Separation Processes, ChE 4M3, 2013

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 [10]

1. Identify the mechanism (principle of separation) 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. Apart from the mechanism used, also identify the separating agent in each instance, and state whether it is an MSA or ESA.

Unit operations to consider:

- Crystallization
- Adsorption
- Steeping (brewing) tea
- Using monoethanolamine in a carbon dioxide scrubber
- Flotation (mining industry)

Question 2 [10]

Give actual example(s) of where the following mechanism (principle of separation) could be used to split components from a given feed stream. State the name of a unit operation that exploits this mechanism to cause the separation. *For example*, the first answer could be "Petrochemical industry: naphtha from heavy gas oil; distillation column".

- Relative volatility
- Evaporation
- Condensation of liquid phase
- Relative solubility
- Particle size differences

Question 3 [8]

Describe what the following separators do (be a bit more adventurous than just using Wikipedia in your research)

- mechanical deboner
- flotation column
- pressure swing adsorption
- evaporator

Question 4 [10]

Dust particles, assumed to have a spherical shape, with diameter of 500μm are falling in an air stream that is at 405K. The particles have a density of 1530 kg.m^{-3}; what is the terminal settling velocity?

The density of air at this temperature is 0.83 kg.m^{-3} and viscosity of air is approximately $\mu = \dfrac{C_1 T^{1.5}}{C_2 + T}$ where $C_1 = 1.46 \times 10^{-6}$ kg.m^{-1}.s^{-1}.K$^{-0.5}$ and $C_2 = 110.4$ K.

Question 5 [10]

In this flowsheet for converting sugar cane to raw sugar from King's textbook, *Separation Processes*, identify 5 separation unit operations.

For each unit operation, describe:

1. the principle being exploited to create the separation
2. the ESA and/or MSA being added.

Also, watch the video on the sugar process again [http://www.youtube.com/watch?v=ZBOou6cahtw] to visualize the size of these units.

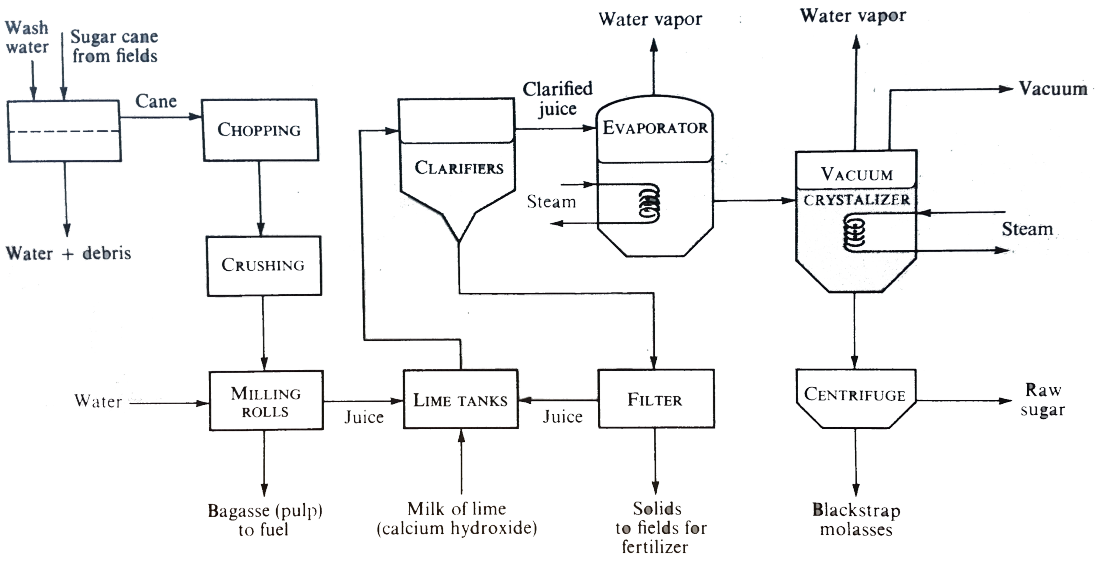

Figure 1-1 Processing steps for producing raw sugar from sugar cane.

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