Penilaian

MLF
WAN
SRD
Praktikum

100%

Ujian : 60%
Tugas (paper/presentasi/kuis) : 40%
Reference

• Earle R.L and Earle, M.D, *Unit Operations in Food Processing*
Bioseparation engineering → the large-scale separation and purification of biological products: biopharmaceuticals, biochemicals, foods, diagnostic reagents, etc.
Bioseparation

Why?

Processing

Waste treatment
Application

Separation
Basic of separation

- Size: e.g. filtration, membrane separation, centrifugation
- Density: e.g. centrifugation, sedimentation
- Diffusivity: e.g. membrane separation
- Shape: e.g. centrifugation, filtration, sedimentation
- Polarity: e.g. extraction, chromatography, adsorption
- Solubility: e.g. extraction, precipitation, crystallization
- Electrostatic charge: e.g. adsorption, membrane separation, ion exchange
- Volatility: e.g. distillation, evaporation
Coagulation-Flocculation-Sedimentation-Filtration

- Coagulation: the process in which dispersed colloidal particles agglomerate.
- Flocculation: the process where in colloids come out of suspension in the form of floc or flakes by the addition of a clarifying agent.
- Sedimentation/settling: the process of letting suspended material settle by gravity.
- Filtration is the process of removing suspended solids from water by passing the water through a permeable fabric or porous bed of materials.
Membrane separation

• A membrane is a thin semi-permeable barrier which can be used for separation: particle-liquid, particle-solute, solute-solvent, solute-solute separation

• Driving force: solute size, electrostatic charge, diffusivity, solute shape

• A membrane may be made from organic polymers or inorganic material such as glass, metals and ceramics, or even liquids.
Centrifugation

- Separates particles from suspensions, macromolecules from solutions
- Driving force: Size and density
- Centrifugation efficiency: large particle diameter, large density
- Ultracentrifuge $\rightarrow$ higher speed (30000 rpm - 50000 rpm) $\rightarrow$ separating macromolecules
Precipitation

• Precipitation based bioseparation essentially involves selective conversion of a specific dissolved component of a complex mixture to an insoluble form using appropriate physical or physicochemical means.

• The insoluble form which is obtained as a precipitate (typically an easy to sediment solid)
Precipitation (Con’t)

Biological macromolecules can be precipitated by:
1. Cooling
2. pH adjustment
3. Addition of solvents (aseton)
Crystallization is a special type of precipitation process where the solid is obtained in a crystalline form. The driving force is solubility.
Extraction

- Extraction: partitioning of a solute between two immiscible or partially miscible phases.
- Driving force: Polarity and solubility, density
- Liquid-liquid extraction
- Solid-liquid extraction
- Supercritical fluid extraction (SFE)
- An environmental → separation of acetic acid–water mixtures
Adsorption and desorption

- Adsorption: the binding of molecules on the surface of solid material
- Solid material is called the adsorbent, the molecule that binds on the adsorbent is adsorbate.
- The release of adsorbed material from an adsorbent is called desorption.
- Driving force → size and shape, polarity, electrostatic charge.
- Removal of water → Silica gel, zeolites, membrane.
Adsorption ... (Con’t)
Absorption and stripping

- Absorption is the process of binding molecules into the bulk of the absorbent.
- Stripping (or desorption) is the release of absorbate (solute) from the absorbent.
- Environmental process: the removal of ammonia gas from an air stream with water as the mass-separating agent.
Absorption ... (Con’t)
Ion exchange

• Ion exchange is very similar to adsorption; both processes involve mass transfer from a fluid to a solid phase.
• Ion exchange is based on electrostatic interactions between the molecule and the ion exchanger.
• Cation exchange adsorbent is negatively charged and can therefore bind positively charged molecules.
• Anion exchange adsorbent is positively charged and can bind negatively charged molecules.
Chromatography

- Chromatography is a solute fractionation technique which relies on the dynamic distribution of molecules to be separated between two phases: a stationary (or binding) phase and a mobile (or carrier) phase.
- Stationary phase: Phase that stays in place inside the column
- Mobile phase: Solvent moving through the column.
- Driving force: polarity
Chromatography (Con’t)

Chromatographic Separation

Fresh solvent = eluent
Mobile phase

A   B  Sample components

Column packing
Stationary phase
suspended in a solvent
(Mobile phase)

Porous disk

Flowing mobile phase

B elutes  A elutes

chromatogram
Distillation

- Distillation separates components of a liquid mixture based on their different boiling points.
- Driving force: temperature
Evaporation

- Evaporation is to vaporize most of the water from a solution containing a desired product.
- The final product of evaporation is a concentrated liquid, not a solid.
- Driving force: temperature.
Drying

• Drying is a mass transfer process consisting of the removal of water or another solvent from a solid, semi-solid or liquid.
• The final product is solid.
• Driving force: temperature
Food Technology: Sugar Production
Fig. 1-1  Processing steps for producing raw sugar from sugar cane.
Sugar Refining Process

Fig. 1-2  Cane sugar refining process. (Courtesy California and Hawaiian Sugar Co.)
Separation Processes Used for Sugar Production

1. Settling
2. Filtration
3. Centrifugation
4. Screening
5. Expression (milling rolls)
6. Washing and Leaching
7. Precipitation
8. Evaporation
9. Crystallization
10. Adsorption
11. Drying