking the vacuum seal.

Because of these above reasons, it is recommended that anti-drainback valves be installed when any vertical circulation above the reservoir height is planned. Exceptions where previous experience indicates otherwise or there is room in the reservoir to contain all external fluid may be possible. Anti-drainback is typically accomplished with a mechanical check valve on the chiller outlet and a solenoid valve on the chiller inlet.

Insulation

Insulating the tubing between the chiller and application is highly recommended. It helps to ensure that the fluid entering your application is the same temperature as when it left the chiller. This can also help prevent or limit condensation when the fluid temperature is below the dew point temperature. Insulation ensures that most of the cooling capacity is reserved for the application and not lost into the room. If it is not possible to insulate the tubing, particularly when passing through high ambient areas (e.g., above suspended ceilings), the additional heat load must be accounted for when selecting a chiller.

Air cleanliness

Many chillers are installed in industrial environments in which a large amount of airborne particles may be present. These particles get drawn into the condenser on air-cooled units where it builds up over time, limiting air flow and adding a layer of unwanted insulation to the condenser. It may be difficult to see the condenser and may not be easily removed for cleaning. A chiller with a dirty condenser will continue to lose cooling capacity as the debris further limits the air flow. This will eventually lead to a loss of ability to reach or maintain setpoint temperature. Unchecked, it is possible to overheat and burn out the fan motor or have a compressor failure.

To optimize air-cooled chillers for this type of environment, chiller selection should include a built in re-usable air filter that is highly visible, easy to remove, clean, and re-install.

Electrical requirements

Voltage selection may seem simple, but there is a lot to consider before choosing the appropriate voltage, amperage and frequency (Hertz or Hz) for a chiller. Care must be taken to ensure that the correct voltage and hertz are selected to avoid poor performance and damaging heat within the electric motors used. The location of the installation is important information. In North America, no selection for Hertz is needed, as it is entirely 60 Hz or Europe which is entirely 50 Hz. However, some regions may support both 50 and 60 Hz, such as Japan, so additional selection criteria should be considered. Chiller selection can be made easier with a dual-rated unit that can run on 50 or 60 Hz, but be aware that even with a dual-rated chiller, the acceptable voltage range may vary with Hertz and may not match the available power at the installation site (e.g., a dual-rated chiller that runs on 230V/50-60 Hz cannot be run at a site with 200V/50-60 Hz). In a country where the available voltage will not be suitable for a dual-rated chiller, a global voltage unit (200-230V/50-60 Hz) will have a wider acceptable voltage range, allowing it to be run on municipal power anywhere in the world.

Important Note: Prior to a chiller's arrival, it is important to review the site to ensure that the required voltage, Hertz, phase, and amperage is available to accommodate the electrical requirements of the unit. If the site cannot accommodate the electrical requirements of the unit, a delay may occur while another location for the unit is found, or the correct electrical installation is completed.

Special Application Requirements

Control system

The control system manages the circulation system and the behavior of the refrigeration system. Digital and analog controllers are available; while analog controllers with a dial and a reference thermometer are mostly a thing of the past; digital controllers are the standard for liquid temperature control equipment. A basic controller that displays the temperature setpoint, current temperature, and alarms meets the needs of most applications.

For a more sophisticated application a controller with advanced features may be needed and the following will need to be considered:

Alarms local and remote:

If your tool, process, or product could be adversely affected by unrequested changes in temperature, flow, or pressure, then a chiller with the appropriate alarm packages should be purchased to ensure that operation within the desired criteria. If the chiller is installed away from human eyes and ears, then the appropriate digital or analog remote communication must also be specified.

Remote control:

Because of floor space, noise, or HVAC limitations, chillers often need to be installed away from the application. In these cases, it is usually desirable to have remote control capability. This can take the form of a remote box that utilizes the same controller as the chiller or serial communication with a computer utilizing software for chiller control. The software may be supplied by the chiller manufacturer, custom software created by the end user, or a commercial software package that may also control the application.

Digital or analog communication:

It is often desirable to have access to alarms and control functions remotely or to have those functions controlled directly by the application. This can be achieved through digital or analog communication:

Digital (or serial) is accomplished by sending and receiving digital strings from the chiller and the computer, allowing the user to monitor and/or control the chiller remotely. Many different standards are available, but RS232 and RS485 are the most common. Choosing between these two options will depend on the use.

The RS232 is limited to about 50 feet and each chiller must have its own communication port on the computer or tool.

The RS485 would be used if the chiller is located hundreds, or even thousands, of feet from the computer or tool. If there are multiple chillers to monitor or control, the RS485 also allows you to utilize a single communication port by assigning a numerical address to each chiller.

Analog communication uses a voltage signal and is typically chosen when tools or equipment used in the application utilize programmable logic control (PLC) to set temperature, read temperature, and monitor alarm status.

Remote temperature sensing:

This capability requires a specific port. Advantages of remote temperature sensing include faster time to temperature of the application itself, the ability to compensate for exothermic or endothermic reactions, and the assurance that the needed temperature has been achieved. Disadvantages are primarily limited to less optimal temperature stability caused by the time lag between a temperature change of the fluid and a resulting temperature change at the remote sensor.

Temperature ramping:

Some applications require a controlled change of temperature where there is a starting setpoint, ending setpoint and time period. This is usually accomplished with software that takes this entry data and converts it to new setpoints sent out over a predetermined period of time.

Considerations when selecting a chiller:

- Digital communication may be required.
- Ensure that the ramp requested is within the time to temperature capability of the chiller.

While it is possible to program the temperature ramp in the software to go from 90°C to 5°C in one minute, traditional chillers could not come close to this performance.

Refrigeration system

For applications that have requirements outside the core requirement of heat load and setpoint temperature, consider the following:

Time to temperature:

Some applications may need to achieve a specific setpoint temperature in a specified period of time or efficient time management dictates the time-to-temperature. In choosing a chiller that can achieve the setpoint temperature in a short period of time, optimized cooling capacity and low internal energy are important factors.

A large reservoir does not translate to an optimal cooling capacity – compressor size and evaporator efficiency does. A chiller that has a large reservoir with evaporator cooling coils will take longer to achieve a new temperature than a chiller with the same compressor, a small reservoir, and a plate style evaporator. The chiller with a smaller reservoir achieves faster time-to-temperature because there is less fluid in circulation, so less internal energy contained within the fluid will need to be removed. Additionally, a more efficient plate style evaporator improves cooling capacity from the same size compressor and will improve time-to-temperature.

Temperature range with a remote sensor:

A temperature differential between the sensor temperature and the fluid temperature must be maintained to achieve and hold the setpoint when using a remote sensor. To achieve this temperature differential, choose a re-circulating chiller with a temperature range that will go below the lowest setpoint and above than the highest set point to ensure that the setpoint and desired time-to-temperature is attained.

Re-circulation system

Fluid selection:

The typical fluid used in re-circulating chillers is water or a water and glycol mix. Both types of fluid may also contain additives such as biosides and/or inhibitors.

Water is an ideal coolant for most temperature control applications because it absorbs and gives up heat energy readily, absorbs large amounts of heat energy with a small temperature rise, has a low and stable viscosity, is low cost, and covers a wide temperature range.

Selecting the type of water can affect the temperature range, longevity of the re-circulating chiller, and the application. These are the four most common types:

Distilled water - Highly recommended because it lacks the minerals that could cause corrosion or deposits within the chiller and application and is biology free which helps prevent the growth of algae and bacteria.

Deionized water – Not preferred because deionized (DI) water is “aggressive,” effectively corroding or weakening metal or plastic wetted parts by leaching ions from them. DI water uses a specialized filter containing ion exchange resins that removes mineral ions (metals and salts) from the water but does not specifically remove any biology that might cause clogging or blocking of filters or passages.

Although distilled water is preferred, there may be cases when only DI water is available. The purity of DI water is rated by its electrical resistivity in MegOhm cm. If DI is going to be utilized, refer to the operations manual for the acceptable resistively level of the chiller. Although standard re-circulating chillers can typically accept DI water between 1-3 MegOhm cm; distilled water is still preferred because it is in the range of 0.1 MegOhm cm, making it much less corrosive.

Applications that do require DI water are most often found in the semiconductor industry due to the electrical isolation provided by DI water. It should be noted that these types of applications may have a requirement for a highly deionized water (greater than 3 MegOhm cm) requiring specialized chillers that can handle the corrosive nature of DI water.

Tap water - If tap water is going to be utilized, refer to the operations manual for water quality standards for the chiller. Tap water may need to be tested to determine if it meets the applicable standards specified for the chiller.

Glycol: Water - Glycols, ethylene or propylene, can be mixed with water, usually in a 1:1 ratio, to suppress the freeze point below 0°C. Depending on the efficiency and power of the chiller’s refrigeration system, freeze point protection may or may not be needed at setpoints above 0°C. (In these cases, refer to installation and operations manual.)

Where freezing is a concern, consideration should also be given to maintaining the correct ratio. In open systems, at temperatures below the dew point, atmospheric moisture can condense into the water glycol mix. When this happens, the glycol concentration is lowered and the freeze point is increased. An early indication this is happening is an unexplainable increase in the fluid level. A hydrometer or refractometer is the best way to monitor the concentration and freeze point.

While glycols also increase the boiling temperature in open systems they do not prevent water from evaporating out of the system at temperatures well below the boiling point. When topping off, in most cases only water needs to be added, as adding glycol with the water will increase the ratio of glycol. Open systems and elevated temperatures also hasten the acidic thermal degradation of glycols causing them to become quite corrosive. Adding copper and aluminum to the same system further accelerates the degradation. Because of this, glycol: water is not preferred at temperatures above 60°C. Accurately monitoring the pH of glycol is difficult. The best strategy may be to change the glycol: water out every six months and to use an inhibitor when circulating through applications that include aluminum as a wetted material.

Additives – Most typically fall into two categories: biocides and inhibitors. Biocides stop or prevent biological growth in the re-circulating fluid. Inhibitors are used to prevent corrosion caused by an interaction of dissimilar metals, such as copper and aluminum, or corrosion caused by interaction with the fluid itself.

Fluid filtering:

Filtering may be required or desirable to protect the pump or application from debris or fluid particulates. When choosing a re-circulating chiller, consider which of the following four scenarios applies:

- The application does not require a filter, but the chiller manufacturer has included a filter to protect the positive displacement or turbine pump. In this case, the filter should be left in place and maintained per the manufacturer's requirements.
- The application requires a filter and the manufacturer included a filter. Be sure to verify that the included filter meets the application specifications.
- The application requires a filter, but the manufacturer does not include one because centrifugal pumps typically do not require a filtration system. Check to see if accessories or filter options may be available from the manufacturer.
- The application does not require a filter and the manufacturer did not include one. In this case, a filter is not required and fluid maintenance is more important.

Wetted materials:

The interaction of wetted materials between the chiller and the application is often misunderstood - both when requesting a chiller with all stainless steel wetted materials or overlooked when aluminum is being considered in the application as a wetted material.

Chiller manufacturers use a wide variety of wetted materials (metals and polymers) that are typically compatible with DI water between 1 and 3 MegOhm cm. It is a common perception that an all stainless steel unit should be used anytime that DI water is used, however, an all stainless steel unit may only be needed at resistances maintained above 3 MegOhm cm.

Chillers are not manufactured with aluminum as a wetted material. Aluminum is not recommended as a wetted material in the application because the corrosion can damage your application and the pump in the chiller. If its use is unavoidable, then hard anodizing and/or a corrosion inhibitor should be used to limit the galvanic corrosion between dissimilar metals.

Flow control and pressure regulation:

There are instances where flow or maximum pressure will need to be controlled. For any given application, when a change has been made to flow, a change is also made to pressure. A choice needs to be made to either change the flow (which in turn changes the pressure) or regulate the pressure (which in turn changes the flow).

Changing the flow - Pump availability is typically limited to two or three choices. This most often makes it necessary to select a pump that exceeds the flow and pressure needed for the application. When a steady reduction in flow rate is needed (which also has a corresponding reduction in pressure), a flow control valve is recommended. When the actual flow requirement is unknown, a flow controller is used. The flow controller can alter the flow rate to find and meet the applications needs, while also maintaining a safe pressure. For applications that have a valve or device that limits or stops the flow of liquid to the application, a flow controller is not recommended

Regulating the pressure - Pressure regulating valves are best used as a safety device to prevent accidental high pressure. These valves can also be used as a bypass for applications with a solenoid valve or device that limits or stops the flow of fluid which could result in pump or chiller damage. While in many instances pressure regulating devices can be used as flow control, the risks of doing so include noisy operation - as the valve opens and closes rapidly or a high p itch squeal when high volumes of fluid are bypassed.

Fluid pressure pulsations:

Pressure waves are caused by the acceleration of the fluid by the pump. For applications that are sensitive to fluid pressure pulsations (e.g., electron microscopes), pumps with lower amplitude pulsations are typically more desirable. Turbine pumps and centrifugal pumps typically offer lower amplitude fluid pressure pulsations than positive displacement pumps at the same flow rate.

Duty cycle:

The duty cycle of re-circulating chillers may run from just a few hours per week to 24 hours per day, 7 days per week. When high duty cycles are anticipated and minimum down time is crucial, it is critical to select a long-life re-circulating pump. Positive displacement pumps are low cost and reliable, but have a shorter life than a turbine pump or centrifugal pump.

Preventative Maintenance

Preventative maintenance is often overlooked when selecting a re-circulating chiller. To attain the highest cost of ownership, consider the following:

- Quick and easy access to fluids or filters to be maintained without having to shut down the unit.
- Re-circulating chillers require a minimum fluid level. The ability to easily see the fluid level (such as a site tube on the front of the unit) ensures performance and prevents component damage caused by accidental low fluid level.
- A fluid filter and air filter that can be cleaned and reused.

Conclusion

Selecting a re-circulating chiller begins with the four core criteria of heat load, setpoint temperature, flow rate, and pressure loss, but should not end there. Optimizing the selection of a re-circulating chiller is accomplished by performing a complete application review to uncover the unique requirements for the application. Taking the time to identify these requirements means the difference between buying a re-circulating chiller that may work for the application and making an investment in a re-circulating chiller that is truly optimized for your application.

In addition to these offices, Thermo Fisher Scientific maintains a network of representative organizations throughout the world.

Benelux
Tel. +31 (0) 76 579 55 55
info.tc.nl@thermofisher.com

China
Tel. +81 3 5826 1616
info.tc.china@thermofisher.com

France
Tel. +33 (0) 1 60 92 48 00
info.tc.fr@thermofisher.com

Germany
Tel. +49 (0) 721 4 09 44 44
info.tc.de@thermofisher.com

India
Tel. +91 (22) 27 78 11 01
Contact.lpg.in@thermofisher.com

Japan
Tel. +81 45 453 9220
info.lpg.jp@thermofisher.com

USA
Tel. 603 436 9444
info.tc.us@thermofisher.com

www.thermoscientific.com/tc

TNTCCHILLER1210