Comparison Of Axial Dispersion And Tanks-In-Series Models For Simulating The Performance Of Enzyme Reactors

Abu-Reesh, IM; Abu-Sharkh, BF

AMER CHEMICAL SOC, INDUSTRIAL ENGINEERING CHEMISTRY RESEARCH; pp: 5495-5505; Vol: 42

King Fahd University of Petroleum & Minerals

http://www.kfupm.edu.sa

Summary

A comparison of two modeling approaches for simulating the performance of enzyme reactors using the axial dispersion and tanks-in-series models is described. The two modeling approaches are compared for the steady-state performance of enzyme reactors assuming Michaelis-Menten kinetics with competitive product inhibition. The performance of the reactors is described in terms of substrate conversion and yield. The equation Pe = 2(N - 1) is used to correlate the parameter of the dispersion model (Pe) with that of the tanks-in-series model (N) for the entire range of dispersion from plug flow to CSTR. The predictions of the two models agree well, especially at low dimensionless residence times and high Peclet numbers. Practically, the predictions of the two models are essentially equivalent when the above equation is used to relate their two parameters. However, the tanks-in-series model is simpler and has computational advantages over the dispersion model, although its physical basis is not as clear as that of the dispersion model. Lactose hydrolysis by the enzyme beta-galactosidase, which exhibits Michaelis-Menten kinetics with competitive product inhibition, is used as a model system in this study. The kinetic parameters for lactose hydrolysis are obtained from the literature.

References:

1. ABUREESH IM, 1997, BIOPROCESS ENG, V17, P131
2. ABUREESH IM, 2000, BIOPROCESS ENG, V23, P709
3. ARIS R, 1993, CHEM ENG SCI, V48, P2507

4. BALAKOTAIAH V, 1998, CHEM ENG SCI, V53, P1787
5. BUFFHAM BA, 1968, AICHE J, V14, P805
6. DANCKWERTS PV, 1953, CHEM ENG SCI, V2, P1
7. DOMMETI SMS, 2000, CHEM ENG SCI, V55, P6169
8. ELGETI K, 1996, CHEM ENG SCI, V51, P5077
9. FOGLER HS, 1999, ELEMENTS CHEM REACTI
10. KOBAYASHI T, 1971, BIOTECHNOL BIOENG, V13, P893
11. KOMOLPRASERT V, 1991, BIOTECHNOL BIOENG, V37, P681
12. KRAMERS H, 1953, CHEM ENG SCI, V2, P173
13. LEE TT, 1997, J ENVIRON SCI HEAL A, V32, P83
14. LORTIE R, 1994, J CHEM TECHNOL BIOT, V60, P189
15. NARDI IR, 1999, BIOPROCESS ENG, V21, P469
16. NAUMAN EB, 1987, CHEM REACTOR DESIGN
17. PONZI EN, 1980, CHEM ENG SCI, V35, P1804
18. POUGHON L, 1998, BIOPROCESS ENG, V20, P209
19. SANTOS A, 1998, ENZYME MICROB TECH, V22, P558
20. SHINNAR R, 1987, CHEM REACTION REACTO
21. STOKES RL, 1970, CAN J CHEM ENG, V48, P723
22. TURNER JR, 1990, CHEM ENG SCI, V45, P2317
23. VANHASSELT BW, 1999, CHEM ENG SCI, V54, P5047
24. WEN CY, 1975, MODELS FLOW SYSTEMS
25. YANG ST, 1989, BIOTECHNOL BIOENG, V33, P873

For pre-prints please write to: abstracts@kfupm.edu.sa