6.6 Analysis of Simple Vapor Compression Refrigeration Cycle:

(a) Mass of Refrigerant in Circulation:

Refrigeration effect = $(h_B - h_A)$ kJ/kg of refrigerant

Or, mass of refrigerant in circulation, $m_r = \frac{3.5 * 60}{(h_B - h_A)} \text{ kg/min-ton}$

(b) Piston Displacement:

Let the specific volume of the vapor at B i.e at suction of the compressor be, v_B and let the volumetric efficiency of the compressor be η_{vol}, then piston displacement required per min.

$$\text{Piston displacement} = \frac{v_B \, m_r}{\eta_{vol}} \ (m^3/\text{min-ton})$$

(c) Power Required by Compressor:

(i) If the compression is isentropic, then,

Work of compression = $(h_C - h_B)$ kJ/kg

$$\text{Hence, Power required} = \frac{m_r (h_C - h_B)}{60} \ (\text{kw/ton})$$

(ii) If the compression is polytropic ($Pv^n = C$).

$$\text{Work of compression} = \frac{n}{n-1}(p_C v_C - p_B v_B) \ (\text{N-m/kg})$$

$$\text{Or Power required} = m_r * \frac{n}{n-1} * \frac{(p_C v_C - p_B v_B)}{60 * 1000} \ (\text{kW/ton})$$

(d) Heat Rejected to Cylinder Jacket:

$$Q_{jacket} = m_r \left\{ \frac{n}{n-1}(p_C v_C - p_B v_B) - (h_C - h_B) \right\} \ (\text{kJ/min-ton})$$

(e) Heat Rejected in Condenser:

$$\text{Heat rejected in condenser} = (h_C - h_D) \ (\text{kJ/kg})$$

$$\text{Total heat rejected} = m_r (h_C - h_D) \ (\text{kJ/min-ton})$$