Module ChE-311 Biochemical Engineering

Downstream processing
Exercices Lecture 4
Liquid-solid adsorption and chromatography

Simon Crelier, HES-SO Valais – Sion

simon.crelier@epfl.ch
+41 (0)27 606 86 65

Exercise 4.1 Adsorption kinetics

20 ml of an antibiotic solution with initial concentration C_0 = 30.0 mg/ml were contacted with 2.5 g of an adsorption resin. The evolution of the solute concentration in the liquid phase was measured as a function of contacting time. The results are given in the table below.

Assuming the kinetics is of the second order, determine the adsorption rate constant k_2 and the equilibrium concentration q_{eq}. Please don't forget to specify the units for these parameters.

t [min]	0	2	5	10	18	30
C [mg/ml]	30.0	24.4	20.4	17.4	15.4	14.1
q [mg/g]						

Exercise 4.2 Adsorption isotherm

To characterize the adsorption isotherm of an antibiotic on a resin, 20 mL of antibiotic solutions with variable initial concentrations C_0 were contacted with 2.5 g adsorbent. The residual concentration C_{equ} was measured in the liquid phase once equilibrium was reached. The results are given in the table below.

Also, use the result of Exercise 4.1 to complete the table.

C_0 [mg/ml]	0.0	10.0	20.0	30.0	40.0	50.0
C_{equ} [mg/ml]	0.0	2.3	6.0		19.0	27.3
q_{equ} [mg/g]						

Calculate the adsorbed concentrations at equilibrium q_{equ} and treat the data according to the Langmuir model to determine the parameters of the isotherm curve.

Hint: to linearize the Langmuir model, try plotting C_{equ}/q_{equ} as a function of C_{equ}. What do you obtain? How do you extract the parameters from the obtained slope and intercept?

Exercise 4.3

NPT and HETP for a preparative column

A pulse injection was performed at time t=0 to determine the packing efficiency of a preparative chromatography column (diameter 5 cm, bed length 36 cm). The resulting peak is shown in the figure below.

Determine the number of theoretical plates NTP and the height equivalent to a theoretical plate HETP.