Department of Biochemical Engineering & Biotechnology

BBL 731: Bioseparation Engineering

Major Test

November 23, 2017
MM 40
2 hour

1. 1 L of 2 M KCl is mixed with 1 L of 8 M $NaNO_3$ at 298 K. Solubility product values at 298 K in $(mol\ L^{-1})^2$ are KCl: 10; KNO_3: 1.7; NaCl: 35; $NaNO_3$: 100. Assuming ideal solutions, determine what will precipitate and by how much. 5

2. **A** Make a sketch of multi-stack electro-dialysis system showing the removal of salts from the protein solution. 2.5

B Make a sketch of membrane based Iso-Electric Focussing system for a mixture of three proteins with three distinct pIs. 2.5

3. Consider the series of experiments for UF of a protein solution at room temperature. The experiments are carried out on a totally retentive membrane in a tubular module for different feed concentration of the protein and the limiting volumetric flux measured as given below. Using the following data, find out the mass transfer coefficient (k) and the maximum membrane protein concentration (C_m or C_w): 8

Feed concentration of Protein (g/l)	1	2	5	10	20
Limiting Volumetric Flux (cm/s) x 10^{-4}	11	9	6.5	5.5	4.5

4. An antibiotic is extracted from fermented broth using butyl acetate. Subsequently, it is extracted back into water phase using three stages. If the concentration of the antibiotic in butyl acetate is 50 g/l and is produced at the rate of 200 l/h, calculate the amount of water required per hour to give the antibiotic yield of 96%. Assume that K = 0.2 for this system. 3

b. Show that after n batch extractions with equal amounts of pure L, the fraction of solute in the total extract nL is $[\{(E+1)^n - 1\}/(E+1)^n]$ where E = KL/H 4

5. The modified dextran can adsorb up to 7.8×10^{-6} mol of immunoglobulin G per cm^3 of adsorbent. This adsorption follows a Langmuir isotherm, with a constant K of 1.9×10^{-5} mol/liter. If 80 cm^3 of this dextran is put in 1.2 liters of feed solution containing immunoglobulin G, it exhaust 90% of the dextran's capacity. Determine the concentration of immunoglobulin G in the feed solution. 5

6. Gaussian form of equation is used to explain a typical chromatography peak, in which three parameter, namely y_0, σ & t_0 are used to represent the chromatography peak. Can you show that the width of this peak is 2.354 σ at $y = (1/2)\ y_0$? Write all steps. 5

7. A column of 20 cm long, with an internal diameter of 5 cm, gives sufficient purification to merit scale up. The column produces 3.2 g of purified protein per cycle, and a cycle take 6 h, from equilibrium through regeneration. We want a throughput of 10 g/h. What are the new column's dimensions if linear velocity and column length is held constant? 5