Heat Exchanger

E- Course on Heat Transfer

3151909

Heat Exchanger

- A Heat Exchanger may be defined as an equipment which transfer the energy from hot fluid to cold fluid, with maximum rate and minimum investment and running costs.
- Example of Heat Exchanger
  - Inter cooler
  - Condenser
  - Boiler
  - Oil cooler
  - Milk chiller
  - Automobile radiator

Classification of Heat Exchanger

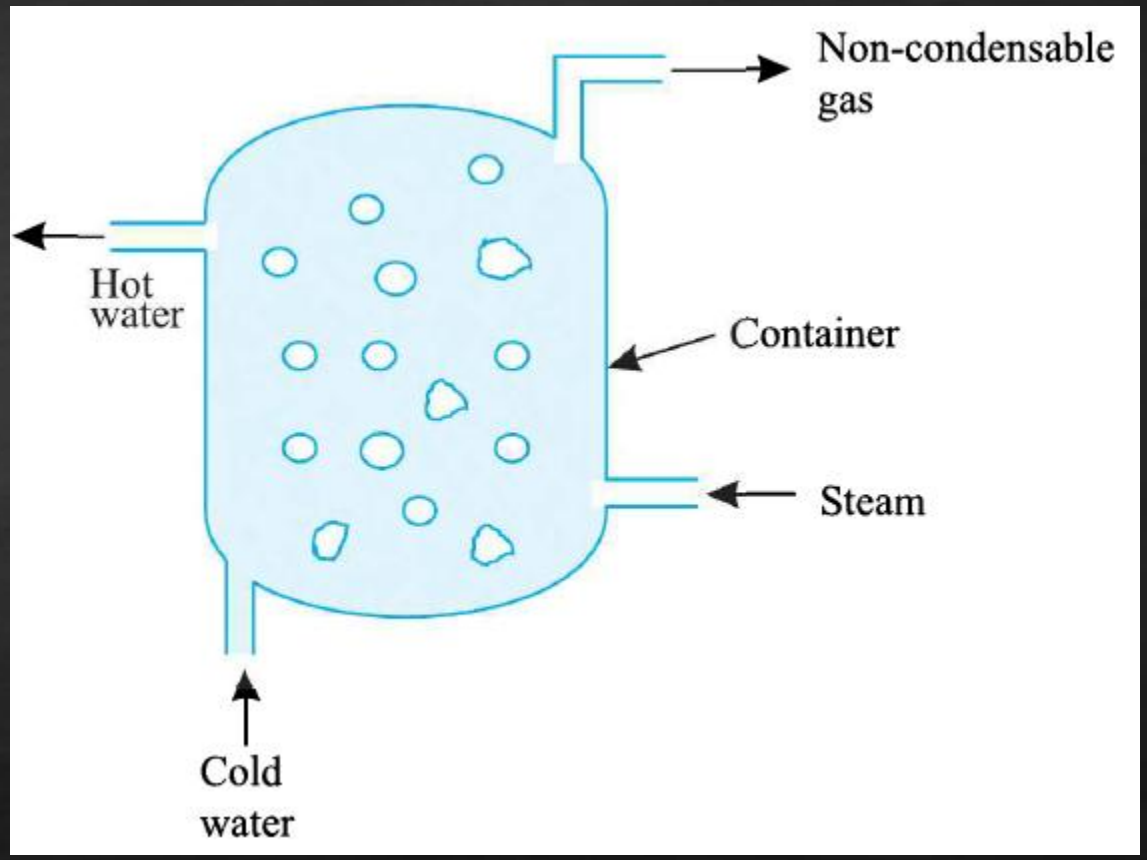
- In order to meet the widely varying applications, several types of heat exchanger have been developed which are classified based on the following criteria
  - Nature of heat exchange process
  - Relative direction of fluid motion
  - Design and construction features
  - Physical state of fluids

1. Nature of Heat Exchange process

1. Direct Contact type (open) heat exchanger
2. Indirect Contact type heat exchanger
   - Regenerator
   - Recuperators

Direct Contact type Heat Exchanger

- In direct contact type of heat exchanger the exchange of heat takes place by direct mixing of hot and cold fluid and transfer of heat takes place
- Ex.
  - Cooling Tower
  - Jet Condenser



2. Indirect contact type of heat exchanger

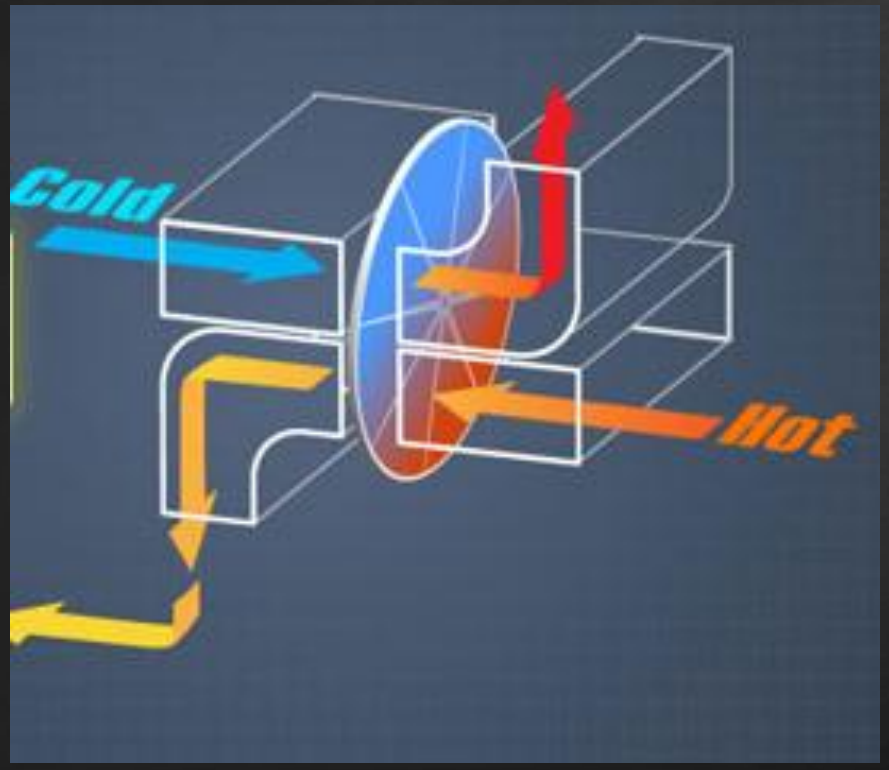
- In this type of heat exchanger, the heat transfer between two fluid take place through wall which separate the two fluid

- Regenerator: in a Regenerator type of heat exchanger the hot and cold fluid pass alternately through space containing solid particle (Matrix)
- Ex. I.C. Engine, Gas Turbine

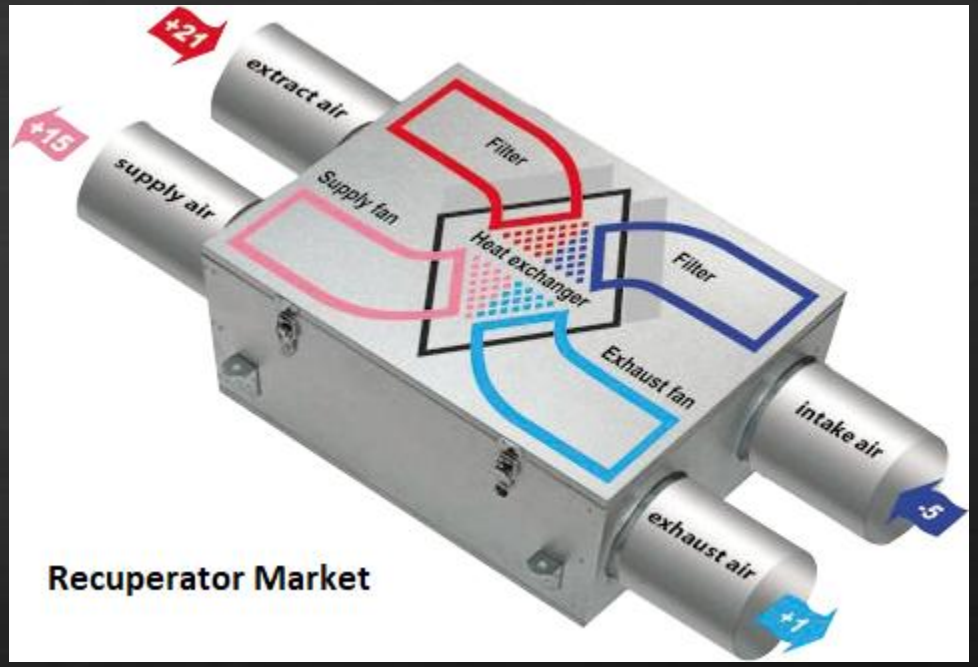
- Recuperators: Recuperators are the most important type of heat exchanger in which the fluid exchanging heat are on either side of dividing wall.
- Ex. Automobile Radiator, oil cooler

Layout of indirect contact type heat exchanger

- Regenerator



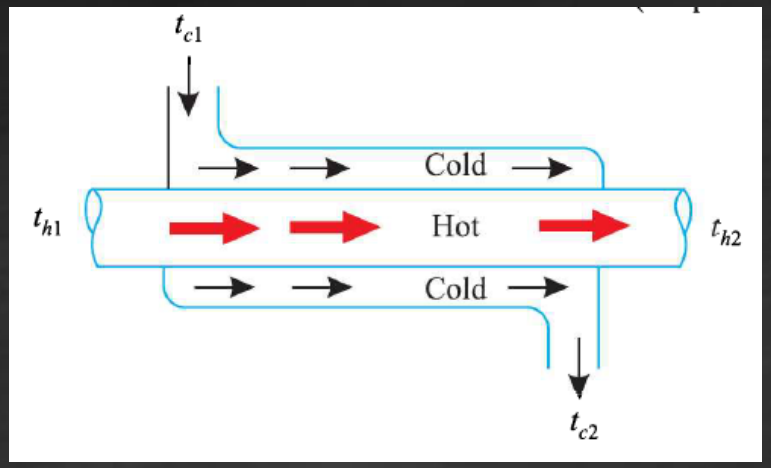
- Recuperator



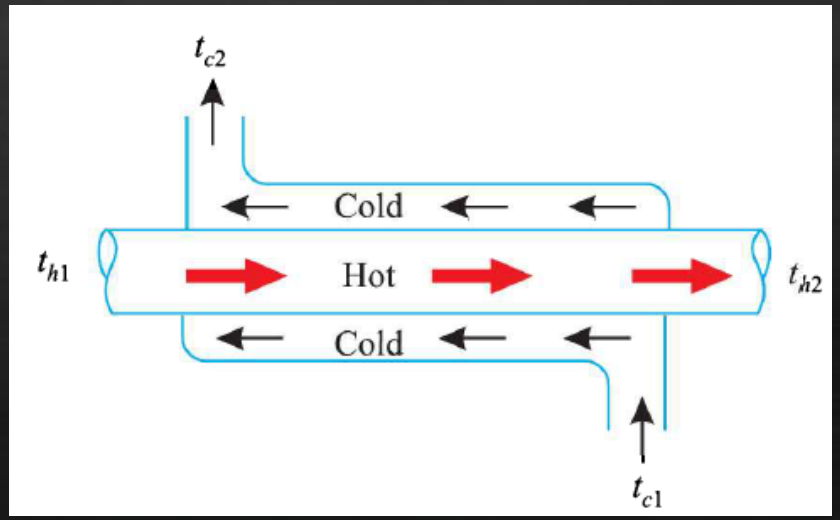
2. Relative Direction of fluid motion

- Parallel flow or indirection flow
- Counter flow
- Cross flow

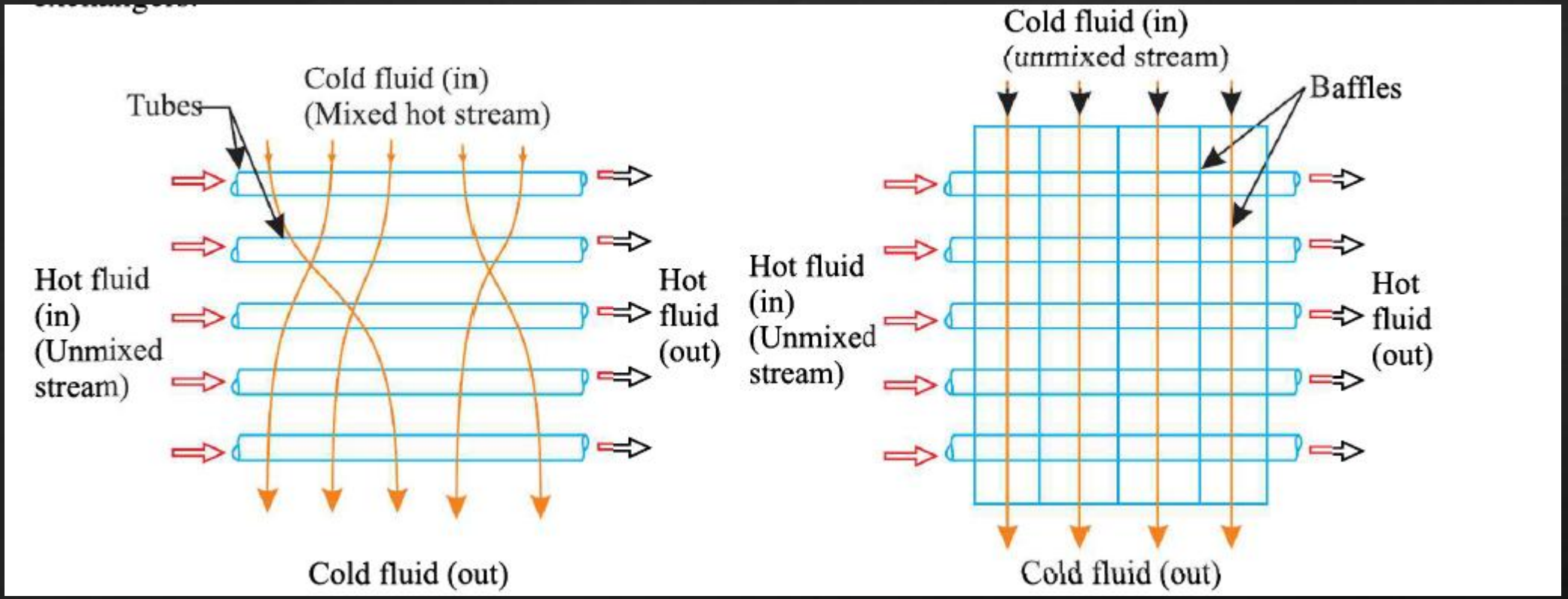
- Parallel flow : in parallel flow heat, the two fluid stream (hot and cold) Travel in the same Direction



- Counter flow : in a counter flow heat exchanger, the two fluid flows in opposite directions.

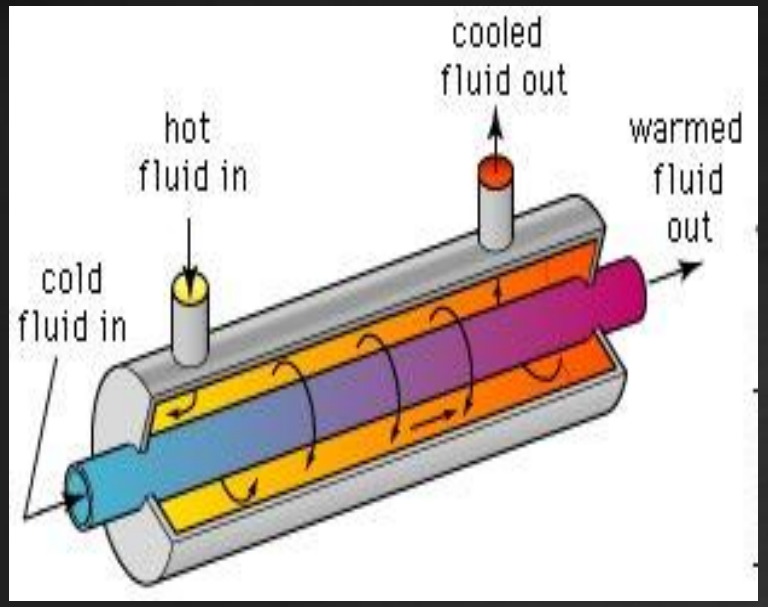


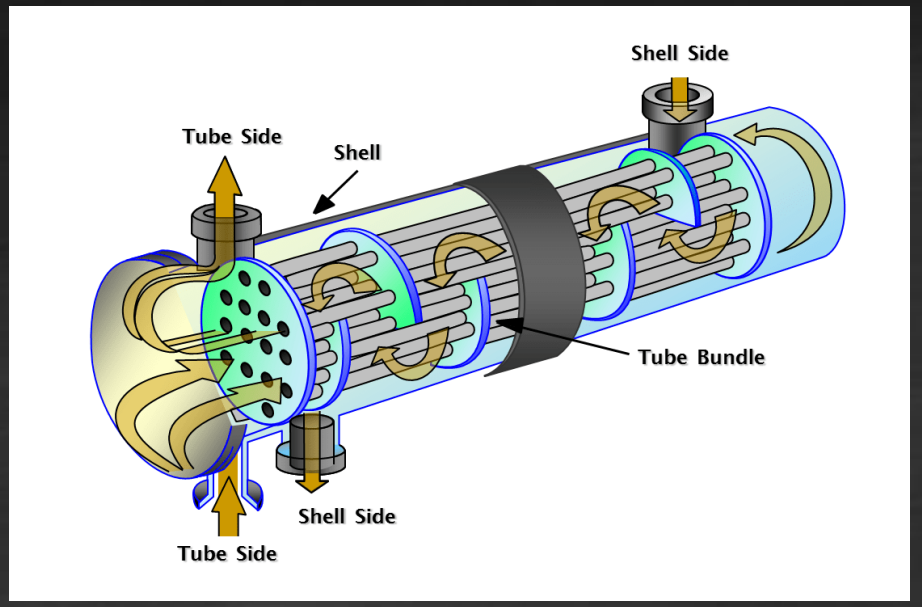
- Cross Flow : in cross flow heat exchanger, the two fluids cross one another in space

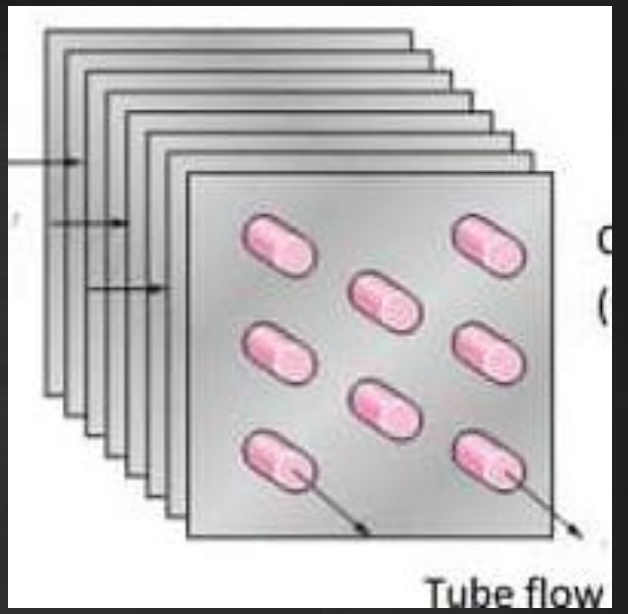


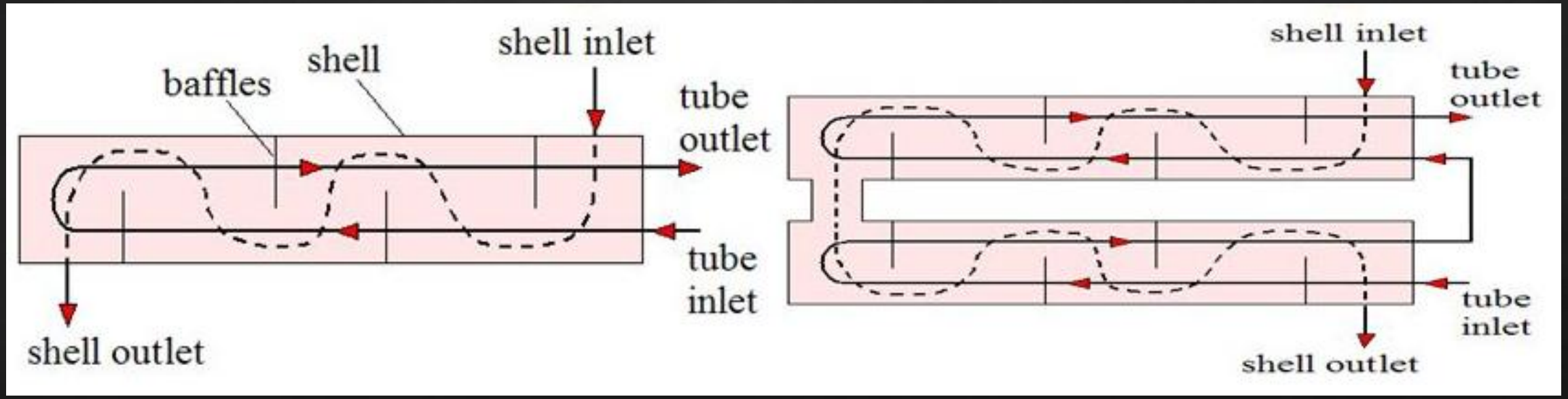
3. Design and Constructional Features

- 1. Concentric tubes
- 2. Shell and Tube
- 3. Multiple shell and Tube Passes
- 4. Compact Heat Exchanger


cooled
fluid out
hot
fluid in
warmed
fluid
out
cold
fluid in

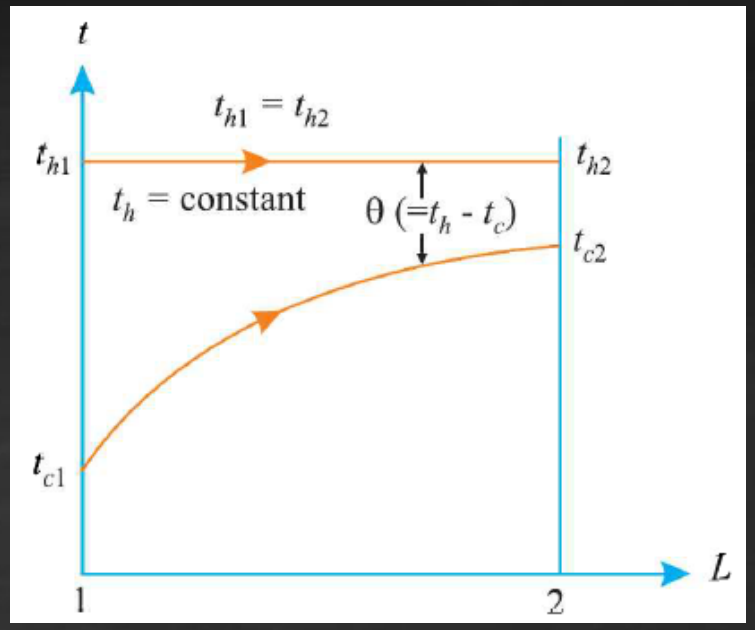

Shell Side
Tube Side
Shell
Tube Bundle
Shell Side
Tube Side

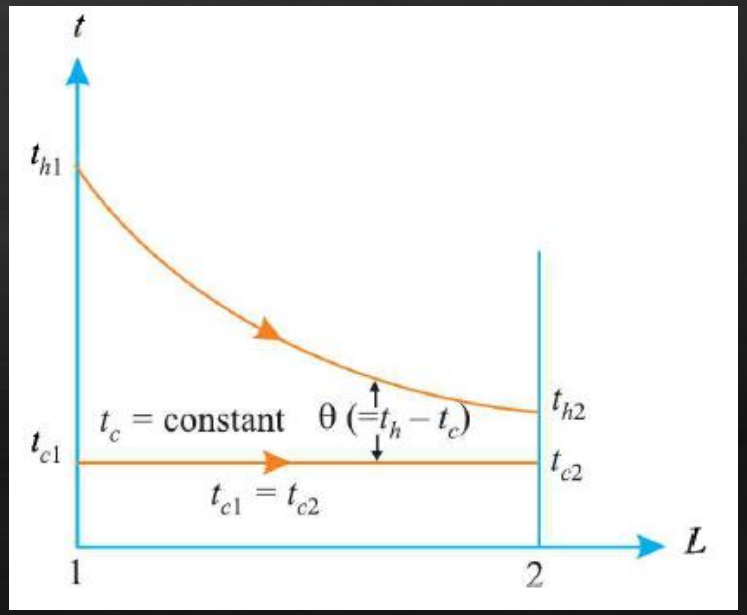

Tube flow


baffles
shell
shell inlet
tube
outlet
tube
inlet
shell outlet
shell inlet
tube
outlet
tube
inlet
shell outlet

4. Physical State of fluid

- 1. Condenser
  - In a condenser, the condensing fluid remains at constant temperature throughout the exchanger while the temperature of the colder fluid gradually increase from inlet to outlet
- 2. Evaporator
  - In case, the boiling fluid (cold fluid) remains at constant temperature while the temperature of hot fluid gradually decrease from inlet to outlet





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Thank You