

Improving operating efficiency of chilling plants

At present a chiller is operated for 15 hours a day to supply chilled water to reactors. The present level of efficiency is only 40 percent since the differential temperature is only 2.6°C. This efficiency can be raised to at least 80 percent

Proposed System

It is recommended to overhaul the compressor, de-scale the evaporator, and check the specific gravity of the brine. By doing this, the operating efficiency can be improved, resulting in reduction of energy consumption and process improvement. It is also suggested to carry out regular preventive maintenance.

Benefits	:	Rs. 3.11 lakh
Investment	:	Rs. 20,000 for overhauling/ de-scaling
Payback	:	Less than a month

Backup Calculations for Working Efficiency

- Present power consumption by compressor motor = 30.3 kW
- Present running hours = 15 hours/ day
- By improving efficiency to 80 percent reduction in operating hours = 7.5 hours
- Present power consumption
= $23.4 \times 15 \times 350 \text{ kWh} \times 3.56$
= $159,075 \text{ kWh} \times 3.56$
= Rs. 566,307
- By improving chiller efficiency, the expected reduction in power consumption = Rs. 283,153 (50% operation)
- Advantage of reducing operating hours of cooling water circulation pump
= $3 \times 15 \times 350 \text{ kWh} \times 3.56$
= Rs. 56,070
- Advantage of cutting down 50 percent in operating hours
= Rs. $0.5 \times 56,070$
= Rs. 28,035
- Total advantage = $2.83 + 0.28$
= Rs. 3.11 lakh

(* Discussed with the repairer and asked him to submit a quotation for overhaul)

Chilling Plant Carrier, USA

- Power consumed by compressor motor = 30.3 kW
- Power consumed by condenser circulation motor = 3 kW
- Power consumed by brine circulation to evaporator = 7.2 kW
- Total = 40.5 kW
- Specific kW per ton of refrigeration = $40.5/32 = 1.26 \text{ kW}$
- As per reciprocating compressor standards, the ratio can be 1.25-2.5 tons

Procedure to Measure Flow of Brine Circulation Pump and Efficiency Calculation:

Circulation water for one hour and record difference in temperature

Performance of Cooling Tower

- Inlet water temperature to Cooling Tower = 34°C
- Outlet water temperature = 29°C
- Dry bulb temperature = 30.9°C
- Wet bulb temperature = 26.5°C (Calculated)
- Cooling Tower range = $(34-29) = 5 \text{ °C}$
- Cooling Tower approach = $29-26.5 = 2.5 \text{ °C}$
- Effectiveness = $100 \times \text{Range} / (\text{Range} + \text{Approach})$

$$= 100 * 5/7.5$$

$$= 66.6\%$$

Calculation of Efficiency for Chilling Plant

- Size of the hotwell = 1.87*1.65 m
- Time = 6 min
- Difference in level = 595 mm
- Flow in one hour (m³) = 1.87 * 1.65 * 0.595 * 10
= 18.35 m³
- Inlet brine to evaporator = 0.9 °C
- Outlet from evaporator = -1.7 °C
- Temperature difference = 2.6 °C
- kW taken by chiller (measured) = 30.3
- TR (Ton of refrigeration)
= $\frac{Q * \text{Specific heat} * \text{specific gravity} * \Delta T}{3024}$

= $\frac{18350 * 0.8 * 0.98 * 2.6}{3024}$
- TR/ kW = 12.47/ 30.3
= 0.41

Normally it should be between 0.8 and 0.9

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Reference book

Cane Cogen India
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