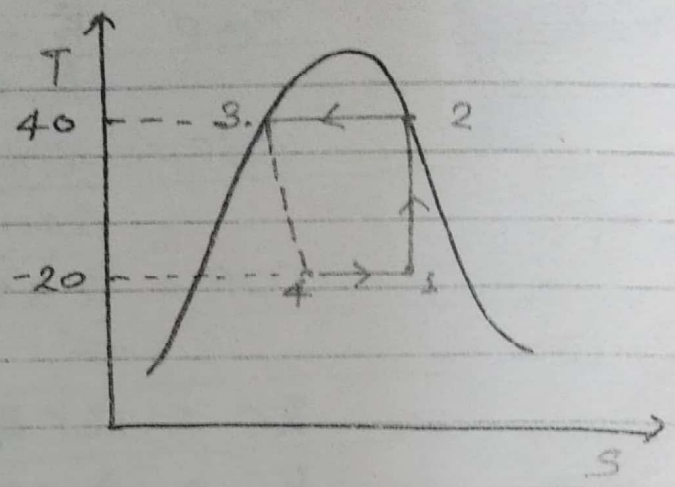
Problm - A refrigerator based on V-C cycle operates blw temp. limits of -20°C & 40°C. The refrigerant enters the condenser as saturated vapour & leaves as saturated liquid. The enthalpy & entropy of saturated liquid & saturated vapour at these temps. are given in the table. If the mass flow rate of refrigerant is .025 kg/sec, find COP & refrigeration capacity in kW.

Soln -

| t(°C) | $h_f$ (kJ/kg) | $h_g$ (kJ/kg) | $S_f$ (kJ/kgk) | $S_g$ (kJ/kgK) |
|---|---|---|---|---|
| -20 | 20 | 180 | 0.07 | 0.7366 |
| 40 | 80 | 200 | 0.3 | 0.67 |

$$COP = \frac{h_1 - h_3}{h_2 - h_1}$$




$h_2 = h_g$ at $40°C$
$= 200\ kJ/kg$

$h_3 = h_f$ at $40°C$
$= 80\ kJ/kg$

$h_1 = h_f + x(h_g - h_f)$ [at $-20°C$]
$= 20 + x(180 - 20)$
$= 20 + 160x$

$S_1 = S_2$ (1-2 → isentropic)

$S_2 = S_g$ at $40°C$
$= 0.67\ kJ/kg-K$

$S_1 = S_f + x(S_g - S_f)$ [at $-20°C$]
$= 0.07 + x(0.7366 - 0.07)$
$= 0.07 + 0.66x$

$S_1 = S_2$
$0.67 = 0.07 + 0.66x$
$0.66x = 0.6$
$x = 0.909$

$h_1 = 20 + 160(0.909)$
$= 165.44\ kJ/kg$
$= 164\ kJ/kg$

$$COP = \frac{h_1 - h_3}{h_2 - h_1}$$

$$COP = \frac{164 - 80}{200 - 164}$$

$$COP = 2.33 \quad \text{Ans.}$$

$$RC = \dot{m}(h_1 - h_3)$$

$$RC = 0.025(164 - 80)$$

$$RC = 2.1\ kW \quad \text{Ans.}$$