Since the various performance parameters are expressed in terms of enthalpies, it is very convenient to use a pressure – enthalpy chart for property evaluation and performance analysis. The use of these charts was first suggested by Richard Mollier. Figure 10.9 shows the standard vapour compression refrigeration cycle on a P-h chart. As discussed before, in a typical P-h chart, enthalpy is on the x-axis and pressure is on y-axis. The isotherms are almost vertical in the subcooled region, horizontal in the two-phase region (for pure refrigerants) and slightly curved in the superheated region at high pressures, and again become almost vertical at low pressures. A typical P-h chart also shows constant specific volume lines (isochors) and constant entropy lines (isentropes) in the superheated region. Using P-h charts one can easily find various performance parameters from known values of evaporator and condenser pressures.

In addition to the P-h and T-s charts one can also use thermodynamic property tables from solving problems related to various refrigeration cycles.

Questions:

1. A Carnot refrigerator using R12 as working fluid operates between 40ºC and -30ºC. Determine the work of compression and cooling effect produced by the cycle. (Solution)

2. An ideal refrigeration cycle operates with R134a as the working fluid. The temperature of refrigerant in the condenser and evaporator are 40ºC and -20ºC respectively. The mass flow rate of refrigerant is 0.1 kg/s. Determine the cooling capacity and COP of the plant. (Solution)

3. A R-12 plant has to produce 10 tons of refrigeration. The condenser and evaporator temperatures are 40ºC and -10ºC respectively. Determine

a) Refrigerant flow rate
b) Volume flow rate of the compressor
c) Operating pressure ratio
d) Power required to drive the compressor
e) Flash gas percentage after throtting
f) COP (Solution)

4. A NH_3 refrigerator produces 100 tons of ice from water at 0ºC in a day. The cycle operates between 25ºC and -15ºC . The vapor is dry saturated at the end of compression. If the COP is 50% of theoretical COP, calculate the power required to drive the compressor. (Solution)

5. In a refrigerator the power rating impressed on the compressor is 1.2 kW. The circulating wire in evaporator is 5 kW and the cooling water took away 10 kW from condenser coil. The operating temperatures range is 18ºC and 0ºC and their corresponding latent heats are 170 kJ/kg and 230 kJ/kg and the difference between the