

Mass and Energy Balances

Why, a four-year-old child could understand this. Someone get me a four-year-old child

Groucho Marx

Basic Steps in Flowsheet Synthesis

- ✓ Gather information about the process chemistry
- ✓ Generate flow diagram based on Douglas Hierarchy
- **Solve mass and energy balances**
- Estimate equipment size based on flow rates from previous step
- Estimate equipment cost based on size from previous step
- Optimize process

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1. **The Chemist's Approach:** Build larger sizes of laboratory equipment and experimentally measure all the process variables.
2. **The Engineer's Approach:** Develop **process models** for each unit and solve these equations to estimate the mass and energy flow rates. Use these rates to determine size.

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1. **Fundamental Model**: Derived from
 - Material and energy balances
 - Physical and Chemical Properties
2. **Empirical Model**: Obtained by “fitting” data
 - Numerical Methods
 - Statistical Analysis

Types of Process Models

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In this course, we will develop:

- **steady state** models from **first principles**.
- **approximate** models of chemical processes.

Dynamic models will be considered in ECH 4323: Chemical Process Control.

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Reactor

Flash

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Absorption

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Models for other unit operations may be found in:

- *Transport Processes and Separation Process Principles* by Geankoplis
- *Separation Process Principles* by Seader and Henley
- *Elements of Chemical Reaction Engineering* by Fogler