HW Ch # 5: Compound vapour compression refrigeration systems

1- A two stage compression ammonia refrigerating system with intercooler working between the pressure limits of 1.55 bar and 14 bar, is used to take a load of 50 TR. The intercooler pressure is 4.92 bar. The ammonia is cooled to 32°C in the water intercooler and subcooled as liquid to 30°C. Find (*a*) the rate of ammonia circulation per minute ; (*b*) power required to drive the compressors ; and (*c*) C.O.P. of the system.

2- The following data refer to a two stage compression ammonia refrigeration system with water intercooler, liquid sub-cooler and a liquid flash chamber :

Condenser pressure	= 14 bar
Evaporator pressure	= 1.55 bar
Intercooler pressure	= 4.92 bar
Temperature of ammonia leaving the intercooler	= 32°C
Temperature of ammonia leaving the sub-cooler	= 30°C
Volumetric efficiency of low pressure compressor	= 85%
Volumetric efficiency of high pressure compressor	= 80%

If the load on the evaporator is 50 TR, find (*a*) rate of ammonia circulation per minute ; (*b*) power required to drive the compressors ; (*c*) piston displacement for both low pressure and high pressure compressors in m³/min; (*d*) diameters of the cylinders for the single acting low pressure and high pressure compressors, when the speed of compressors is 300 r.p.m. and the stroke is equal to the diameter of low pressure cylinder ; and (*e*) C.O.P. of the system.

3- A two stage compression ammonia refrigeration system with water and flash intercooling and water sub-cooling, operates between overall pressure limits of 13.89 bar and 1.9 bar. The flash intercooler pressure is 4.97 bar. The temperature of refrigerant leaving the water intercooler and the water sub-cooler is limited to 30°C. If the load is 10 TR, find : (*a*) coefficient of performance of the system ; (*b*) power required to drive each compressor ; and (*c*) swept volume for each compressor, assuming the volumetric efficiency for both the compressors as 80%.

4- The following data refer to a 10 TR three stage compression system :

Condenser pressure	= 15 bar
Evaporator pressure	= 2.5 bar
Intermediate pressures	= 5 bar and 10 bar

Find the power required to drive the system when it is provided with (*a*) water intercooling ; and (*b*) flash intercooling.

Compare the C.O.P. of the above system with that of simple saturation cycle working between the same overall pressure limits.