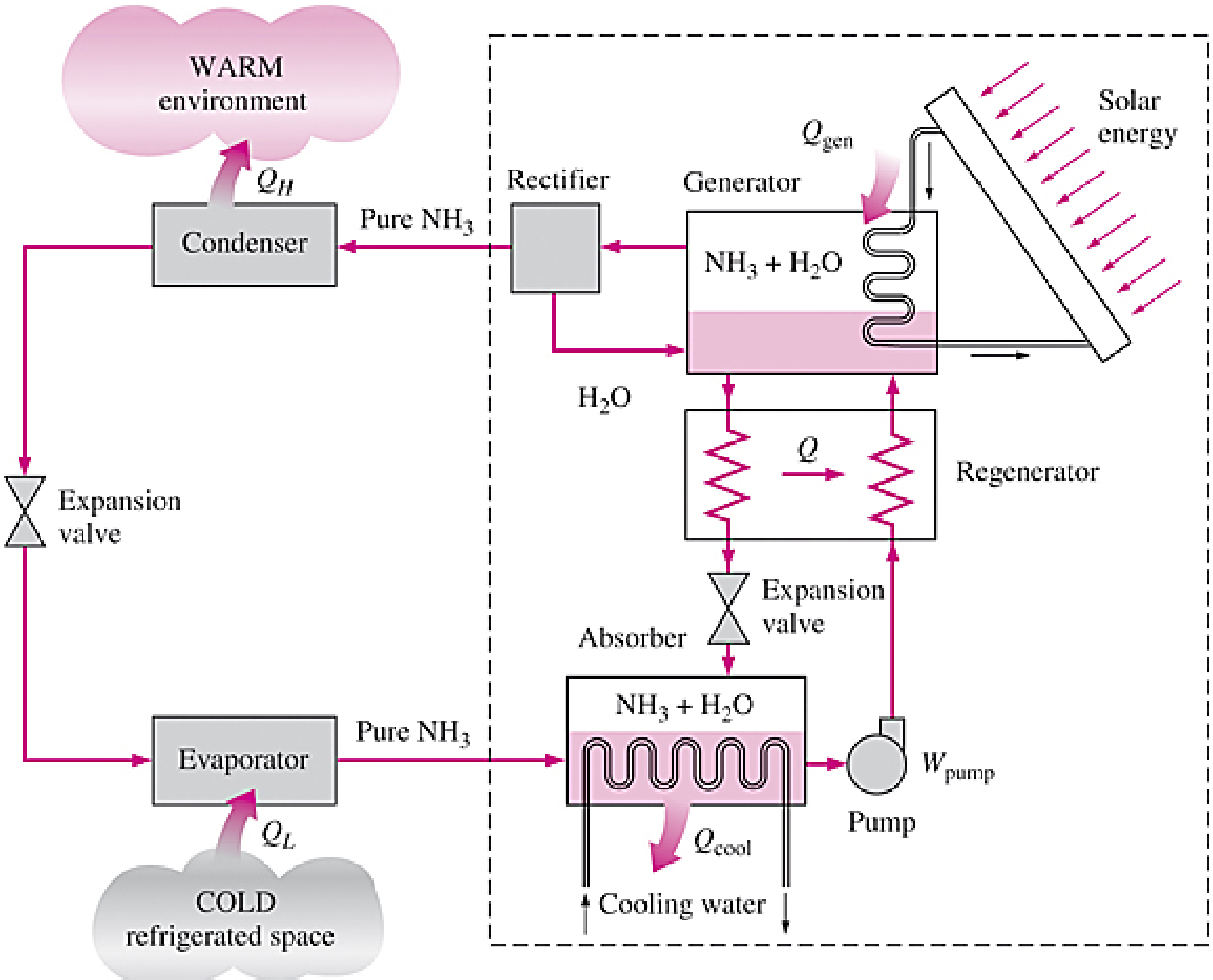
ABSORPTION REFRIGERATION SYSTEMS

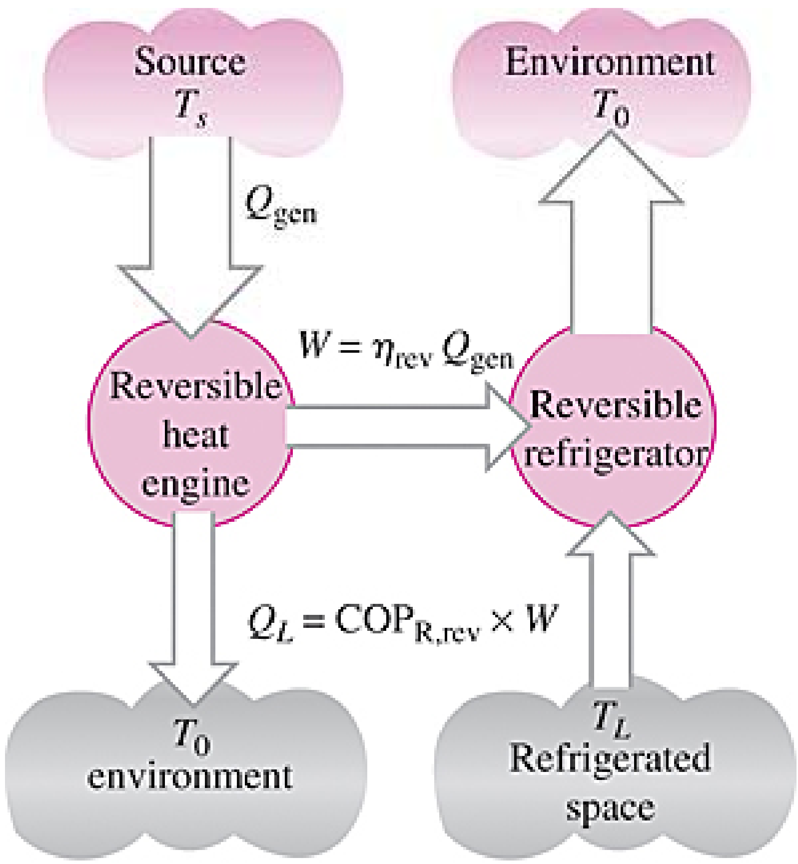


Ammonia absorption refrigeration cycle.

When there is a source of inexpensive thermal energy at a temperature of 100 to 200°C is **absorption refrigeration**.

Some examples include geothermal energy, solar energy, and waste heat from cogeneration or process steam plants, and even natural gas when it is at a relatively low price.

- Absorption refrigeration systems (ARS) involve the absorption of a *refrigerant* by a *transport medium*.
- The most widely used system is the ammonia–water system, where ammonia (NH_3) serves as the refrigerant and water (H_2O) as the transport medium.
- Other systems include water–lithium bromide and water–lithium chloride systems, where water serves as the refrigerant. These systems are limited to applications such as A-C where the minimum temperature is above the freezing point of water.
- Compared with vapor-compression systems, ARS have one major advantage: A liquid is compressed instead of a vapor and as a result the work input is very small (on the order of one percent of the heat supplied to the generator) and often neglected in the cycle analysis.
- ARS are often classified as ***heat-driven systems***.
- ARS are much more expensive than the vapor-compression refrigeration systems. They are more complex and occupy more space, they are much less efficient thus requiring much larger cooling towers to reject the waste heat, and they are more difficult to service since they are less common.
- Therefore, ARS should be considered only when the unit cost of thermal energy is low and is projected to remain low relative to electricity.
- ARS are primarily used in large commercial and industrial installations.



$$W = \eta_{rev} Q_{gen} = \left(1 - \frac{T_0}{T_s}\right) Q_{gen}$$

$$Q_L = COP_{R,rev} W = \left(\frac{T_L}{T_0 - T_L}\right) W$$

$$COP_{rev,absorption} = \frac{Q_L}{Q_{gen}} = \left(1 - \frac{T_0}{T_s}\right)\left(\frac{T_L}{T_0 - T_L}\right)$$

$$COP_{absorption} = \frac{\text{Desired output}}{\text{Required input}} = \frac{Q_L}{Q_{gen} + W_{pump,in}} \cong \frac{Q_L}{Q_{gen}}$$

The COP of actual absorption refrigeration systems is usually less than 1.

Air-conditioning systems based on absorption refrigeration, called ***absorption chillers***, perform best when the heat source can supply heat at a high temperature with little temperature drop.

Determining the maximum COP of an absorption refrigeration system.