

Homework 2
due September 11, 2008

If you find yourself without enough information, make and justify a reasonable approximation. Please answer all parts of a question! (This is good practice for an exam setting.)

1. Draw a flowsheet (i.e. a picture of the process, with what flows in and out) for Felder and Rousseau, problem 4.12. Use the equipment program from the textbook cdrom to see what a distillation column looks like. Write down the concentrations and flow rates that are available from the problem statement on your flowsheet.
2. Draw a flowsheet for Felder and Rousseau, problem 4.9. Write down the compounds and mass fractions in each stream. Consider “solids” to be a compound for this problem.
3. If the flowrate of the “bottom stream” in problem 4.12 has a density of 0.95 g/cm^3 , calculate its volumetric flow rate in units of cm^3/s . (Note: you don't need to solve 4.12 to do this problem. We'll also get to solving 4.12 later.)
4. A bioreactor (as in homework 1) contains *E. coli* bacteria that have the capability (via recombinant DNA) to produce human insulin. For purification reasons, the insulin is produced at the same time as another protein, β -galactosidase (call it “ β -G” for this problem).

In order to recover the insulin, the cells are suspended in water and are then extracted using a centrifuge. The centrifuge separates out the cells, and a sample of the remaining liquid (called “supernatant”) is determined to have the following amounts:

- insulin, 0.0004 moles
- β -G, 0.0008 moles
- water, 250 moles

(a) What is the mole fraction of insulin in this sample of the liquid?

(b) Next all the water is evaporated in an oven. What is the mass fraction of insulin in the mixture that remains afterwards? The molecular weights are 5808 g/mol for insulin and 464000 g/mol for BG.