

Micro Steam Recovery Compressor / MSRC160L

KOBELCO Compressors Corporation

KOBELCO

Figure 1: External appearance

Summary of technology

The micro steam recovery compressor (MSRC) is a mechanical vapor recompression (MVR) system packaged for general-purpose applications. The MSRC was commercialized in 2011. This system can be used as a steam recovery by compressing the steam which is a flash steam deriving from condensate drain, or low-pressure steam after being used in a heating process.

Steam is used in many industries as a heating medium, In general, steam is produced by heating and evaporating water, and a lot of energy input is necessary for its sensible heat and latent heat. For example, when producing 160°C saturated steam from 20°C water, sensible heat of 591 kJ/kg and latent heat of 2,082 kJ/kg needs to be heated by boiler. Or even if the water supply is preheated using drain water, at least the latent heat of 2,082 kJ/kg needs to be heated by boiler. In contrast, when reusing 110°C low-pressure saturated steam generated at flash tank recovering condensate drain, the needed heat is only latent heat of 66 kJ/kg. Hence the steam recompression can significantly reduce the energy consumption for steam generation.

The MSRC is mainly composed of an oil-free twin-screw compressor and a drain separator. The compressor recovers the low-pressure steam (0.05-0.1 MPaG) and compresses it to a required pressure (0.3-0.8 MPaG). When adiabatically compressing 110°C saturated steam (0.05 MPaG) to 0.5 MPaG, the discharge superheated steam temperature reaches about 264°C. The superheat derived from the compression heat is a large value of 104 K because the saturated temperature at 0.5 MPaG is 160°C. While the rotors of the compressor rotate at high speed with keeping a minute gap for non-contact. Due to the thermal expansion derived from the compression heat, the rotors may come into contact each other. 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.

The drain separator is equipped to prevent the injection water that did not evaporate and remained as liquid from being sent out. By removing the water droplet, the compressed steam can be supplied as a form of saturated steam.

The compressor rotating speed can be changed with the inverter in a wide range from 100% to 10%. This enables



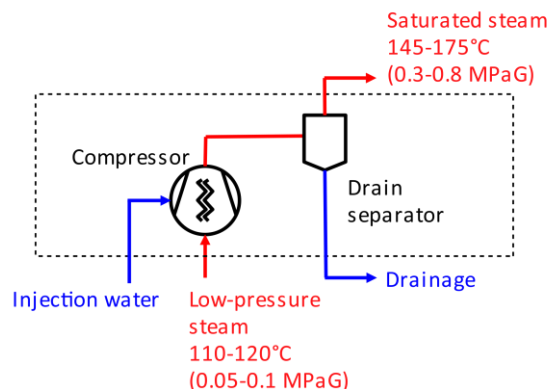


Figure 2: System configuration

Table 1: Performance

T _{source} [°C]	P _{suction} [MPaG]	T _{sink} [°C]	P _{discharge} [MPaG]	COP _{heating} ² [-]
120	0.1	175	0.8	4.4
120	0.1	152	0.4	6.9
111	0.05	175	0.8	3.1
111	0.05	152	0.4	5.3

$$* \text{COP}_{\text{heating}} = G_{\text{discharge}}(h_{\text{discharge}} - h_{\text{sat,liq}})/W_{\text{el}}$$

- $G_{\text{discharge}}$: Discharge steam mass flow rate [kg/s]
- $h_{\text{discharge}}$: Specific enthalpy of saturated steam at discharge pressure [kJ/kg]
- $h_{\text{sat,liq}}$: Specific enthalpy of saturated liquid at discharge pressure [kJ/kg]
- W_{el} : Electric power consumption [kW]

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

The energy performance of the MSRC is listed in Table 1. Both of the suction and discharge steam are saturated steam. To calculate the COP, the enthalpy difference from the discharge saturated steam and the saturated liquid at the discharge pressure is assumed to equal the supply heat.

Project example

More than 25 MSRCs have been installed in steam supply lines in various industries such as paper, chemical and food productions. Here, an example installed in a tissue

FACTS ABOUT THE TECHNOLOGY

Heat supply capacity: 800 kW

Temperature range: Suction steam 110-120°C (0.05-0.1 MPaG), Discharge steam 145-175°C (0.3-0.8 MPaG)

Working fluid: R718 (water)

Compressor technology: Twin-screw

Specific investment cost for installed system without integration:

TRL level: TRL 9

Expected lifetime: 15 years

Size: Weight 2,700 kg, Footprint 3.5 m²

factory is introduced. In the papermaking process, steam is used for a yankee dryer and condensate is generated. The flash steam from high-temperature drain is thermally compressed with ejector and is directly re-used for drying. While low-temperature 120°C drain was used to preheat the boiler water supply. By using the MSRC, the flash steam from the 120°C drain can be directly re-used for drying. This leads to 5% reduction of the primary energy consumption for the yankee dryer. In response to the good effect, the customer installed another unit.

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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.

