BASIC VAPOUR REFRIGERATION CYCLE

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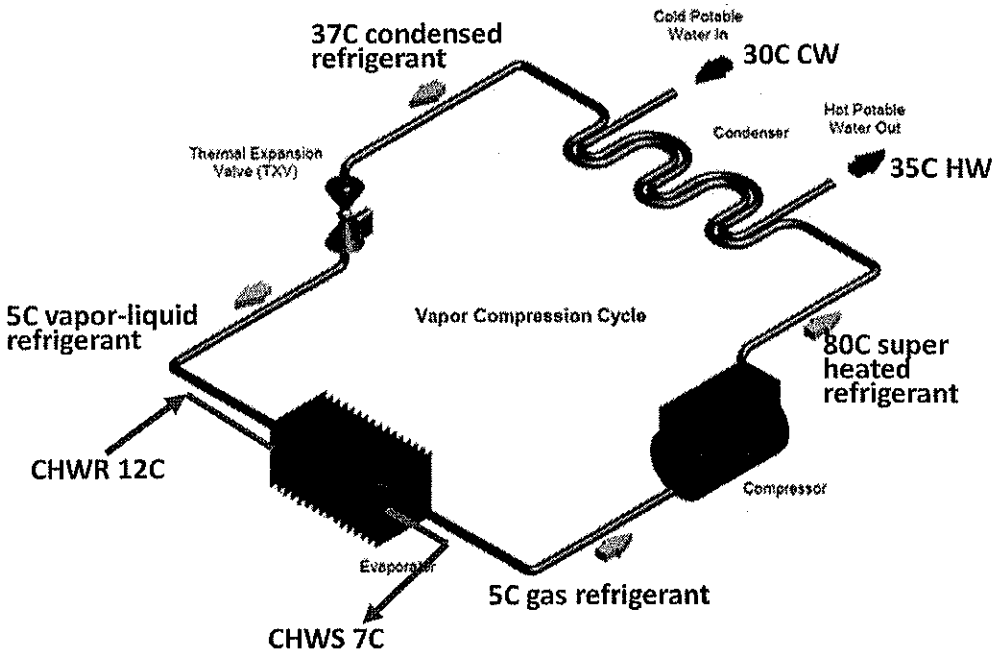
Agenda

1. Vapour Compression Cycle
2. Pressure – Enthalpy Chart
3. Refrigeration Cycle And Efficiency
4. Improving Coeficient Of Performance
5. Exercise

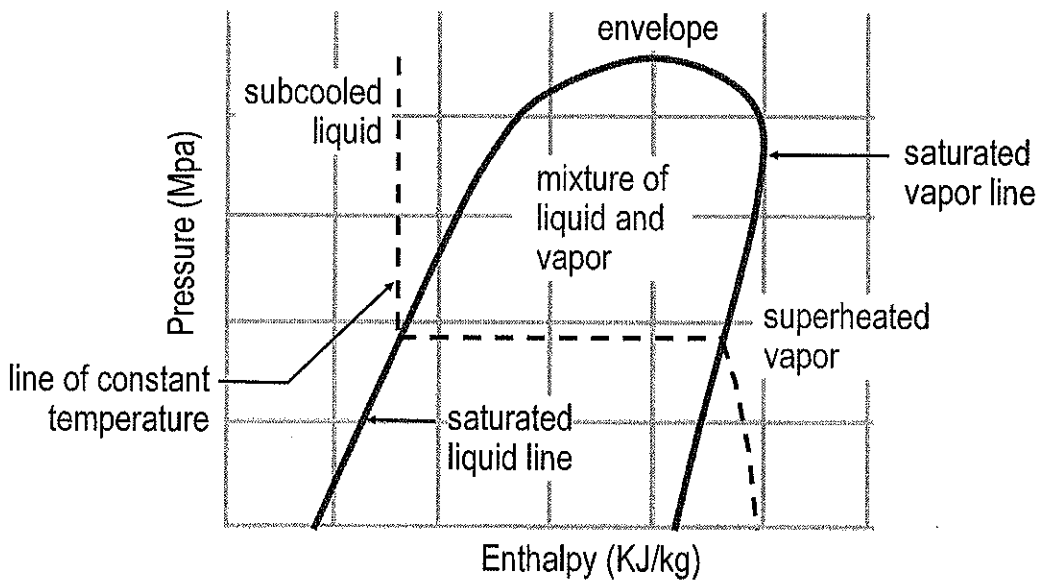
VAPOUR COMPRESSION CYCLE

Vapour Compression Cycle

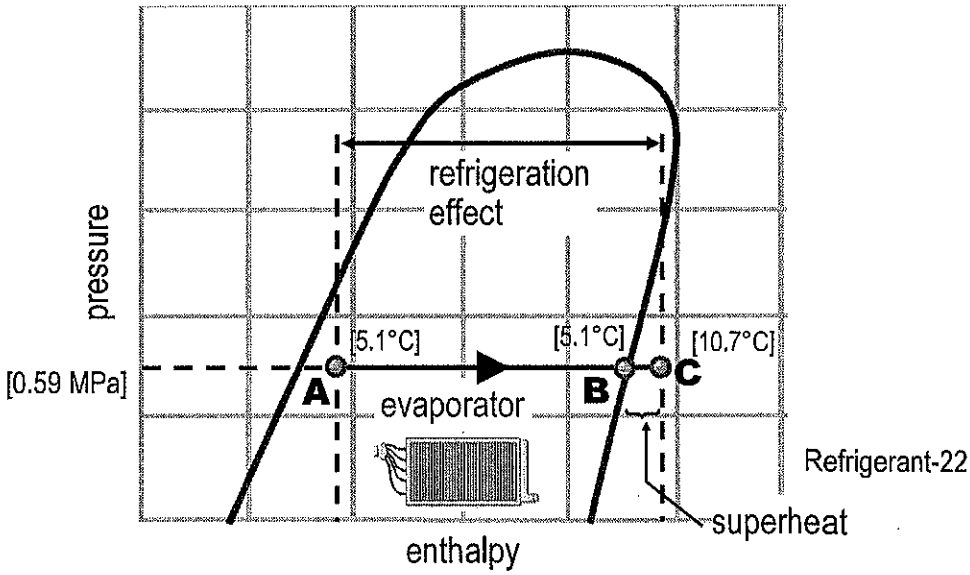


PRESSURE – ENTHALPY CHART

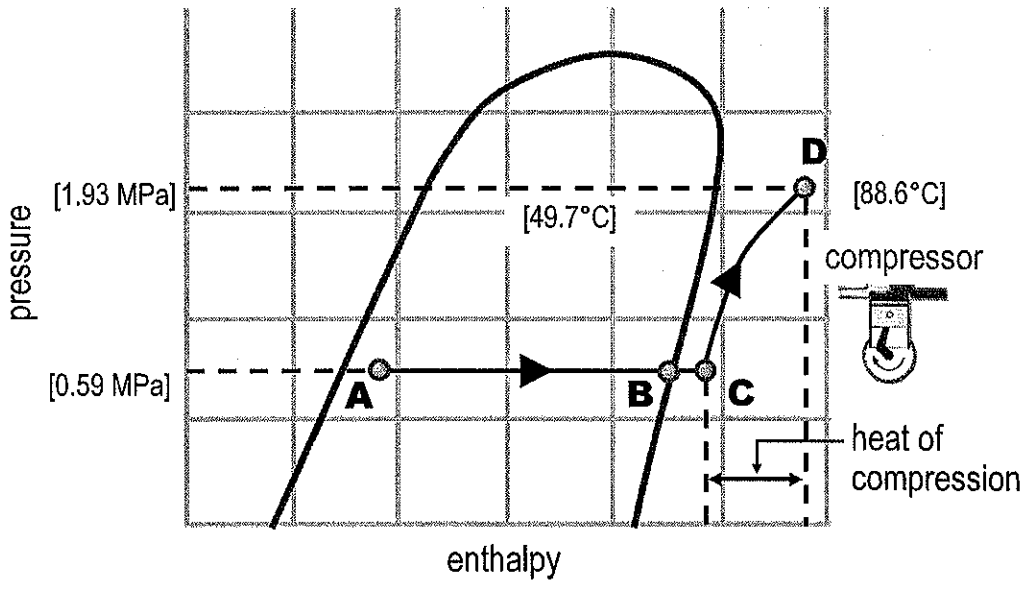
Pressure - Enthalpy (PH) Chart for R22



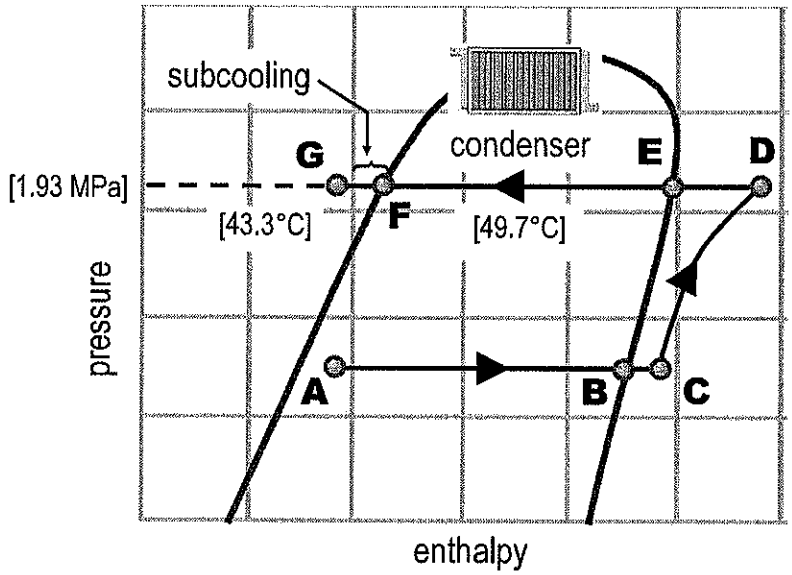
Evaporator



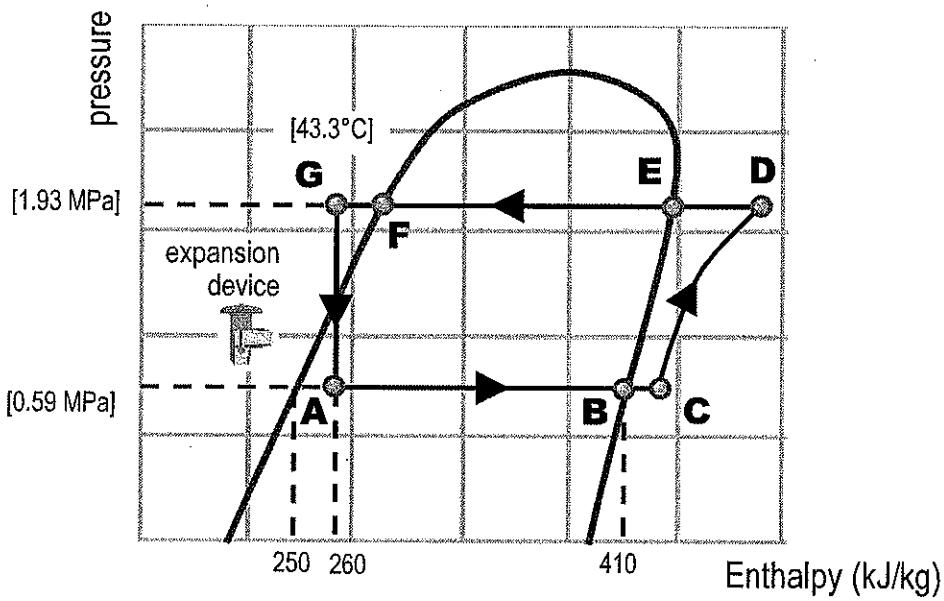
Compressor



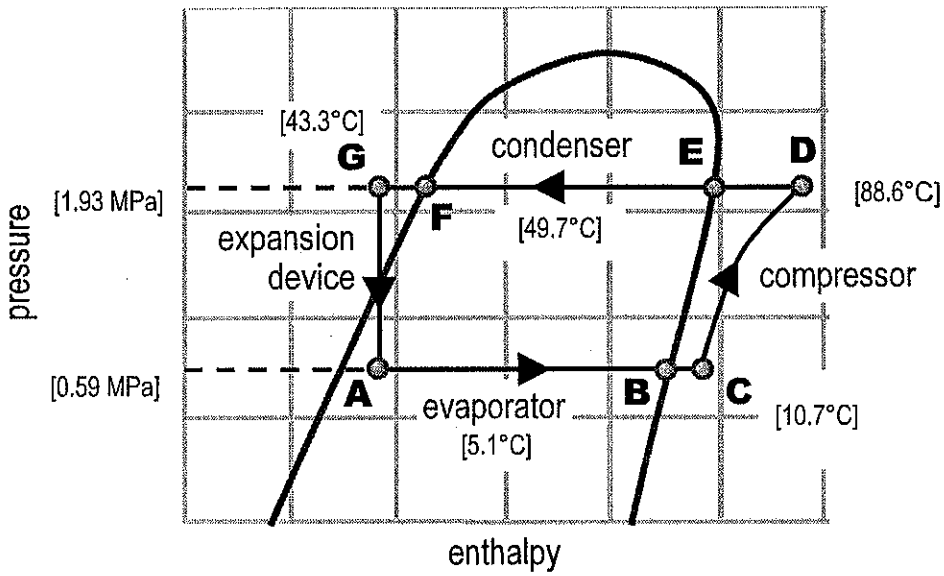
Condenser



Expansion Device



Refrigeration Cycle



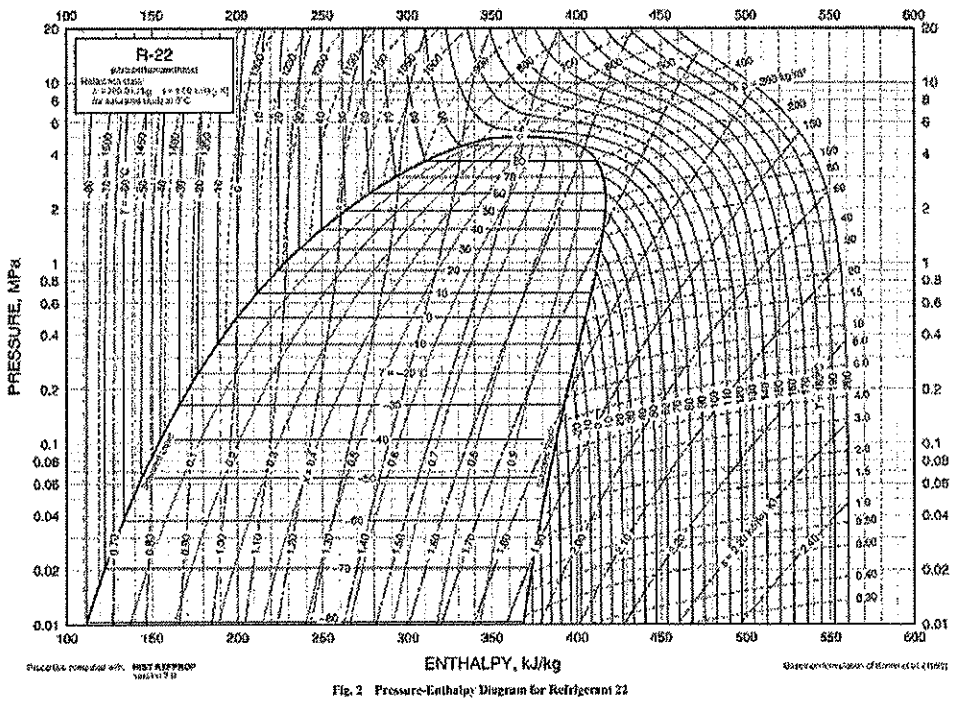
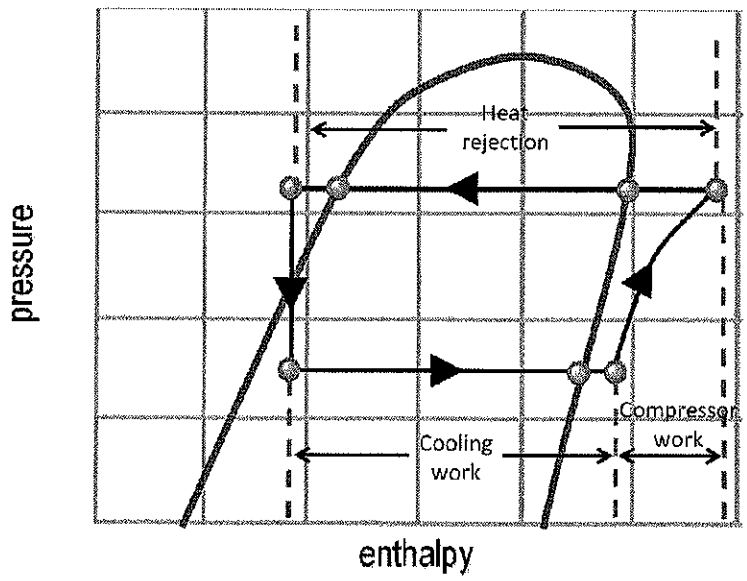


Fig. 2 Pressure-Enthalpy Diagram for Refrigerant 22

2009 ASHRAE Handbook—Fundamentals (SI)

REFRIGERATION CYCLE AND EFFICIENCY

Refrigeration Cycle & Efficiency



Refrigeration Cycle & Efficiency

$$\text{Cooling COP} = \frac{\text{Cooling work (KW)}}{\text{Power input (KW)}}$$

$$\text{Heating COP} = \frac{\text{Heat rejection (KW)}}{\text{Power input (KW)}}$$

$$= \frac{\text{Cooling work(KW) + Power input (KW)}}{\text{Power input (KW)}}$$

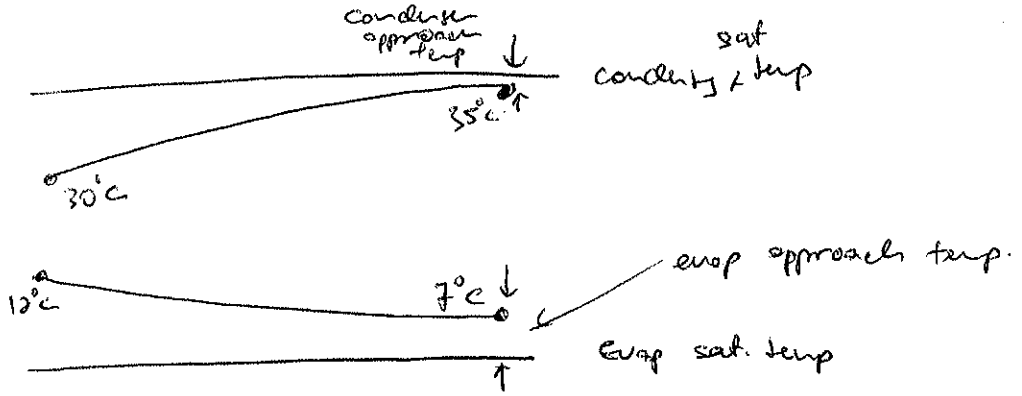
$$= \text{Cooling COP} + 1$$

$$\text{Integrated COP} = \text{Cooling COP + Heating COP}$$

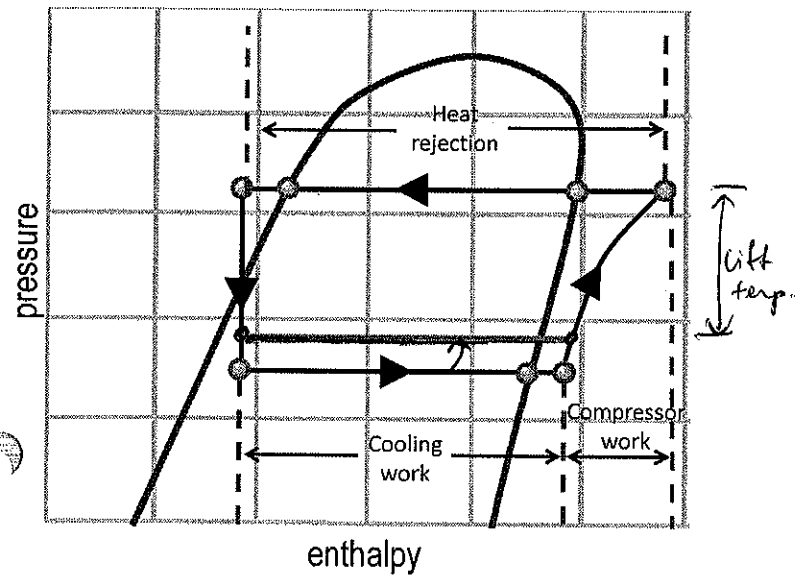
$$= 2 \times \text{Cooling COP} + 1$$

Assumes that all heat rejection is recovered for HW heating

IMPROVING COEFICIENT OF PERFORMANCE



Improving Cooling COP



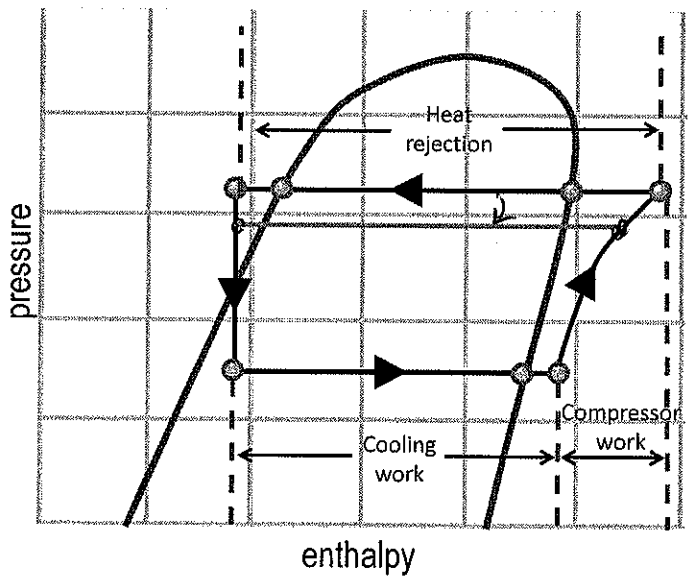
Raise evaporating pressure

Use more efficient evaporator HX which has lower approach temperature

→ subject to fouling (air or cw)

① Raise evaporator air or water temp set-pt. But trade off is higher air or water flow rate across evaporator.

Improving Cooling COP



Lower condensing pressure

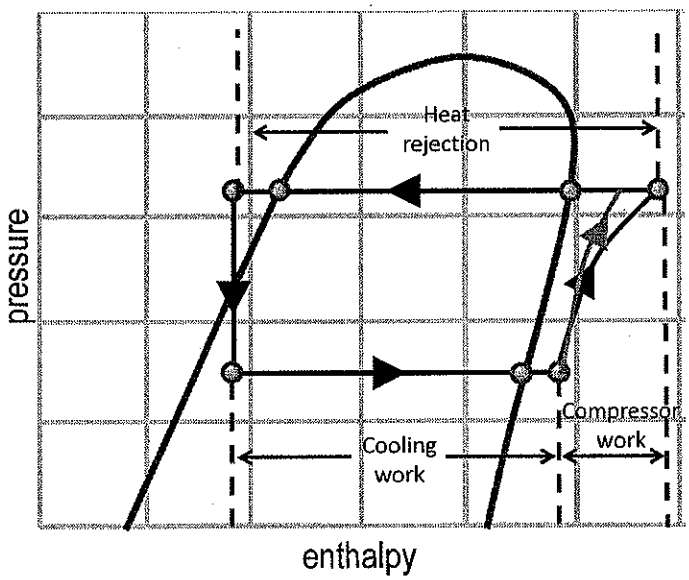
Use more efficient condenser HX which has lower approach temperature

fouling. ↓ affects tube cleaning.

② Lower condenser water supply temperature or increasing condenser water flow rate.

increase tubes in HX.

Improving Cooling COP



Reduce compressor power

Use more energy efficient compressor

EXERCISE

Exercise

1) Plot the R22 refrigeration cycle on the PH diagram.

2) Assuming a R22 flow rate of 1kg/s, calculate the

- Cooling capacity
- Heat rejection
- Compressor power
- Cooling COP
- Heating COP
- Integrated COP

Exercise 1

KW = Mass flow (kg/s) x Delta H (KJ/kg)

THANK YOU

