Steam Grow Heat Pump / SGH165
KOBELCO 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 middle-pressure steam boiler used for various heating processes such as drying, sterilization, distillation and concentration.

The system is composed of an electrically driven heat pump unit, a flash tank and a steam compressor unit (see Figure 2). The heat pump unit lifts the heat from the heat source water (35-70°C) and sends the heat to the pressurized circulating water. In the flash tank, the pressurized water at 115°C is decompressed, and the flash steam at 110°C (0.1 MPaG) is generated. The steam compressor unit compresses the steam up to 175°C (0.8 MPaG) with injecting water. The saturated steam 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, the mixture of R245fa and R134a is selected for achieving a good performance. As the heat pump cycle, an economizer cycle with an internal heat exchanger is selected for higher efficiency.

The heat pump unit equips a twin-screw compressor which is optimized in a certain range of compression ratio. The lubricant oil is selected so that it has the required viscosity even high temperatures and does not deteriorate and generate sludge.

The steam compressor is an oil-free twin-screw compressor. For preventing the superheat of the discharge steam and keeping the clearance between rotor and rotor and between rotor and casing, water is injected into the compressor.

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 both compressors' rotating speeds 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 2.5 under the heat source water temperature of 70°C and the steam supply.
High-Temperature Heat Pumps

The rated heating capacity per unit is 624 kW (0.84 ton/h of steam). 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. 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.

temperature of 165°C (see Table 1). The rated heating capacity per unit is 624 kW (0.84 ton/h of steam).

**Table 1: Performance**

<table>
<thead>
<tr>
<th>$T_{\text{source,in}}$ [°C]</th>
<th>$T_{\text{source,out}}$ [°C]</th>
<th>$T_{\text{sink,in}}$ [°C]</th>
<th>$T_{\text{sink,out}}$ [°C]</th>
<th>COP$_{\text{heating}}$ [-]</th>
</tr>
</thead>
<tbody>
<tr>
<td>70</td>
<td>65</td>
<td>20</td>
<td>165</td>
<td>2.5</td>
</tr>
<tr>
<td>70</td>
<td>65</td>
<td>20</td>
<td>135</td>
<td>3.0</td>
</tr>
<tr>
<td>50</td>
<td>45</td>
<td>20</td>
<td>165</td>
<td>1.9</td>
</tr>
<tr>
<td>50</td>
<td>45</td>
<td>20</td>
<td>135</td>
<td>2.2</td>
</tr>
</tbody>
</table>

**Facts about the Technology**

- **Heat supply capacity**: 624 kW
- **Temperature range**: Heat source water 35-70°C, Feed water 5-95°C, Steam 135-175°C
- **Working fluid**: R245fa+R134a (mixture) for heat pump unit, R718 for steam compressor unit
- **Compressor technology**: Twin-screw
- **Specific investment cost for installed system without integration**: 
- **TRL level**: TRL 9
- **Expected lifetime**: 15 years
- **Size**: Weight 7,050 kg, Footprint 13.8 m$^2$

**Project example**

The SGH165 was installed at CRIEPI (Central Research Institute of Electric Power Industry) lab in 2013. On the assumption of actual different industrial process temperatures, the energy performance data were obtained under various heat source temperatures, feed water temperatures and steam discharge temperatures. In addition, the control performances including the start-up and shut-down operations, the condensed water blow operation, and the load-following capability were obtained. After the performance evaluation and reliability test, some units were installed in actual factories.

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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.