BBL 731 Major

17.11.2018, 3:30 PM-5:30 PM

Max: 30

1. (a) Consider a tubular centrifuge of bowl length l, bowl radius r_2, radius to the gas-liquid interface r_1 spinning at an angular velocity ω. Particles (density ρ_P) move radially in the liquid (properties ρ, μ...) at their terminal velocity obeying Stokes law. If D_{pc} is the 90% cut diameter, derive an expression for the operating volumetric flow rate q_c corresponding to this cut diameter. (6)

   (b) In many physical situations, the thickness of the liquid layer, t is small compared to the radius of the tubular bowl. What happens then to your result above for q_c? Derive a new result for q_c that is valid under these conditions. (6)

2. (a) We have 30 L of a solution containing 10^{-4} g L^{-1} of gentamycin, an antibiotic used to treat eye infections. We wish to recover 99% of this material using an ion-exchange resin for which the adsorption isotherm is $q = Ky$, where y is the equilibrium aqueous phase concentration in g L^{-1}, q is the solid phase concentration in g g^{-1}, and K = g^{-1} L. How much adsorbent will we need if we run the process in a batch system? (6)

   (b) Consider the paper given to you (Nath and Shukla, Chem. Eng. J.) on adsorption in a continuous stirred tank. If the adsoption isotherm were nonlinear instead of the linear $q = Ky$, what terms in the solution of the Chem. Eng. J. Paper, in your view, would that be reflected in and why? (4)

3. (a) Consider a negatively-charged sample injected in the y-z transverse section of a rectangular continuous electrophoresis chamber with negatively-charged walls. Sketch the final form of the sample at the exit transverse section because of disturbances due to i) electroosmosis and ii) parabolic velocity profile of the buffer. The (2 + 2)

   (b) Sketch also what a detector placed at the top (inlet) and bottom (exit/outlet) end of the chamber will record for cases i) and ii) of Question 3(a) above. (2 + 2)

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