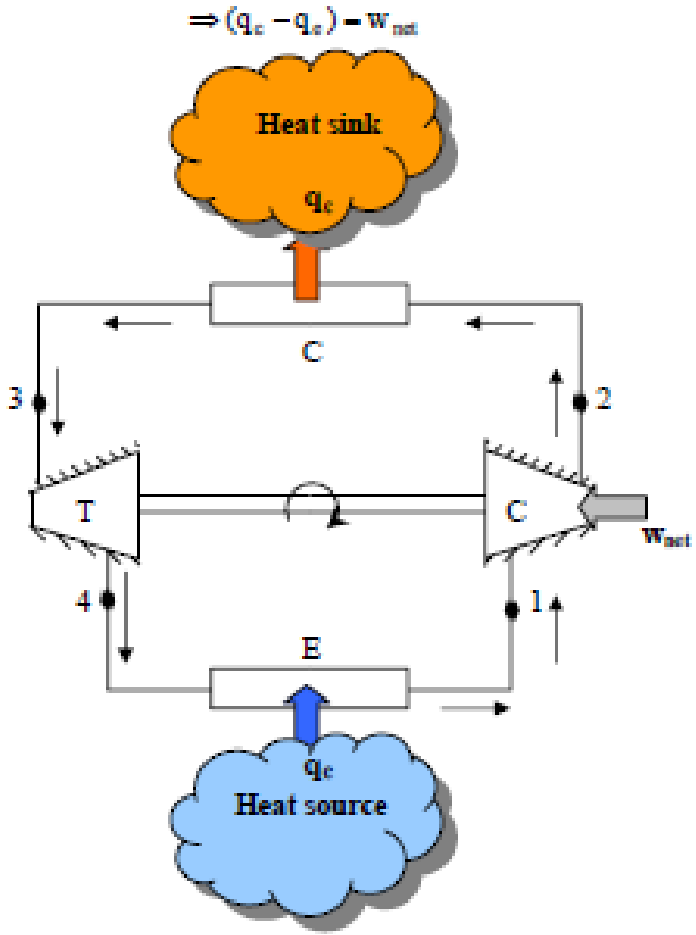
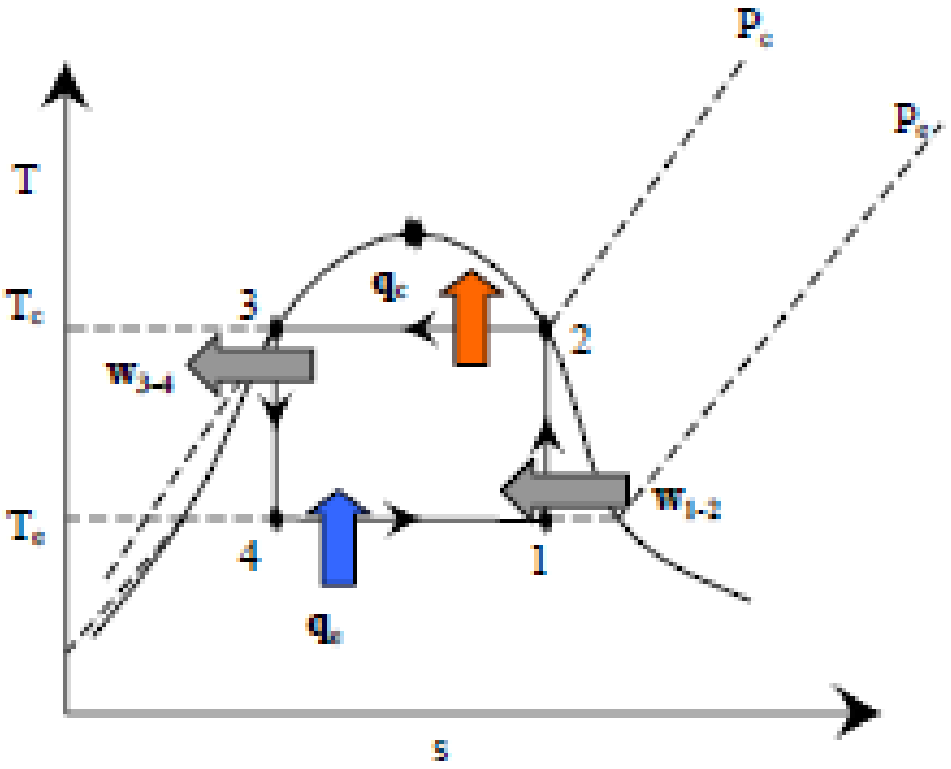
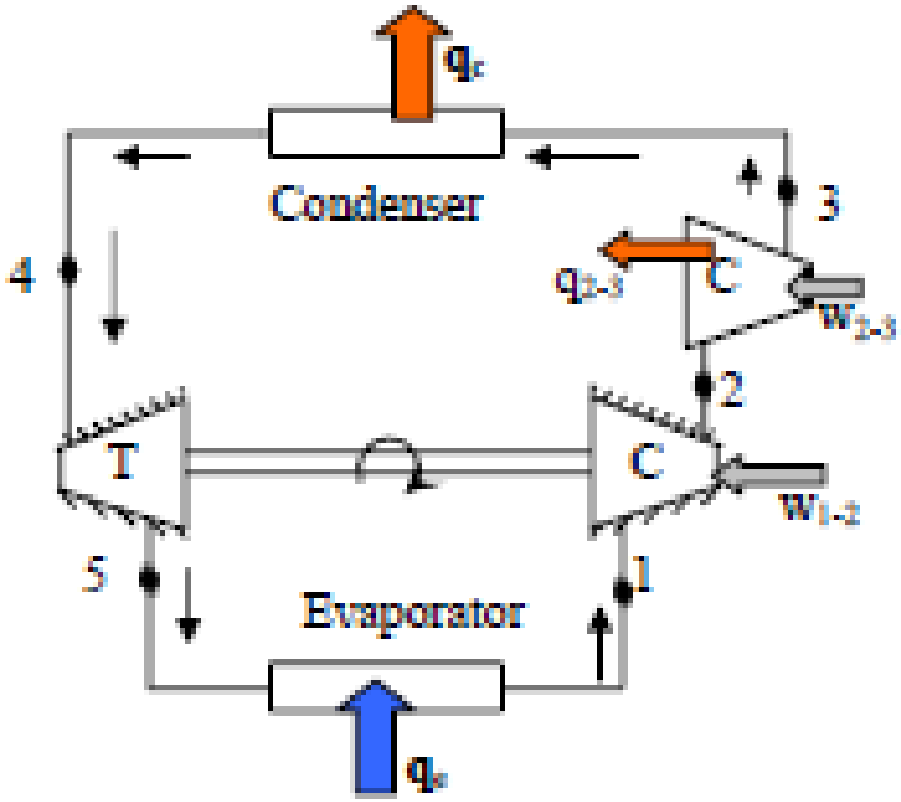
VAPOUR COMPRESSION REFRIGERATION SYSTEMS(VCR)

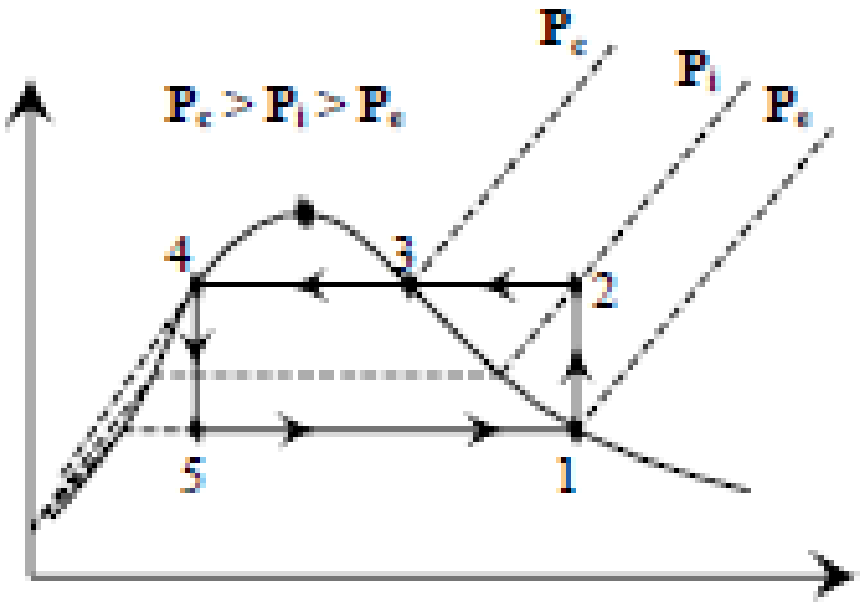
Carnot Refrigeration Cycle



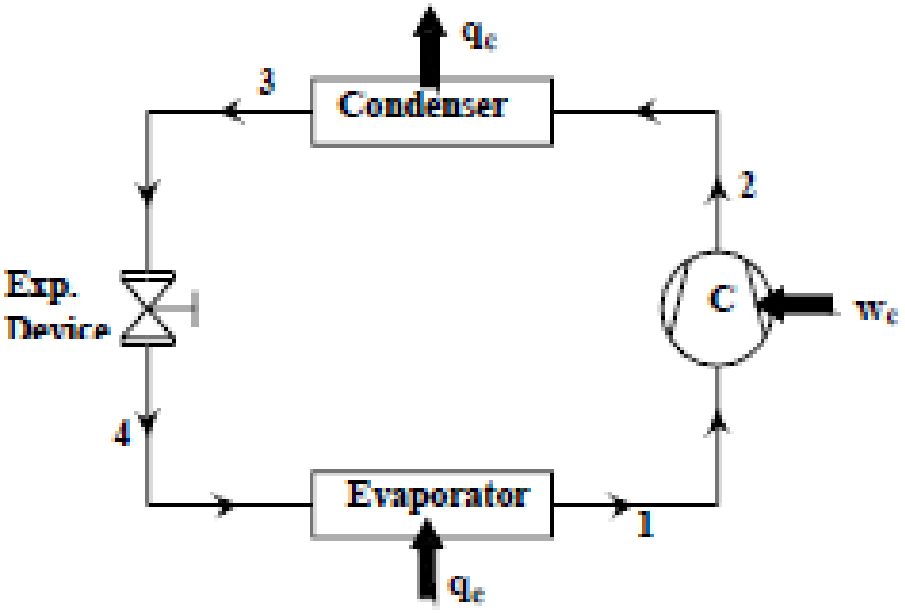


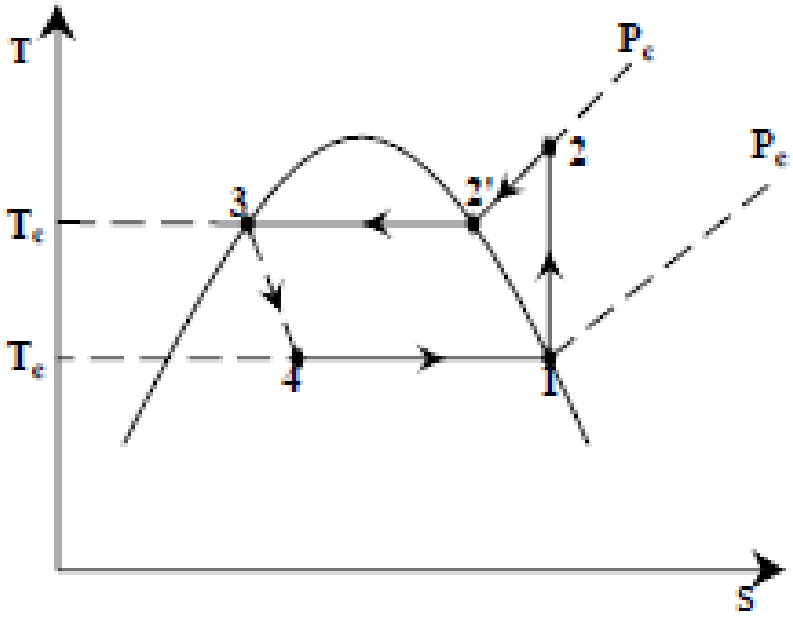
Carnot system with Dry Compression

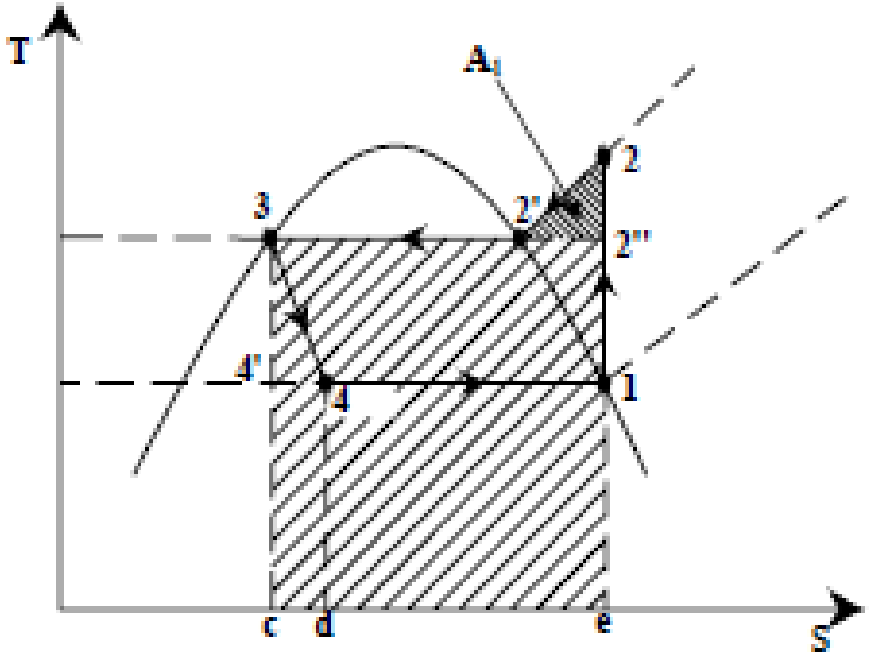


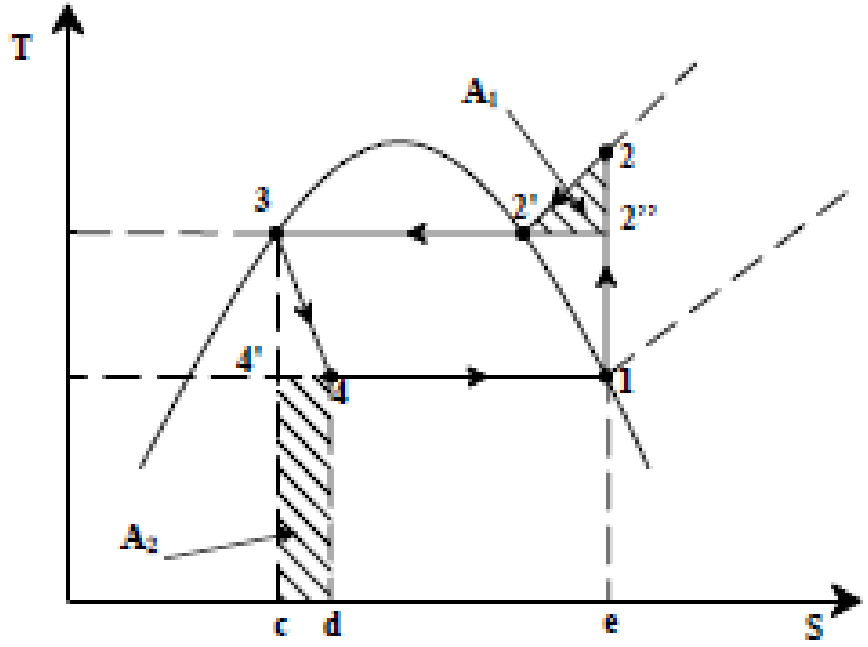


Standard VARS

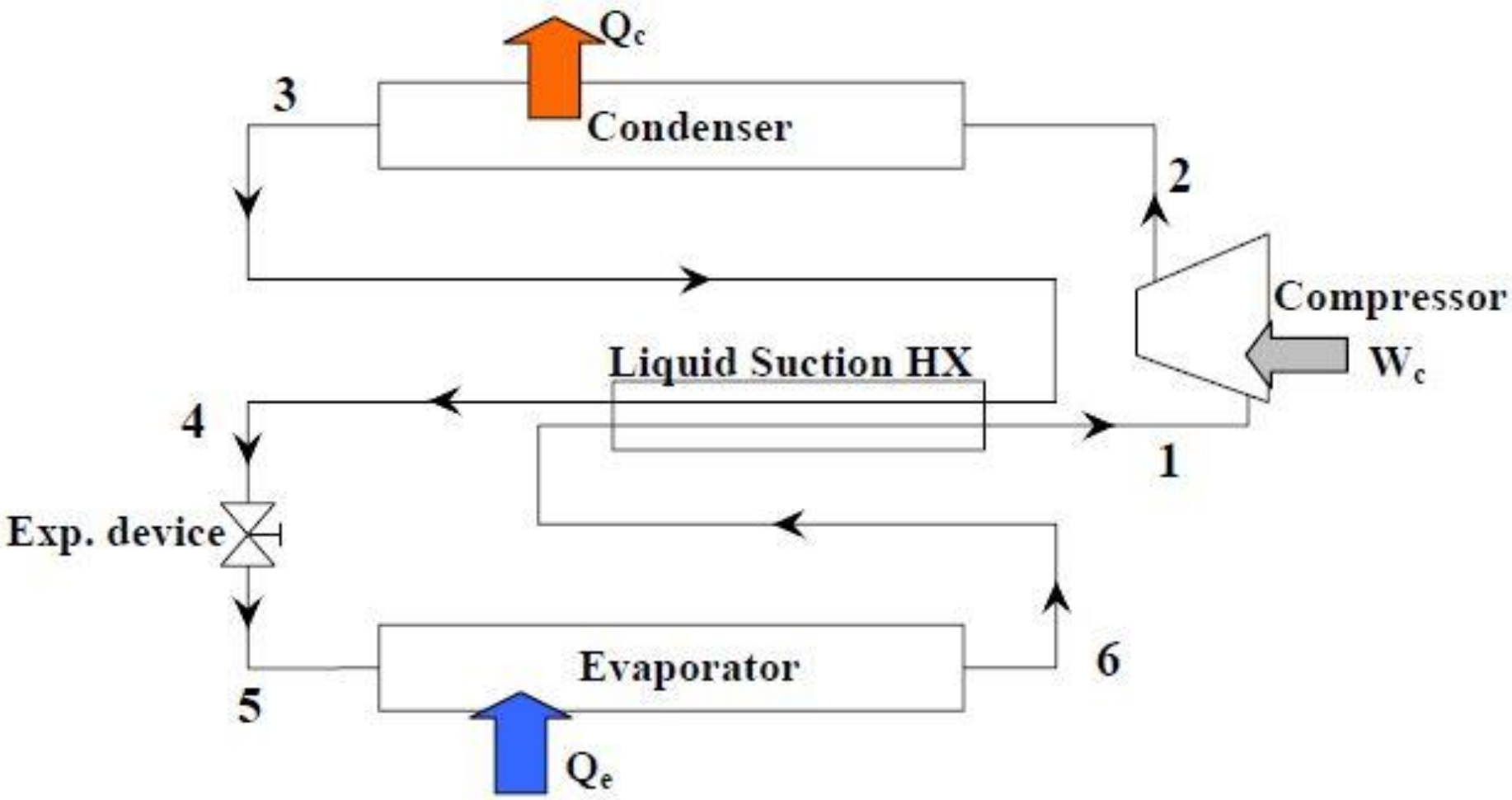


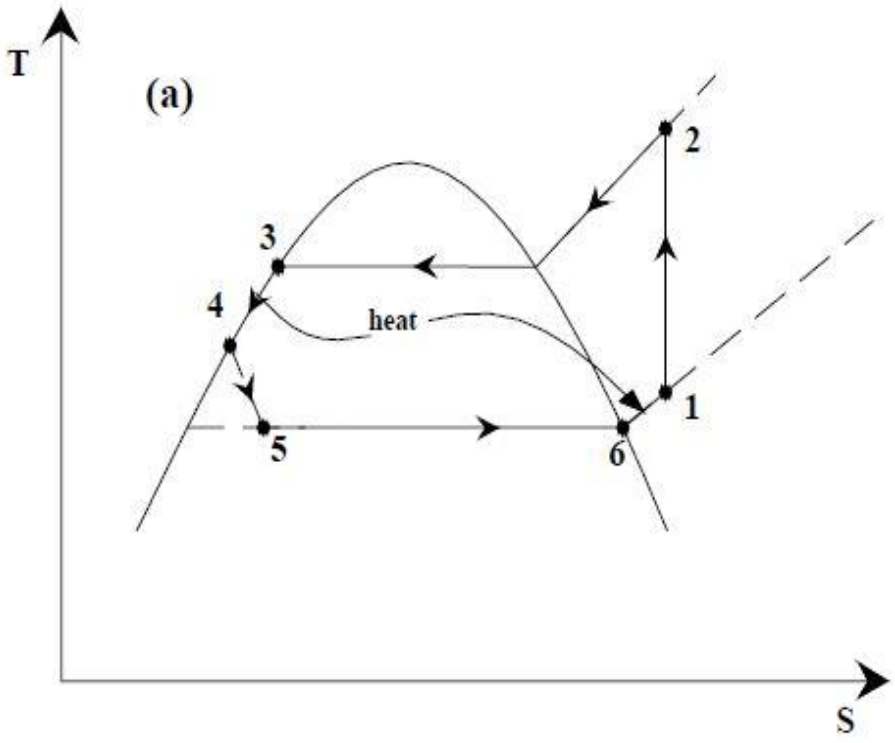


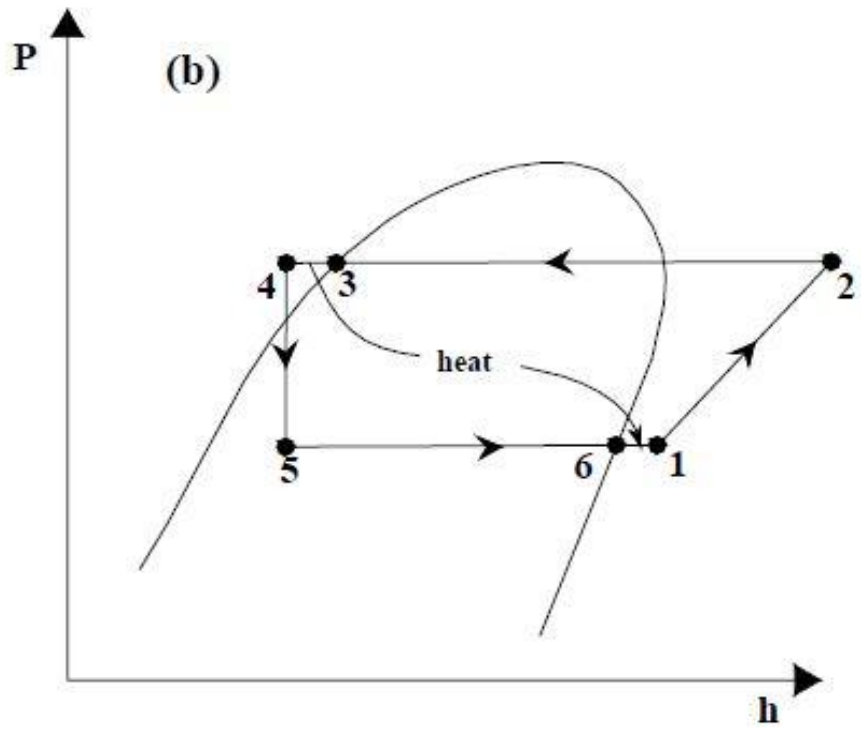

T
A1
2
3
2'
2''
4'
4
1
c
d
e
S


T
A1
2
3
2'
2''
4'
4
1
A2
c
d
e
S

LIQUID SUCTION HEAT EXCHANGER




T
(a)
2
3
4
heat
1
5
6
S


P
(b)
4
3
2
heat
5
6
1
h

$$\dot{Q}_{LSHX} = \dot{m}_r (h_3 - h_4) = \dot{m}_r (h_1 - h_6)$$

$$\Rightarrow (h_3 - h_4) = (h_1 - h_6)$$

$$c_{p,l}(T_3 - T_4) = c_{p,v}(T_1 - T_6)$$

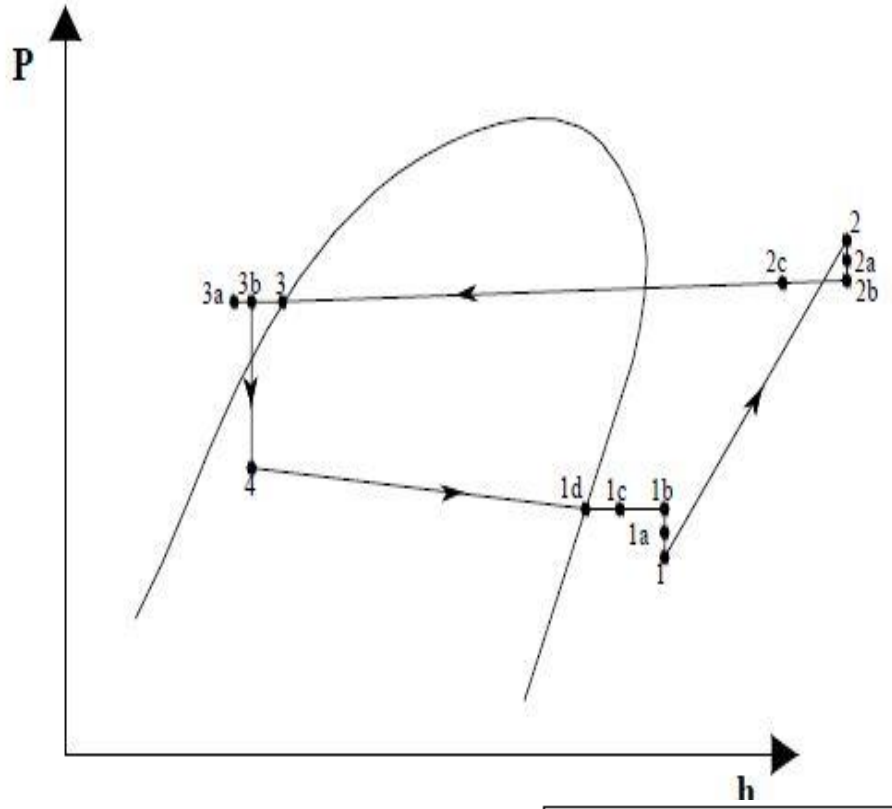
- The degree of subcooling (T_3 - T_4) will always be less than the degree of superheating, (T_1 - T_6)

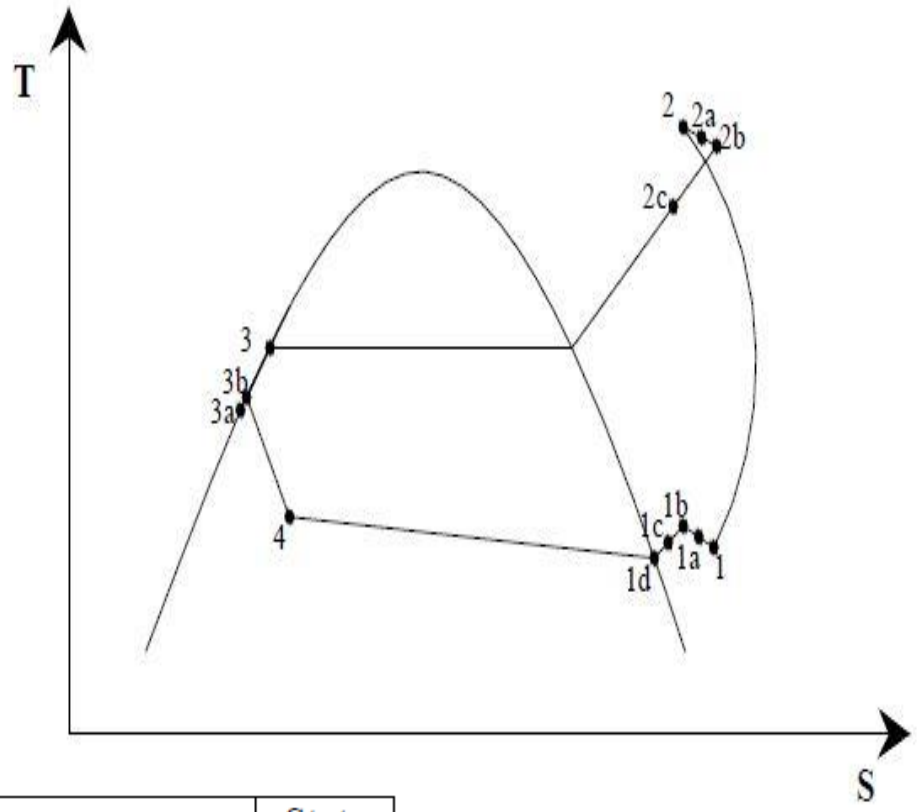
$$\varepsilon_{LSHX} = \frac{Q_{act}}{Q_{max}} = \frac{\dot{m}_r \, c_{p,v}(T_1 - T_6)}{\dot{m}_r \, c_{p,v}(T_3 - T_6)} = \frac{(T_1 - T_6)}{(T_3 - T_6)}$$

ACTUAL VCRS SYSTEMS

In actual VCRS several irreversibilities exist. These are due to:

1. Pressure drops in evaporator, condenser and LSHX
2. Pressure drop across suction and discharge valves of the compressor
3. Heat transfer in compressor
4. Pressure drop and heat transfer in connecting pipe lines





Process	State
Pressure drop in evaporator	4-1d
Superheat of vapour in evaporator	1d-1c
Useless superheat in suction line	1c-1b
Suction line pressure drop	1b-1a
Pressure drop across suction valve	1a-1
Non-isentropic compression	1-2
Pressure drop across discharge valve	2-2a
Pressure drop in the delivery line	2a-2b
Desuperheating of vapour in delivery pipe	2b-2c
Pressure drop in the condenser	2b-3
Subcooling of liquid refrigerant	3-3a
Heat gain in liquid line	3a-3b