Battery Production

Energy Storage and Sustainable Manufacturing

Using Thermo Scientific™ System Water-to-Water Heat Exchangers

Keywords

- **EV**- Electric Vehicle
- **ESG**- Environmental, Social and Governance
- **ICE**- Internal Combustion Engine
- **HX**- heat exchanger, a temperature control unit that uses facility water to cool process water.
- **Facility Water**- the cooling water system built into the building for process cooling.
- **Process Water**- the water that circulates to the tool. It may be the same as the facility water, or it may be separate from it.

Introduction

New manufacturing sites are being constructed globally to produce electric vehicles (EV) and energy storage solutions. A key focus for organizations planning or constructing new facilities, or rehabilitating existing facilities, should include methods to reduce the impact on micro and macro environments, lower energy usage, minimize greenhouse gas emissions and maximize renewable energy. Automobile manufacturers and contract organizations are at the forefront of innovating new products requiring new manufacturing methods, while re-purposing old techniques to facilitate production and testing equipment to lower the environmental footprint.

One area of concern is the many process cooling needs found in EV and storage battery manufacturing. Production of batteries emits mass amounts of heat and requires a great deal of cooling for lasers (i.e. slitting and winding, bus bar, tab pack, module welding, etc.), dry rooms, mixers, extruders, test stations and much more. To decarbonize manufacturing, companies must revolutionize their businesses by reusing, recycling and rethinking processes that have been in place for decades.

Challenges of traditional cooling water

Traditional and historic ways to provide cooling water includes a multitude of mediums – from rivers, lakes, wells and municipal waters, to roof-top refrigerated cold-water plants, and/or individual point-of-use chiller refrigeration units. The problem with these methods includes:

- Harmful greenhouse gas refrigerants
- High electrical usage
- High maintenance costs
- Difficulty recycling

- Municipal restrictions preventing the use of river, lake or tap water
- Dirty or corrosive water
- Seasonal or load dependent variations in water temperature
- Insufficient water flow or pressure

Addressing these concerns means finding sustainable, low energy methods to cool equipment. One example is the utilization of large water storage tanks with water to air heat exchangers that are filled during the day with heated facility water. Overnight, the cooler nocturnal conditions chill the facility water, which is then distributed to various cooling processes again the next day. Another method recovers the heat from process cooling to then be used to heat cooler parts of buildings, or even local dwellings. In some locations, direct geothermal cooling or geothermal heat pumps can be used to dissipate heat.

Using heat exchangers for process cooling

While traditional cooling methods can save large amounts of energy and recycle water, it does not address water that is too dirty/ corrosive, at the wrong temperature, or unable to supply the required flow and pressure. To correct this, small heat exchangers are used one-on-one with tools to supply clean water that meets the stringent requirements of sophisticated production equipment.

By putting a compressor-less heat exchanger between these massive cooling loops and the tools they are cooling, damage due to particulates, dissolved minerals, corrosion or galvanic coupling through the cooling fluid can be prevented. The temperature can also be controlled to compensate for facility water temperature variations throughout the day and prevent unwanted condensation (the enemy of lithium). In addition, the required flow and pressure rates can be set for each tool individually.

The type of heat exchanger used would be made up of the heat exchanger itself (tube-in-tube or plate types are common), a pump that can support the flow and pressure specification of the tool being cooled and a control system that regulates the water temperature of the process fluid going to the tool. This process fluid is typically distilled water, low level deionized water or even bottled drinking water- it never mixes or contacts the facility water directly in any way.

Heat exchanger benefits

There are many ways small heat exchangers make business sense when compared to refrigerated chillers or the direct use of facility water:

Purchasing advantages

- **Reduced utilities cost**- lower cost per kW of cooling compared to refrigerated chillers can help save on utility bills.

- **Reliable**- a simple interface makes heat exchangers dependable and easy to use for process cooling.

- **Process optimization**- a small heat exchanger can be utilized on each tool where the temperature accuracy, flow and water quality can be controlled. Combine with geothermal cooling, water tower, outdoor heat exchanger, or excess capacity of an existing cooling system.

- **Shipping benefits**- less costly to ship per kW of cooling (smaller dimensions/ lower mass = less energy to ship = lower cost to ship). Lower risk of shipping damage due to no risk from refrigerant leaks.

Installation advantages

- **Compact footprint**- a small footprint requires less floor space dedicated to temperature control, with an added bonus of less packaging to recycle.

- **Optimize temperature regulation**- waste heat can be reused to warm other processes, or to heat the facility at night/ during cold weather.

- **Lower power consumption**- heat exchangers do not require a compressor or fan, thereby reducing overall power consumption.

- **Heat reduction**- air-cooled chillers convert all of the energy they use to heat that enters the room, along with the process heat load. Water-cooled chillers still have a small amount of heat enter the room from the compressor shell and pump motor case. Heat exchangers only have the heat from the pump motor case, lowering energy usage and removing the load from the HVAC system.

- **Decreased noise**- air-cooled chillers contain a fan, compressor and pump all adding to the decibel level. Water-cooled chillers make less noise because they only consist of a compressor and pump motor. Heat exchangers make much less noise because they only contain a pump motor – the reduction in noise provides a more pleasurable working environment for employees.

Maintenance advantages

- **Easy maintenance**- heat exchangers are less costly and easier to upkeep. No refrigeration assembly eases the overall burden of maintenance, repairs and replacements.

- **Longer life**- when required, repairs can more often be completed in the field. There is no compressor or refrigerant to become outdated and fewer components equates to less failures.

Environmental advantages

- **Positive ecological impact**- no refrigerant leads to zero global warming potential (GWP) from refrigerant escaping into the environment due to leaks, improper service or disposal.

- **Reduced manufacturing environmental footprint**- compared to internal combustion engine (ICE) vehicles, more energy is required to produce electric vehicles- any opportunity to reduce the manufacturing footprint adds to the overall environmental benefit.[1]

- **Lower energy consumption**- lowers the facility electrical load, possibly reducing the cost of on-site renewable energy sources and lowering the amount of energy that is purchased

These environmental advantages help a company fulfill their commitment to ESG (environmental, social, and governance) goals.

Heat exchanger disadvantages

With all of these advantages, you might wonder why heat exchangers aren't more prevalent in pre-existing manufacturing facilities. As good as they can be, they are not appropriate for every facility or every cooling application. Below are some of the drawbacks that can prevent their use:

- **Temperature stability**- temperature stability may not be as consistent when compared to using a refrigerated chiller.

- **Temperature limitations**- fluids cannot reach temperatures below the facility water temperature.

- **Size**- few other manufacturers offer heat exchangers in the smaller capacities (<100kW) that are typical to a one-to-one tool and heat exchanger installation compared to large capacity systems (>500kW) intended to supply cooling water to much larger processes or even entire buildings.

Conclusion

In summary, automobile manufacturers and contract organizations must find ways to reduce energy and emissions in their manufacturing processes. Using heat exchangers as part of the solution makes business sense while providing environmental benefits to contribute towards making the world healthier, cleaner, and safer.

Reference

1. "Electric Vehicle Myths" United States Environmental Protection Agency (EPA) https://www.epa.gov/greenvehicles/electric-vehicle-myths

Learn more at **thermofisher.com/heatexchangers**