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						S5	renewable energy
F-67	Keywords	Y2	device	Z4	electricity	E29	electrical machinery

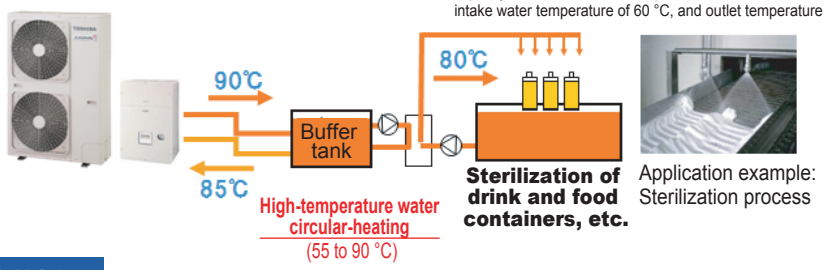
Toshiba Carrier Corporation

Circular-heating Heat Pump for High Temperature Water

Features

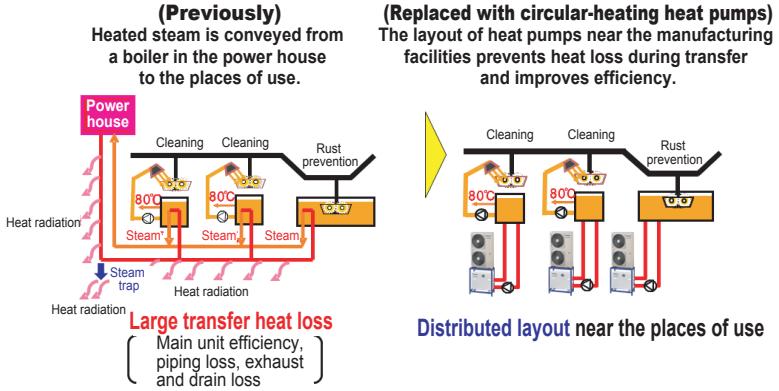
- This high-efficiency heat source unit supplies high-temperature water at 90 °C using heat pump cycles.
- The maximum leaving water temperature of 90 °C realizes the use of heat pump systems for the commercial applications at factory manufacturing lines and hotels and hospitals where combustion-based steam boilers and electric heaters were previously used for heating, thus achieving energy saving and CO_2 emission reduction.
- The supply of hot water from 50 °C to 90 °C at the maximum is possible in a wide ambient temperature range from -15 °C at the lowest to 43 °C at the highest.
- The inverter twin rotary compressor has a high partial load characteristic to offer a high COP in a wide operation range.
  The rated COP is 3.5(*) assuming the leaving water temperatur of 65 °C, indoor installation, and an ambient temperature of 25 °C.

*Capacity of 14 kW, ambient temperature of 25 °CDB/21 °CWB, intake water temperature of 60 °C, and outlet temperature of 65 °C

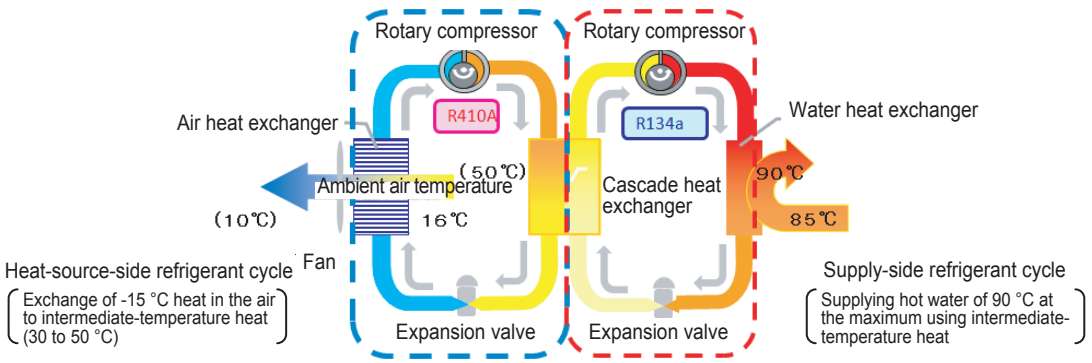


Basic Concept or Summary

- Reduction of transfer loss due to distributed layout near where hot water is used
  The distributed layout of circular-heating heat pumps reduces the heat loss during transfer in comparison with the conventional boiler method and also achieves energy saving and CO_2 reduction with the heat pump method.

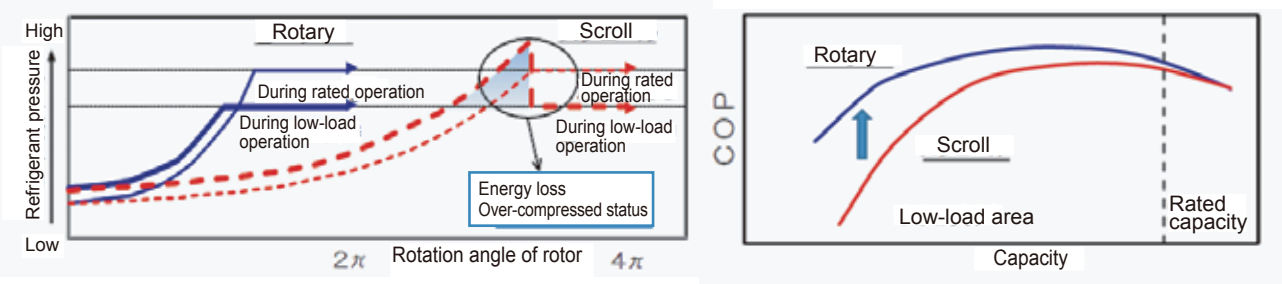


- High-temperature leaving water of 90 °C in a wide operation range made possible by the use of dual cascade refrigerating system
  There are two refrigerant cycles; heat-source-side and supply-side refrigerant cycles. The two refrigerant cycles are connected via a cascade heat exchanger. The heat-source-side refrigerant cycle uses the R410A refrigerant in consideration of heat absorption under low ambient temperature conditions whereas the supply-side refrigerant cycle uses the R134a refrigerant having a high critical temperature and suited for high-temperature leaving water. Since the heat absorbed in the heat-source-side refrigerant cycle is conveyed to the supply-side refrigerant cycle, high-temperature leaving water of 90 °C is available even under a low ambient temperature condition of -15 °C.



Dual cascade refrigerating system configuration

◆ Use of high-temperature-ready inverter twin rotary compressor to realize high partial load characteristic
High-efficiency operation of two independent refrigerant cycles is realized by controlling the temperature (middle pressure) of the cascade heat exchanger to achieve optimal operation efficiency according to the ambient temperature of the heat-source-side refrigerant cycle and the operation status of the entire system. The use of an inverter twin rotary compressor both in the heat-source-side and supply-side refrigerant cycles has enabled operation that makes the most of the high partial load characteristics. For a dual refrigerant cycles equipped with two compressors, in particular, varying loads are applied to each of the compressors according to wide-ranging operation conditions such as the ambient temperature, outlet temperature, and heating capacity. In this circumstance, the high partial load characteristic of the rotary compressors has a remarkable effect.



a) Refrigerant pressure in compression process　　b) Partial load characteristic

Partial load characteristic of compressor

(The rotary compressor having a discharge valve has a varying discharge pressure according to the operation status. Therefore, it does not cause over-compression like a scroll compressor and has a high partial load characteristic.)

Effects or Remarks

◆ Comparison of primary energy consumption and CO2 emission between electric heater system and gas boiler system
These values were estimated assuming indoor installation, constant ambient temperature of 25 °C throughout the year, heating load capacity of 14 kW, and outlet water temperature of 65 °C. This system consumes 71 % less primary energy than electric heaters and 61 % less than gas boilers. This system emits 74 % less CO_2 than electric heaters and 78 % less than gas boilers.

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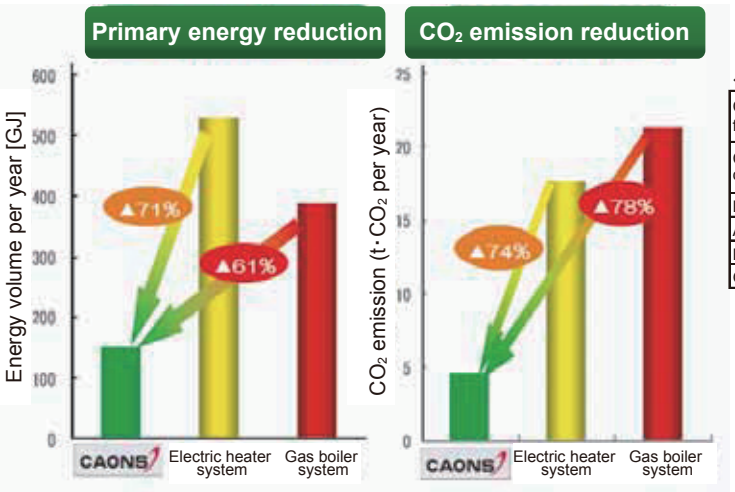

<<Conditions>>

Conversion coefficient for energy use	Electricity	9．76MJ／kWh
	Gas	45MJ／m^3
CO_2 emission coefficient	Electricity	0．324kg／MWh
	Gas	2．23kg／Nm^3
Device operation time		16 hours per day, 20 days per month
Ambient temperature		25℃
Electric heater efficiency		100%
Gas boiler efficiency		50%

◆ This system has been developed through joint research with Chubu Electric Power and Kansai Electric Power Companies in view of applications needed on the market and opinions from customers.

Installation in Practice or Schedule

Domestic　Food processing plants, parts cleaning plants, etc.

Overseas　Parts cleaning plants, etc.

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