

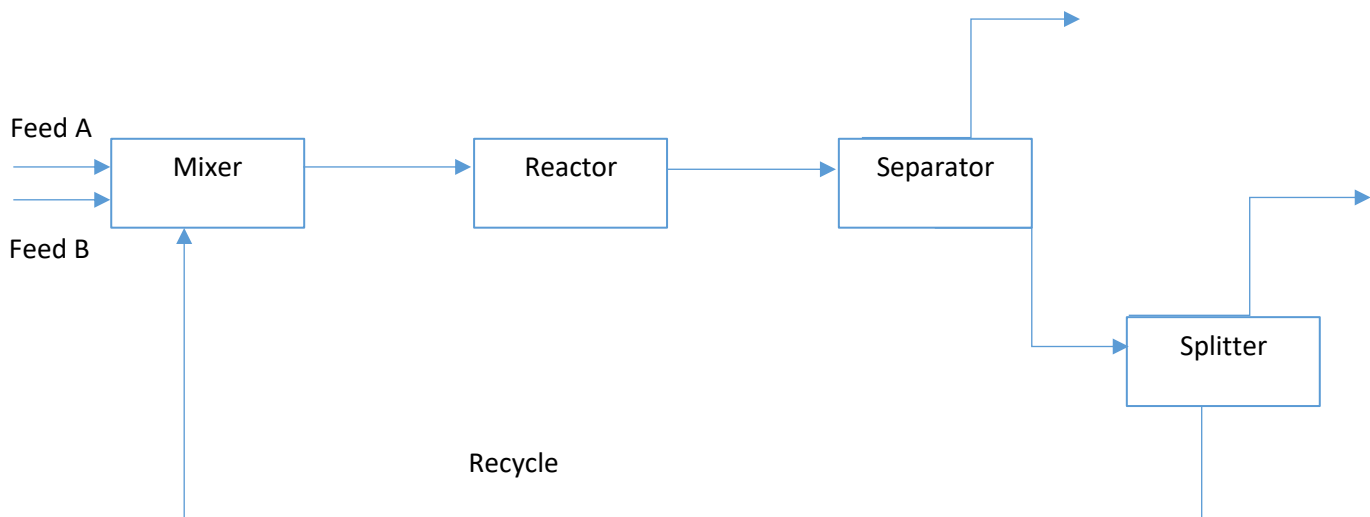
CEN 205 MASS AND ENERGY BALANCES

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FUNDAMENTALS OF MATERIAL BALANCES

The analysis of chemical processes involves writing and solving the material balances for all process species in the feed and product streams. The basis for material balance calculations is the law of conservation of mass, such as 'total mass input=total mass of output'.

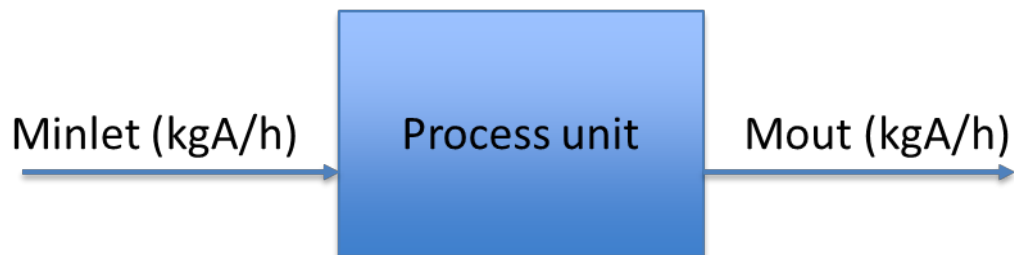
The general procedure in material balance calculations starts with the drawing and labeling of a flowchart that describes the process. The most commonly used flowchart type is the block diagram.



PROCESS CLASIFICATION:

Chemical processes are classified as; batch, continuous and semibatch and as either steady state or transient.

GENERAL MASS BALANCE CALCULATION:



The general mass balance equation is:

$$\text{Input} + \text{generation} - \text{output} - \text{consumption} = \text{accumulation}$$

Total mass balance;

$$\text{Input} = \text{Output}$$

Balance on non-reactive systems;

$$\text{Input} = \text{Output}$$

The flow chart should be completely labeled wꝑth the values of stream variables such as; mass flow rate, mass fraction, temperature and pressure.

BASIS: An amount or flow rate of one of the process streams. If no flow rates are specifies, basis should be assumed for a stream with known composition.

If the system operates at steady state, accumulation term is zero.

For balances on continuous steady state processes:

$$\text{input} + \text{generation} = \text{output} + \text{consumption}$$

Integral balances can be written for batch and semibatch processes, where a differential balance is written on the system and then integrated between two time points.

YOUR TURN:

Classify the following as batch, semibatch or continuous:

- A bottle of coke is taken from the refrigerator and left on the table.
- Filling of a CO₂ tube with gas.
- Ethanol is being evaporated in an open flask.