

Separation Processes, ChE 4M3, 2012

Assignment 1

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There are several viewpoints we can use to understand separation processes. One is to consider them based on the mechanism being exploited; another is to consider them based on separations of solids, liquids and gases from various combinations of each other.

Question 1

Fill in the grid of 9 squares with as many unit operations as possible

		MINOR COMPONENT		
		SOLID	LIQUID	GAS/VAPOUR
MAJOR COMPONENT	SOLID			
	LIQUID			
	GAS/VAPOUR			

For each of the nine entries, give an actual unit and state what the streams in and out of the unit are. For example, cryogenic distillation columns are used during gas from gas separation for nitrogen (major) vs oxygen (minor) separations.

Question 2

1. Identify the mechanism by which the components are being separated in the following instances. For example, when concentrating orange juice in an evaporator, we are exploiting the difference in *volatility* between water, and the complex aqueous compounds that make up the juice.
2. Also identify the separating agent and state whether it is an MSA or ESA.

Unit operations to consider:

- Waste water treatment: secondary clarifier
- Distillation column separating methanol and water
- A chromatography column
- Drying laundry
- Protein purification using a membrane
- Liquid-liquid (solvent) extraction

Question 3

Give actual example(s) of where the following mechanism could be used to split components from a given feed stream. State what is in the feed stream and the output separated streams. Also state the name of a unit operation that exploits this mechanism to cause the separation.

- Density
- Particle size
- Solubility
- Mobility
- Charge
- Phase change
- Magnetism

Question 4

Separation processes cannot operate without bounds (energy input into the process is expensive). But in some instances we are constrained also by the nature of the products being separated. Give examples of a separation process where we have to meet additional constraints on the design and operation of the unit in terms of:

- temperature
- contamination from other sources (human, airborne, limited choices of solvents to separate the components)

For example, in protein separation, we have to ensure the proteins remain in an aqueous phase, else they will denature, in other words, they are sensitive to the chemical environment.

Question 5

For each of the following general industries, please identify two separation systems (unit operations):

- petrochemical
- bioprocessing
- food and beverage
- pharmaceutical
- minerals/mining
- metals
- air products
- wastewater treatment

Question 6

A particle 1mm in diameter, with density of 5000 kg.m^{-3} is settling in an unhindered environment of water. Give an estimate of its terminal velocity.

END