

Thermodynamics and Heat Exchangers

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Independent Study

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Thermodynamics

- Energy: the capacity to do work or produce energy
- Law of conservation of energy: energy can be converted from one form to another but can be neither created or destroyed.

Energy

- System: part of the universe on which we focus on.
- Surroundings: include everything else
- Exothermic: energy flows out of the system
- Endothermic: energy is absorbed from the surroundings.
- Calorimeter: device used to measure heat energy flow.

Laws

- First law of thermodynamics: the energy of the universe is constant.
- Internal energy (E): $\Delta E = q + w$
- q: represents heat and w represents work
- $q = SH (\text{specific heat}) + m (\text{mass}) + \Delta T$

Laws continue

- Second law of thermodynamics: in any spontaneous process, there is always an increase in the entropy of the universe.
- Entropy measure the disorder of a system.
- Nature favors disorder, look at your bedroom as an example.

Heat transfer

- Heat flow is always from hot objects to cold.
- Example: touching a hot object, direction of energy flow?
- Placing ice cubes in cold water, direction of energy flow?

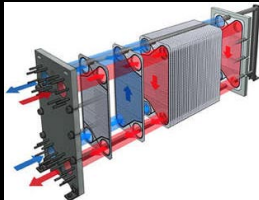
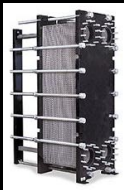
Heat exchangers

- Used to transfer heat
- Example: air conditioners, refrigerators, and cars
- Describe the energy flow in each.
- Energy (q) balance: q into cold = q out of hot = q across barrier

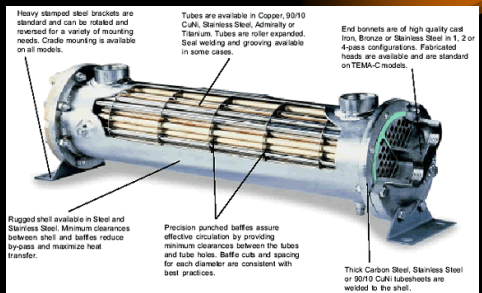
Types of Heat Exchangers

- Noncontact:
- Plate: two liquids of different temperatures move past each other on alternating plates
- Shell and tube: two liquids of different temperatures move past each other one inside a tube and the other in the shell around the tubes.

Plate heat exchangers



Shell and tube heat exchangers



Food industry heat exchangers

- Production of ice cream
- Describe the energy flows
- Describe the heating medium
- Describe the cooling medium
- Describe the barrier

