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natural refrigerants
3-5 February 2015 in Tokyo

Kawasaki turbo chiller using water as a refrigerant

Feb. 4th 2015
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Kawasaki
Powering your potential

Contents

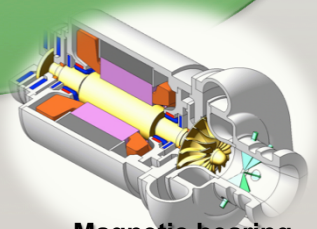
Background

Global warming issue
- HFC ⇒ natural refrigerant
- High-efficient chillers

C_nH_m NH_3 CO_2 H_2O

Kawasaki's technology
- Turbo compressors
- High speed motors
- Heat exchangers

Steam compressor

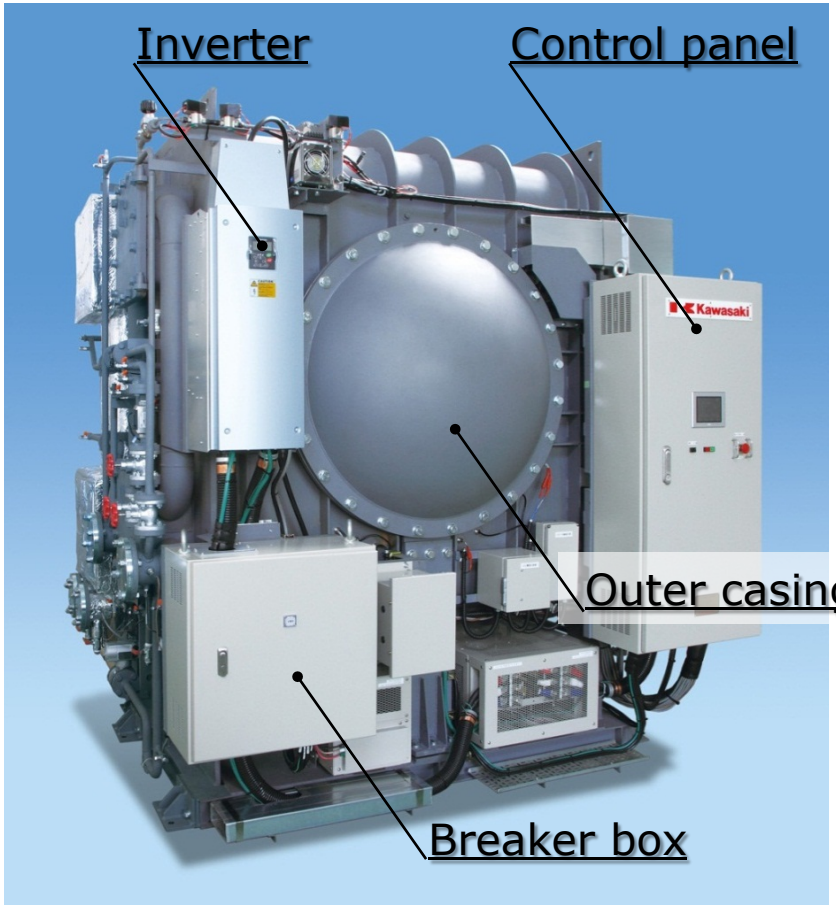


Magnetic bearing
High speed turbo blower

Kawasaki developed the turbo chiller using water as refrigerant

Contents

Kawasaki turbo chiller



Cooling capacity		**100USRt (352kW)**
Rating of motor		**110kW**
Refrigerant		**R718(water)**
Chilled Water temp.	**Inlet**	**12 degC**
	Outlet	**7 degC**
Cooling Water temp.	**Inlet**	**30 degC**
	Outlet	**35 degC**
Motor drive		**Inverter**
Power supply		**3Φ, 400/440V (50/60Hz)**
Size		**2.5m x 2.5m x 2.6m**
Intended application		**Air conditioning**

Compressor, Motor, Evaporator and Condenser are inside the outer casing.

Features

Water refrigerant

➡ **Zero emission of HFC**

Compact

- Development of the core components
- Optimization of their layout

➡ **Alternative to existing chillers**

Oil-free

- The compressor is driven by the high speed motor

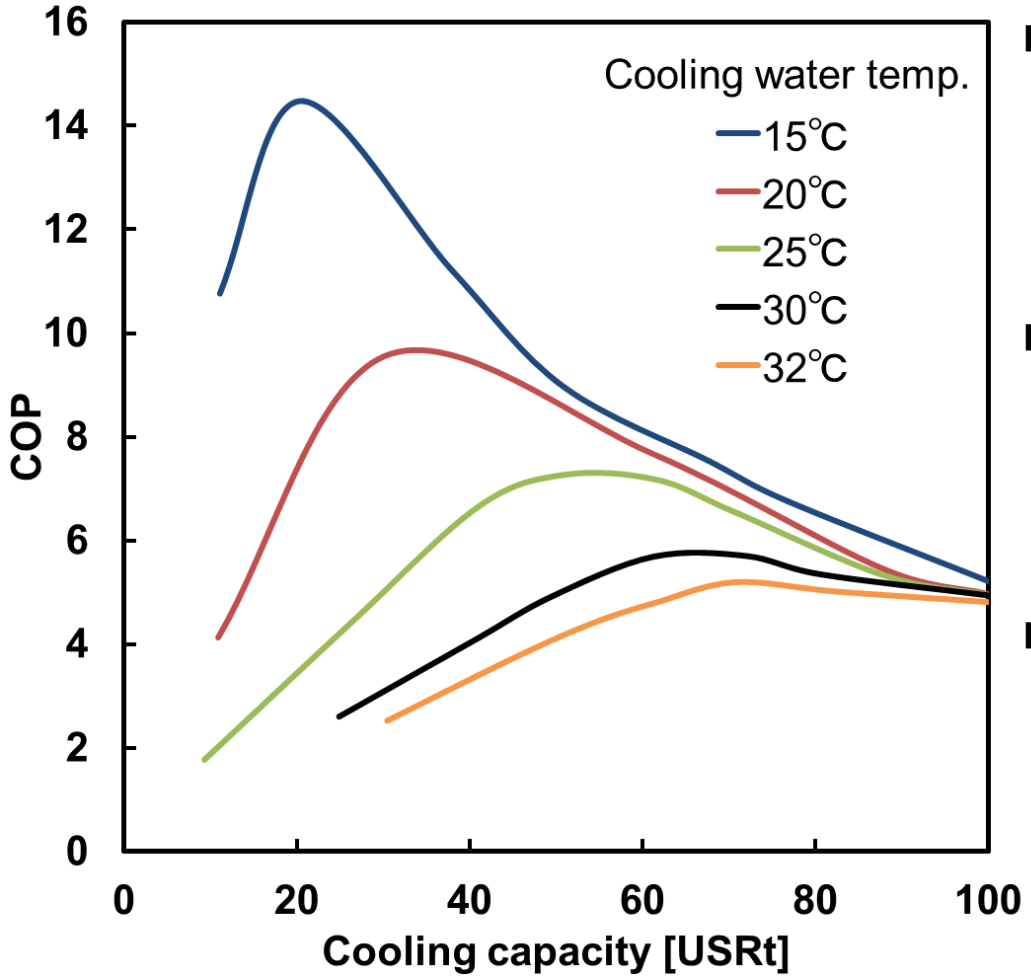
➡ **Auxiliary system for oil is not necessary**

Comparable performance to HFC chillers

- Development of the high efficient compressor under low pressure and high pressure ratio

➡ **Low power consumption**

Performance



■ **COP**
- **5.1 at 100%**
- **Higher at a partial load**

■ **Operating range**
- **10%~100% at below 25degC**
- **Narrower at over 30 degC**

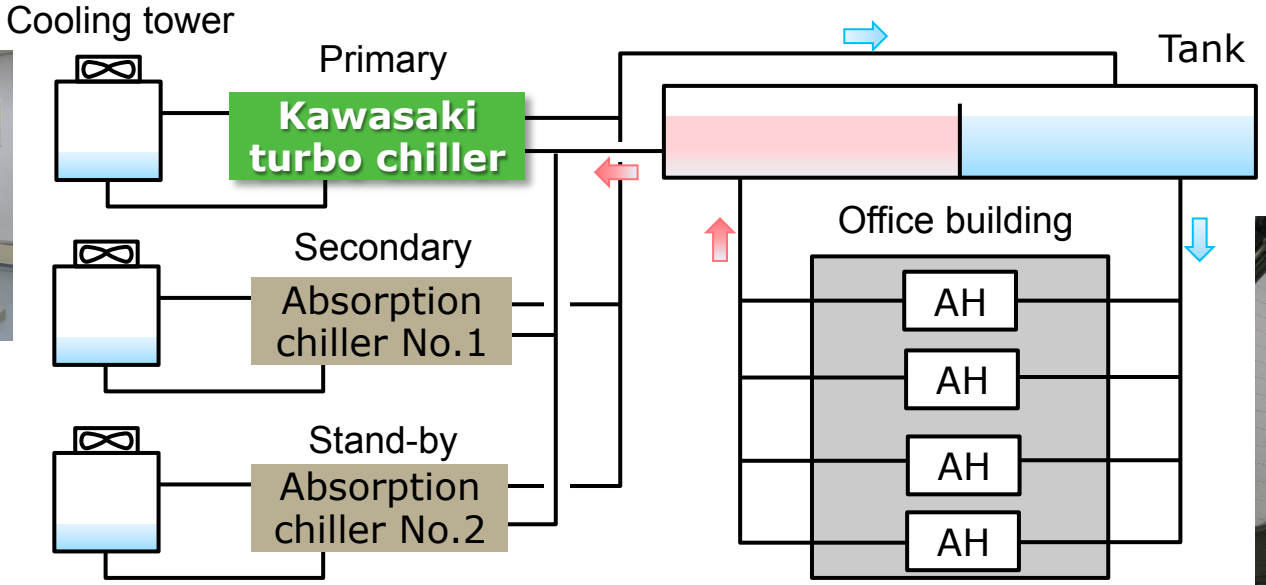
■ **IPLV**
- **ARI standard : 8.0**
- **JRA standard : 7.4**

Comparable performance to the other turbo chillers

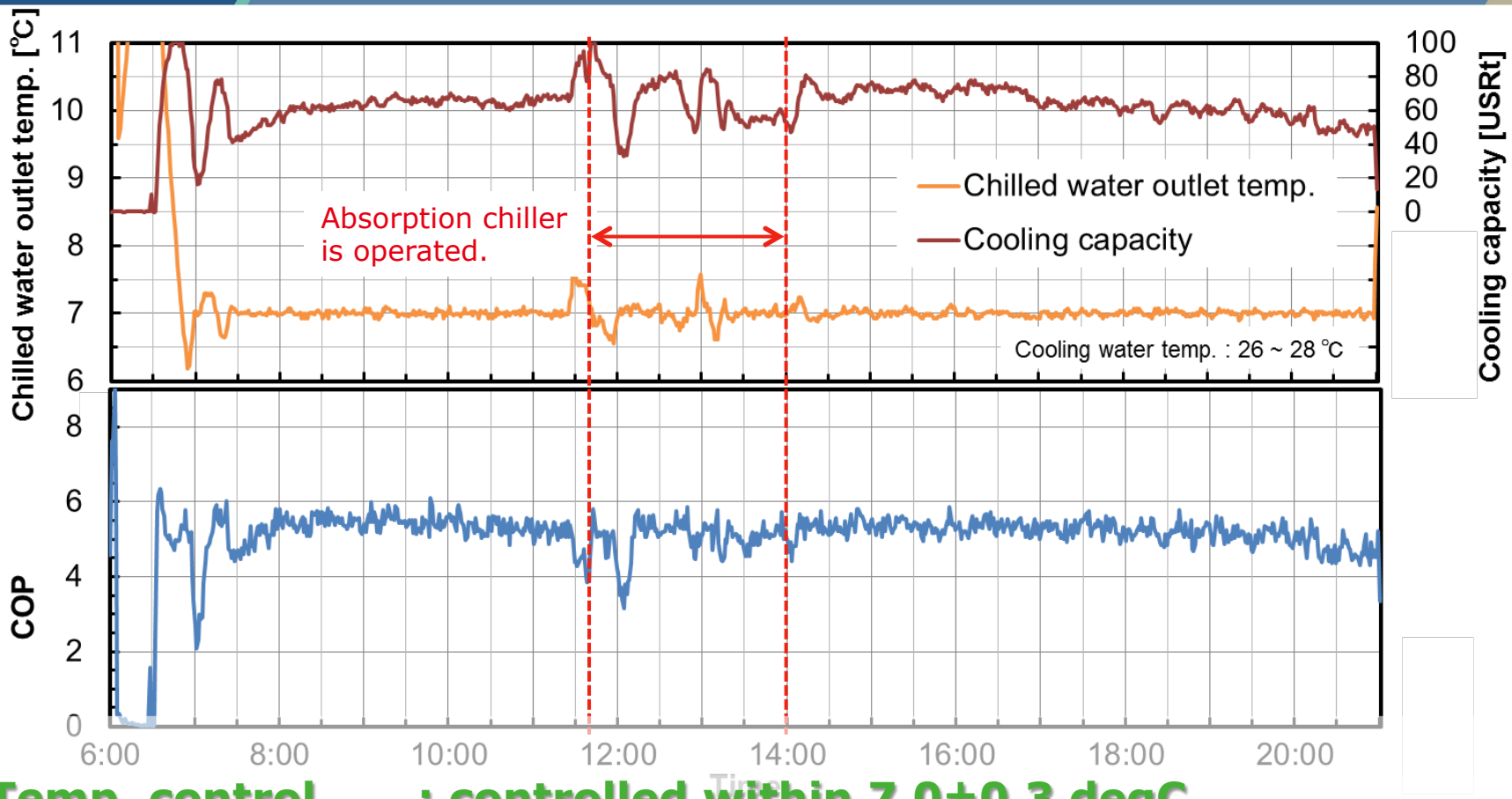
Contents

Actual installation case

- Installed in Kawasaki's Kobe works for an air conditioning in 2013
  - Floor Area : 5,000m^2
  - Primary chiller : Kawasaki turbo chiller 100USRt 1unit
    Secondary chiller : Absorption chiller 120USRt 1unit
- Confirmation Items : 1. Chilled water temp. control
  2. Units control



Performance at actual operations



Temp. control : controlled within 7.0±0.3 degC

Units control : performed without problem
(chilled water controlled within 7.0±0.5 degC)

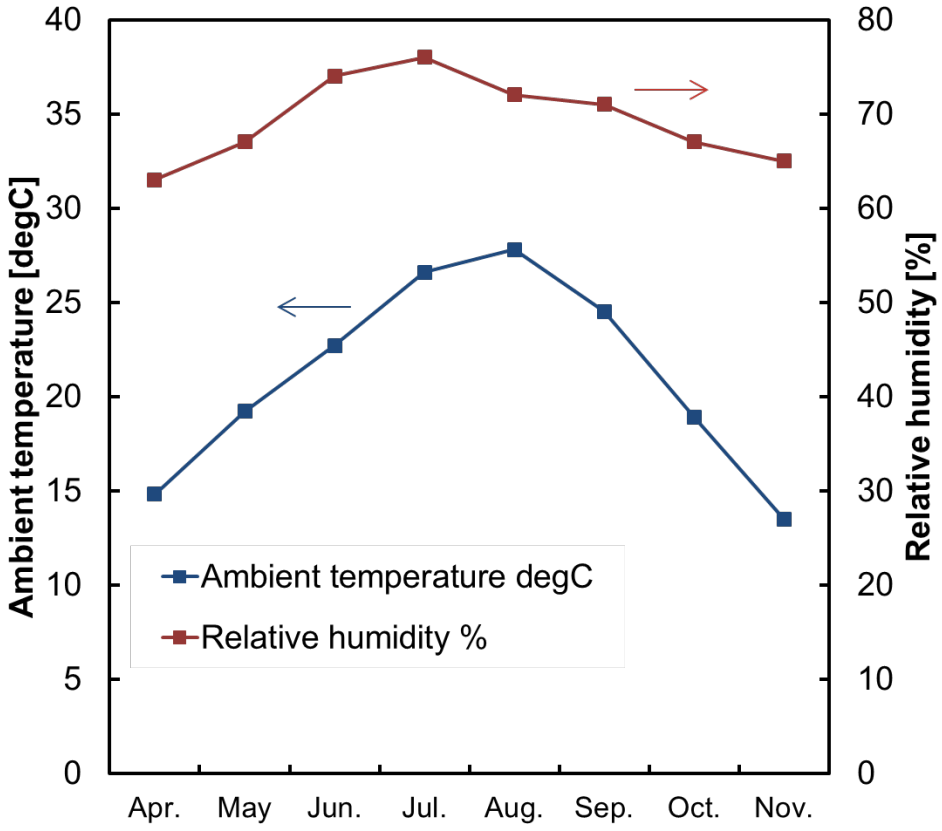
Accumulated time : 2,400 hours (operated since 2013 summer)

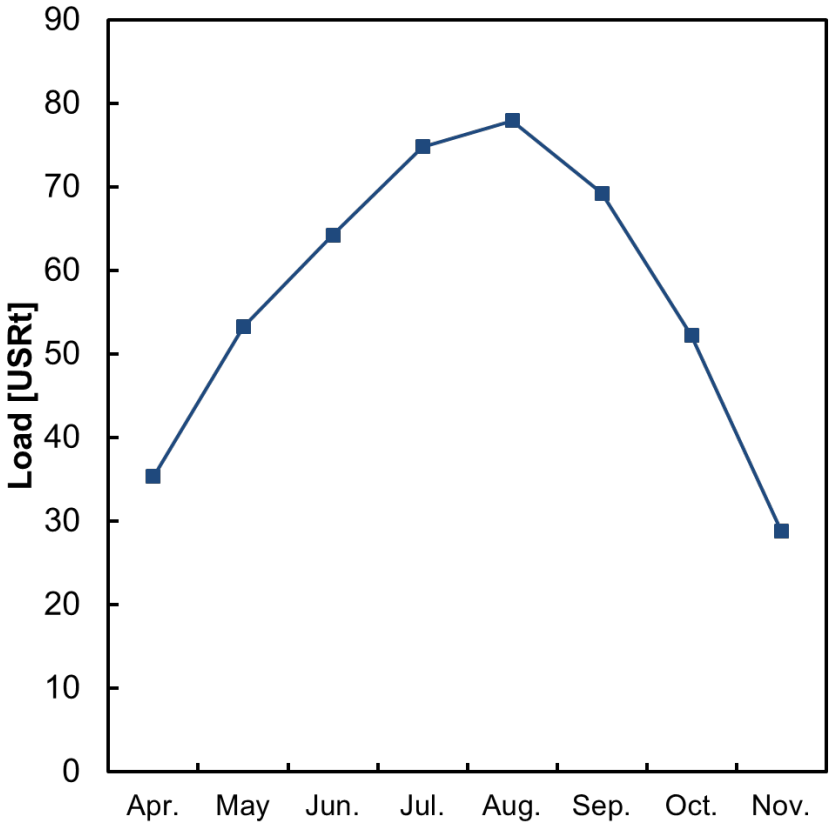
Contents

Calculation conditions

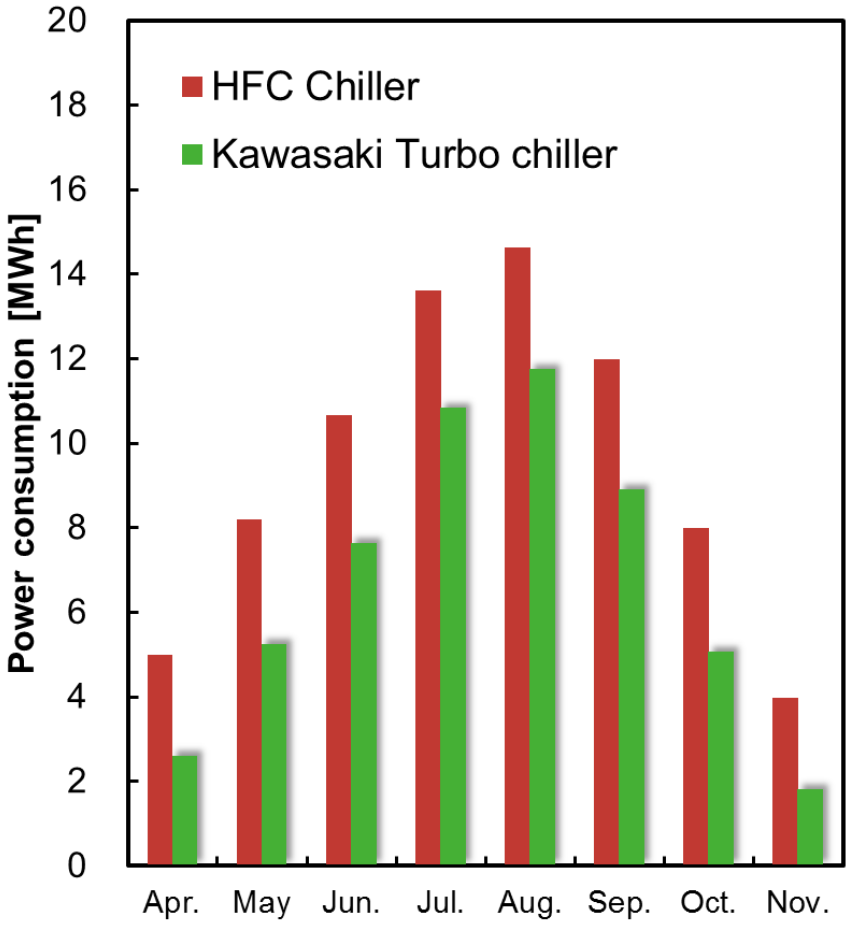
Power consumption has been estimated in the case of a replacement

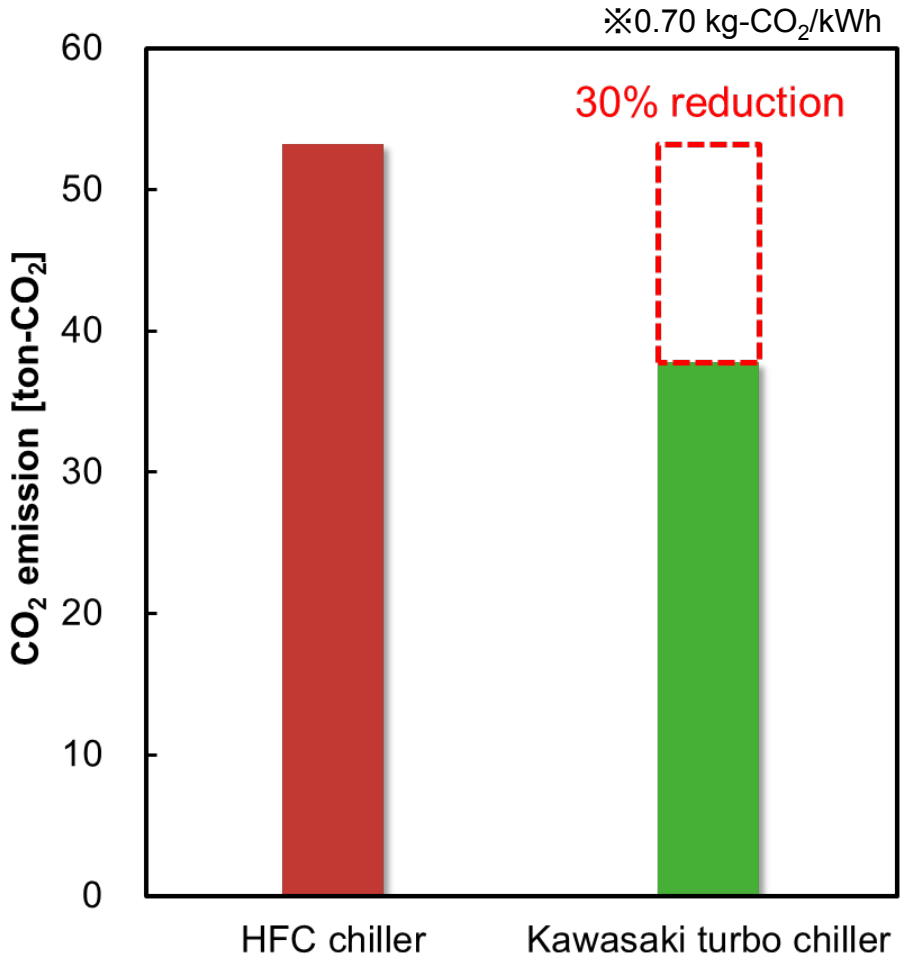
- Weather data : Statistical data from Japan Meteorological Agency
- Operating hours : 240 hours/month





Estimation of power consumption





Power consumption would be reduced by 30%

Contents

Summary

- **Introduction of Kawasaki turbo chiller using water as a refrigerant**
  - **Features and performance**
- **Actual installation**
  - **Chilled water temp. is controlled within 7±0.3degC.**
  - **Units control performs properly**
- **Estimation of power consumption**
  - **Power consumption could be reduced by replacing a HFC chiller with Kawasaki turbo chiller**

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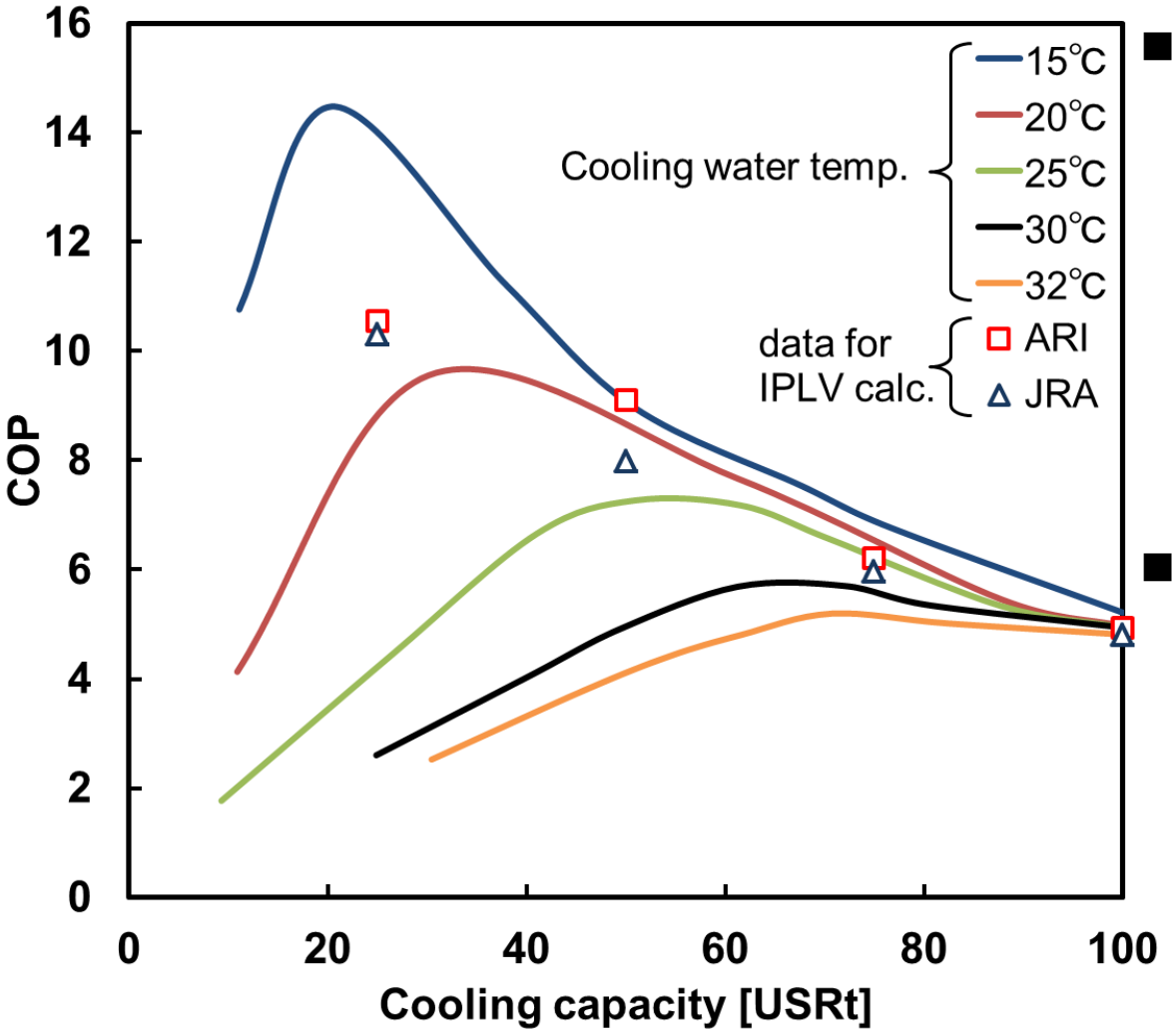
IPLV



■ ARI

IPLV = 0.01A+0.42B+0.45C+0.12D

	Load	Cooling water temp.
A	100 %	29.4degC
B	75 %	23.9degC
C	50 %	18.3degC
D	25 %	18.3degC

IPLV = 8.0

■ JRA

IPLV = 0.01A+0.47B+0.37C+0.15D

	Load	Cooling water temp.
A	100 %	32.0degC
B	75 %	27.5degC
C	50 %	23.0degC
D	25 %	18.5degC

IPLV = 7.4