APPLICATION NOTE

Heating, Ventilation & Air Conditioning (HVAC)

Flow measurement of superheated steam for an absorption chiller

- Energy efficient use of excess heat from cogeneration to drive a chiller
- Integrated measurement of flow rate, pressure, temperature and energy in one device
- Accurate monitoring of thermal energy consumption at changing process conditions

1. Background

A utility company in Latvia operates several combined heat and power (CHP) plants to produce electricity and heat from wood chips and fuel gas. The energy supplier also operates various boiler houses and is responsible for the service and maintenance of a district heating network. For cost and sustainability reasons, and to comply with European carbon emissions regulations, the company uses the available energy sources as efficiently as possible. Among other things, the energy company uses by-product heat from cogeneration to drive an adjacent absorption chiller for cooling purposes.

2. Measurement requirements

Chillers are the system of choice for air conditioning, process fluid cooling or refrigeration in industrial sites and commercial buildings. The utility operates a single stage absorption chiller that is driven by low-pressure superheated steam recovered from the CHP process.

The steam provides an indirect thermal source in a three-phase cycle of evaporation, absorption and regeneration: As heat is removed from a coolant, a refrigerant (water) evaporates and is subsequently carried away by a liquid absorbent (lithium bromide) which chemically bonds to it. This diluted absorbent/refrigerant solution is transported to a generator. In the generator, the steam from the cogeneration process heats the diluted solution, causing the refrigerant to evaporate. As the absorbent is returned to the absorber, the refrigerant vapour undergoes a phase change in a condenser, allowing the cooling cycle to start all over again.

For balancing purposes and to assess the efficiency of the absorption chiller, the steam consumption needs to be measured. Depending on the amount of steam available, the flow rate of superheated steam varies over a wide range. It was equally important for the utility to avoid unnecessary efficiency losses and condensate formation. Therefore, the use of compact orifice plates was not an option.

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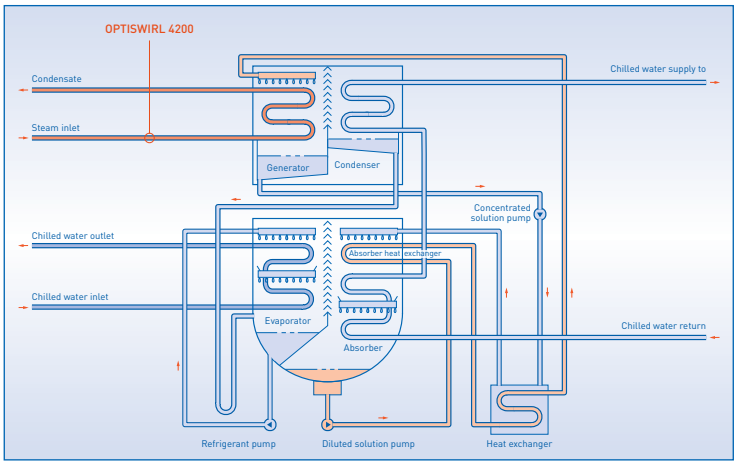
3. KROHNE solution

The customer opted for a cost-effective yet versatile Vortex flowmeter with integrated temperature and energy calculator. The OPTISWIRL 4200 Vortex flowmeter is designed for energy measurements in steam applications up to +240°C / +464°F.



Simplified process scheme of absorption chiller with OPTISWIRL 4200

As superheated steam is used to drive the generator of the absorption chiller, the KROHNE flowmeter also has an additional built-in pressure sensor. This allows it to compensate for changing temperature and pressure conditions. With the IAPWS database integrated into the energy calculator, the Vortex flowmeter can directly output the gross heat mass flow of superheated steam. Due its measurement principle (Karman's law), the Vortex flowmeter offers a wide turndown ratio covering different operating conditions of the plant with good accuracy even at low flow rates. Vortex flow measurement is drift-free and only causes a negligible pressure drop.

Instead of calculating the net heat in the control room, the utility could also connect the temperature sensor installed in the condensate return line directly to the Vortex flowmeter. As the KROHNE flowmeter also has an input available for an external temperature sensor, it would be possible to measure the gross/net heat of steam in one device without using a separate flow computer.

4. Customer benefits

Against the backdrop of increasingly stringent energy-saving regulations and rising cap-and-trade costs in Europe, the utility found an efficient way to use excess heat from cogeneration for year-round cooling purposes. There are no incremental emissions released by the absorption chiller.

KROHNE's Vortex flowmeter helps the customer monitor and balance the chiller's thermal energy consumption. The utility can use these readings to assess the efficiency of the absorption chiller over the long term and to better plan energy distribution. Unlike conventional Vortex flowmeters, the OPTISWIRL 4200 combines flow, temperature and pressure measurement as well as flow calculation in a single device. This can save approximately 45% of installation costs and results in a better overall system accuracy.

The Vortex flowmeter is designed for advanced energy management systems as it can be supplied with integrated gross and net heat measurement for steam and condensate. Whether cooling or heating applications in industrial plants, data centres, university campuses, hospitals, hotels or large commercial office buildings: For companies that want to implement sustainable energy management and need to design their energy networks accordingly, KROHNE offers all the necessary and certified process instrumentation from a single source, including consulting and project support.

5. Product used

OPTISWIRL 4200

- Vortex flowmeter for utility applications and energy management systems
- For liquids, (wet) gases, saturated and superheated steam (+240°C / +464°F)
- Integrated P+T measurement: direct output of mass, nominal flow, energy, gross/net heat

Contact

Would you like further information about these or other applications?
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