

**Course Title: Industrial Chemistry**  
**Course Code: CHEM-461**

**UNIT OPERATIONS**  
**(EVAPORATION)**

# Evaporation

- **Evaporation** is a unit operation that consists of the elimination of water of a fluid food by means of vaporization or boiling.
- Evaporation is the removal of solvent as a vapor from a solution or slurry
- Evaporation is used for concentration of aqueous solutions, it involves removal of water from solution by boiling the liquor in suitable vessel called evaporator and withdrawing the vapor

# Evaporator

- The equipment used to remove water from the food product is called evaporator
- Evaporators are used to separate materials based on differences in their boiling temperatures.
- Its purpose is to concentrate nonvolatile solutes such as organic compounds, inorganic salts, acids or bases. Typical solutes include phosphoric acid, caustic soda, sodium chloride, sodium sulfate, gelatin, syrups and urea.

# Why we need evaporation

Reduces transportation cost

- Storage costs
- Prepare for the next Unit operation – drying, crystallisation etc.
- Reduces deteriorative chemical reactions
- Better microbiological stability
- Recovery of solvent

# Driving force & Result

- **Driving force:** temperature difference in between steam chest temperature and product temperature
- **Result:** volatile solvent is removed from the feed
- **Solution**(high volatile solvent+non volatile solute)
- **Concentrate**(non volatile solute)

# Examples

- Concentration of milk to produce condensed milk
- Concentration of juices
- Concentration of NaOH , NaCl from aqueous solutions to produce salt.
- Ether recovery from fat extraction

# Principles

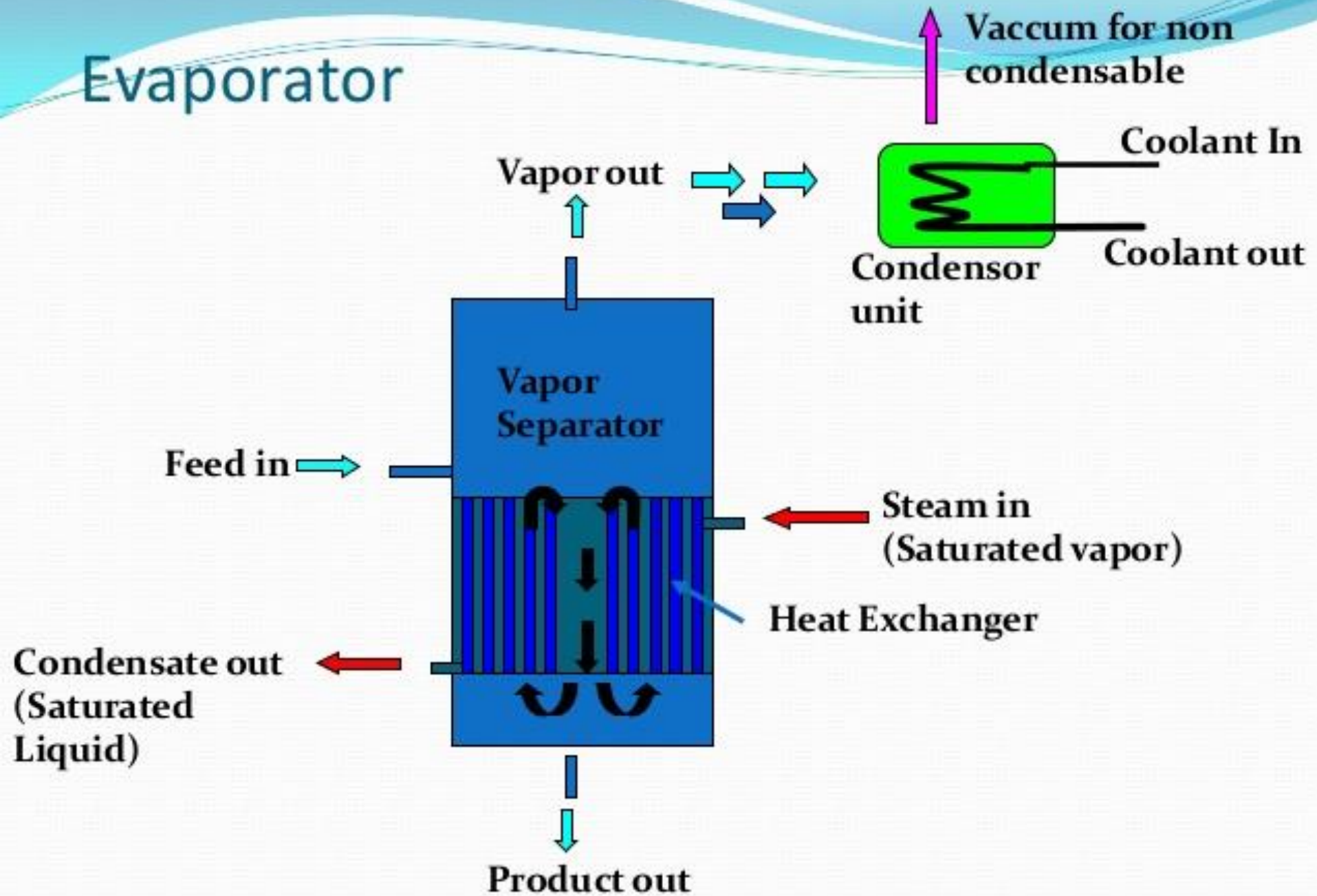
- Steam heat is used for transfer of heat for subsequent vessels. Steam has a very high heat content Heat is given up at constant temperature.
- It can be used at high pressure to generate electric power and low-pressure exhaust steam is used for process heating.
- Evaporation is a process of vaporizing large quantities of volatile liquid to get a concentrated product.
- Evaporation is a surface phenomenon, i.e., mass transfer takes place from the surface.

# Basic Parts of an Evaporator

- Heat-exchanger
- Vacuum
- Vapour separator
- Condenser



# Evaporator



# Evaporator

- An evaporator is used to evaporate a volatile solvent, usually water, from a solution. Its purpose is to concentrate non-volatile solutes such as organic compounds, inorganic salts, acids or bases. Typical solutes include phosphoric acid, caustic soda, sodium chloride, sodium sulphate, gelatine, syrups and urea.
- In many applications, evaporation results in the precipitation of solutes in the form of crystals, which are usually separated from the solution with cyclones, settlers, wash columns, elutriating legs, filters or centrifuges. Examples of precipitates are sodium chloride, sodium sulfate, sodium carbonate and calcium sulphate. The desired product can be the concentrated solution, the precipitated solids, or both.

