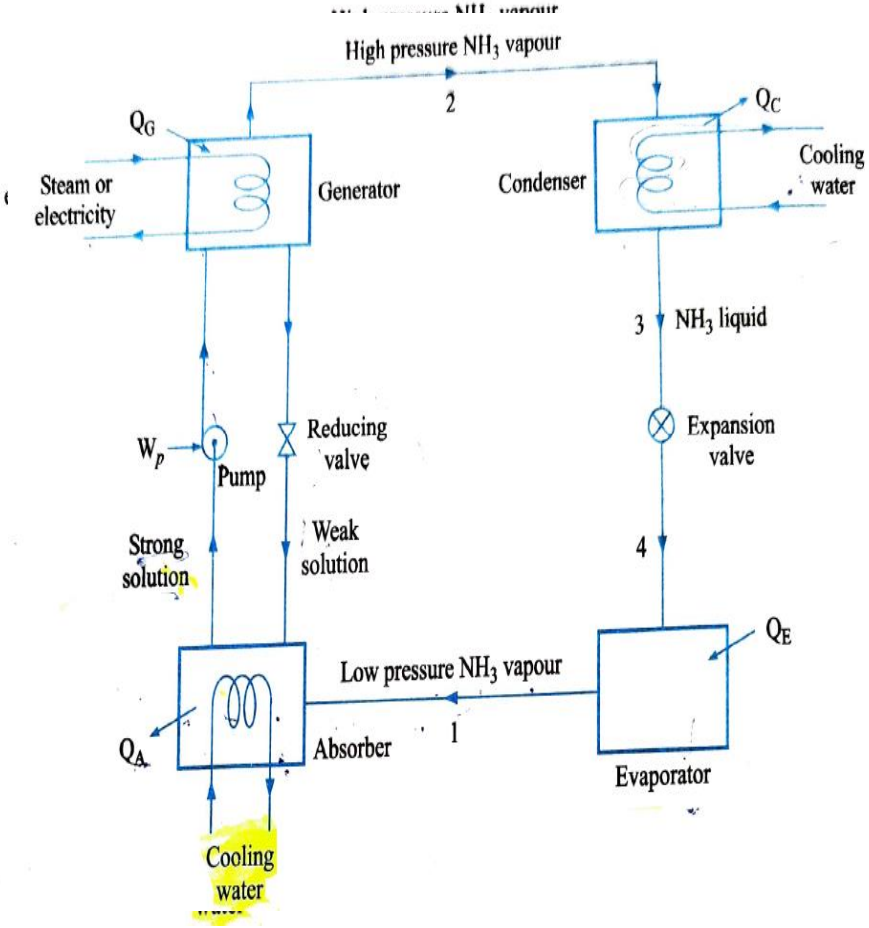
SIMPLE VAPOUR ABSORPTION SYSTEM

VAS



The function of the compressor in the vapour compression system is to continuously withdraw the refrigerant vapour from the evaporator and to raise its pressure and hence temperature, so that the heat absorbed in the evaporator, along with the work of compression, may be rejected in the condenser to the surroundings.

compressor is replaced by absorber, pump and generator

(i) Absorber: Absorption of the refrigerant vapour by its weak or poor solution in a suitable absorbent forming a strong or rich solution of the refrigerant in the absorbent
(ii) Pump: Pumping of the rich solution raising its pressure to the condenser pressure.
(iii) Generator : Distillation of the vapour from the rich solution leaving the poor solution for recycling.

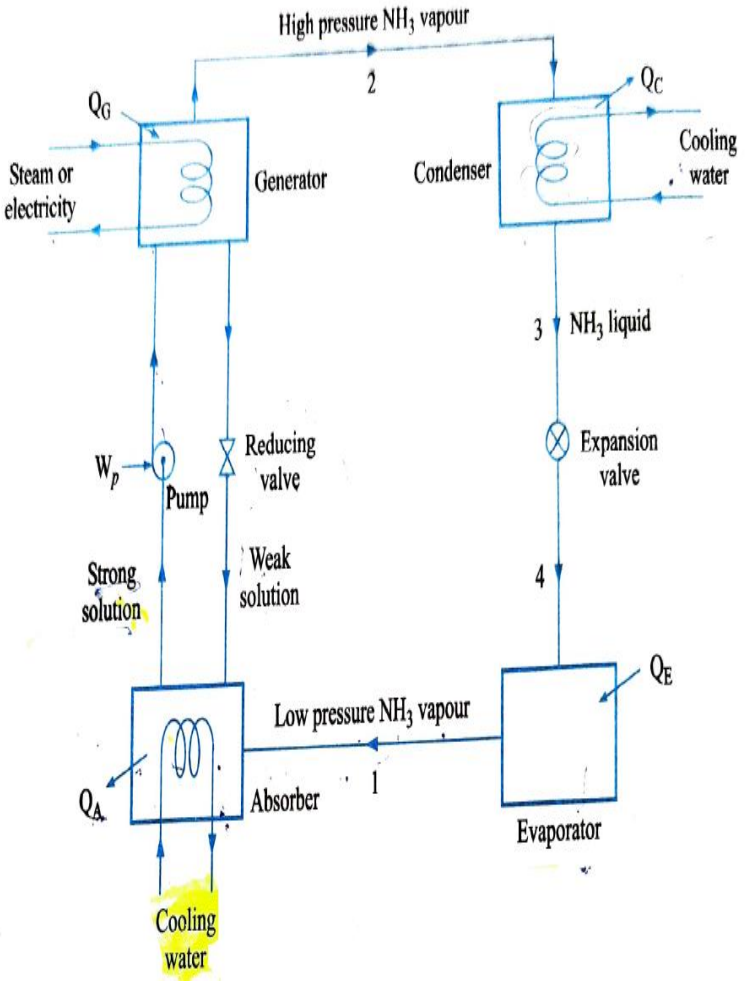
VAS is used where large waste heat is available .

The most popular VAS is $NH_3 - H_2O$ AND $LiB - H_2O$
Solar refrigerant are based on VAS
VAS is used where electricity cost is very high

The ammonia vapour leaving the evaporator and absorbed in the low temperature hot solution in the absorber, releasing the latent heat of condensation. The temperature of the solution tends to rise, while the absorber is cooled by the circulating water, absorbing the heat of solution and maintaining a constant temperature.

Strong solution, rich in ammonia, is pumped to the generator where heat is supplied from an external source (steam, electricity, gas flame, etc.) Since the boiling point of ammonia is less than that of water, the ammonia vapour is given off from the aqua-ammonia solution at high pressure, and the weak solution returns to the absorber through a pressure reducing valve.

The high pressure ammonia vapour from the generator is condensed in the condenser to a high pressure liquid ammonia. This liquid ammonia is throttled by the expansion valve, and then evaporates. absorbing the heat of evaporation from the surroundings or brine to be chilled.



$$\text{COP} = \left(\frac{T_G - T_O}{T_G}\right)\left(\frac{T_R}{T_O - T_R}\right)$$

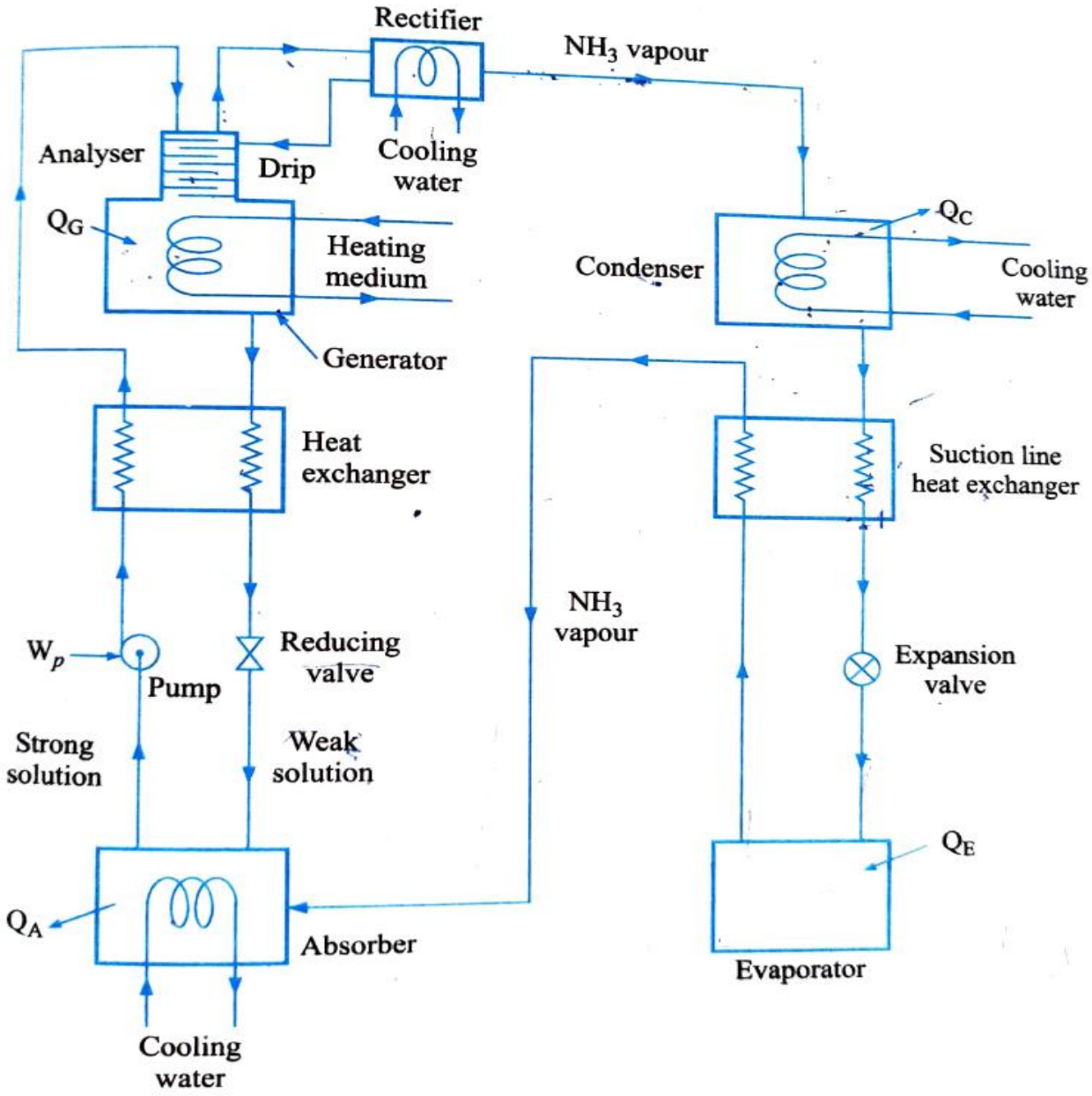
Practical Vapour Absorption System

Improve the Performance and working of the plant following accessories are fitted

1. Heat exchanger.
2. Analyser.
3. Rectifier.

ammonia vapour out of the solution in the generator, it is impossible to avoid

Evaporating the some the water. This water vapour going to the condenser along with the ammonia vapour. After condensation may get frozen to ice and block the expansion valve. So an Analyser – Rectifier are used to eliminate water vapour from the ammonia vapour going into the condenser .


Rectifier
NH_3 vapour
Analyser
Drip
Cooling water
Q_G
Heating medium
Q_C
Condenser
Cooling water
Generator
Heat exchanger
Suction line heat exchanger
NH_3 vapour
W_p
Pump
Reducing valve
Expansion valve
Strong solution
Weak solution
Q_E
Q_A
Absorber
Evaporator
Cooling water

1. Heat exchanger. A heat exchanger is located between the generator and the absorber. The strong solution which is pumped from the absorber to the generator must be heated ; and the weak solution from the generator to the absorber must be cooled. This is accomplished by a heat exchanger and consequently cost of heating the generator and cost of cooling the absorber are reduced.

2. Analyser. The analyser (integral part of the generator or made as a separate piece of equipment) is a direct heat exchanger consisting of a series of trays mounted above the generator. The strong solution from the absorber flows downward over the trays to cool the outgoing vapours. Since the saturation temperature of water is higher than that of ammonia at a given pressure, it is the water vapour which condenses first. As the vapour passes upward through the analyser, it is cooled and enriched by ammonia, and the liquid is heated. Thus the vapour going to the condenser is lower in temperature and richer in ammonia, and the heat input to the generator is decreased.

3. Rectifier. A rectifier is a water-cooled heat exchanger which condenses water vapour and some ammonia and sends back to the generator. Thus final reduction or elimination of the percentage of water vapour takes place in a rectifier.

The co-efficient of performance (C.O.P.) of this system is given by :

$$\text{C.O.P.} = \frac{\text{Heat extracted from the evaporator}}{\text{Heat supplied in the generator + Work done by the liquid pump}}$$

References

Refrigeration and Air conditioning – CP Arora (TMH)

RK Rajput