Steam Grow Heat Pump / SGH120

KOBELECO Compressors Corporation

Summary of technology

The steam supply heat pump system was commercialized in 2011. This system can be used as an alternative to the low-pressure steam boiler used for heating processes such as distillation of alcohol, concentration of beverage or waste liquid, and sterilization in food industry.

The system is composed of an electrically driven heat pump unit and a flash tank (see Figure 2). The heat pump unit lifts the heat from the heat source water (25-75°C) and sends the heat to the pressurized circulating water. In the flash tank, the pressurized water is decompressed and evaporated. The flash steam (up to 120°C, 0.1 MPaG) is supplied to each process, and make-up water is feed into the flash tank for keeping the water level.

For the working fluid of the heat pump, R245fa is selected because of its high critical temperature of 154°C. As the heat pump cycle, a two-stage economizer cycle with an internal heat exchanger is selected for higher efficiency.

This heat pump equips a two-stage twin-screw compressor which can operate with highly efficiency in a wide range of compression ratio. This enables the high temperature lift operation up to 95 K. The motor cooling method which the refrigerant liquid is directly injected into the motor is adopted so that the motor does not overheat even under high suction temperature conditions. This can achieve both high reliability and performance of the compressor.

Although lubricant oil is necessary for operating a compressor, the oil viscosity generally decreases at high temperatures. The oil is selected so that it has the required viscosity even high temperatures and does not deteriorate and generate sludge.

This system can follow the steam fluctuation. When the steam demand decreases and the steam pressure decreases, the steam supply flow rates is reduced by decreasing the compressor rotating speed with keeping the discharge steam pressure. The steam supply with stable pressure enables the stable quality of customers products.

The rated COP of this system is 3.5 under the heat source water temperature of 65°C and the steam supply temperature of 120°C (see Table 1). The rated heating capacity per unit is 370 kW (0.51 ton/h of steam), and up to 5 units can be integrated.
It is desirable that this system is installed near each heating process. Generally, steam boiler is installed at the energy center located far from each process, and the steam is distributed with long pipes. This causes a lot of heat loss from steam pipes. Installing the heat pump near the process can reduce the heat loss as well as effectively recover the waste heat from the process.

**Project example**

This steam supply heat pump system was installed in a bio-ethanol production plant for the distillation of ethanol in 2013. Before the installation, the distillation column was heated with 120°C steam from heavy oil-fired boiler. Distilled ethanol-rich vapor was condensed with cooling water. For the purpose of heat recovery form the condenser and steam supply to the distillation column, this heat pump system was selected.

With 5 units of the heat pump unit integrated for 1 flash tank, usually 4 units of them operate (1 unit is stopped as a spare), and steam of 2 ton/h are supplied to the distillation column. This amount accounts for 70% of the total steam demand. The remained 30% is covered with the existing boiler. The heat pump can operate at the rated condition and shows the rated COP of 3.5. By reducing the heavy oil consumption for boiler, the operating cost can be reduced by 54% in the total of distillation process.

**Contact information**

Takenobu Kaida, CRIEPI

kaida@criepi.denken.or.jp

+81 70 5587 3148

---

**FACTS ABOUT THE TECHNOLOGY**

**Heat supply capacity:** 370 kW/unit (Max. 5 units)

**Temperature range:** Heat source water 25-65°C, Feed water 5-95°C, Steam 100-120°C

**Working fluid:** R245fa

**Compressor technology:** Two-stage twin-screw

**Specific investment cost for installed system without integration:**

**TRL level:** TRL 9

**Expected lifetime:** 15 years

**Size:** Weight 4,250 kg, Footprint 6.6 m²

---

All information were provided by the supplier without third-party validation. The information was provided as an indicative basis and may be different in final installations depending on application specific parameters.