SOLUTION TO PROBLEMS OF REACTOR ASSOCIATION 47-60

47. a) $C_{A1} = 0.828 \text{ mol/L}, C_{A2} = 0.704 \text{ mol/L}, \xi_{A2} = 0.296$; b) $t = 33.7 \text{ min}$; c) graph.; d) eq.

48. $\xi_A = 0.491$

49. $V = 32.1 \text{ L}$

50. a) $V_{CSTR} = 2451 \text{ L}, T_0 = 277.6 \text{ K}$; b) $V_{PFR} = 1846 \text{ L}, T_0 = 288.7 \text{ K}$

51. a) $\xi_{Af} = 0.663$; b) $\xi_{Af} = 0.578$; c) $V = 56.0 \text{ L}$

52. Volumetric flow $Q_v'$ may be increased to a value 95% higher than initial $Q_v$

53. a) $CSTR+PFR$: $\xi_{Af} = 0.464$; b) $PFR+CSTR$: $\xi_{Af} = 0.472$; 2$^{nd}$ arrangement is more suitable; c) Zero order: $\xi_{Af} = 1$ for both arrangements; d) First order: $\xi_{Af} = 0.596$ for both arrangements

54. a) $PFR+CSTR$: $Q_v'/Q_v = 3.88$; b) $CSTR+PFR$: $Q_v''/Q_v = 1.84$; c) In this case, initial concentration does not affect $Q_v$ to get given final conversion; d) Reaction order does affect: for $0<n<1$ order, the 2$^{nd}$ arrangement needs a higher increase of $Q_v$ than the 1$^{st}$ one (unlike for $n>1$) in the isothermal conditions of the problem

55. a) $V_{PFR} = 30.5 \text{ L}, V_{CSTR} = 17.6 \text{ L}$; b) $T_{0,PFR} = T_{0,CSTR} = 350 \text{ K}$; c) For a 500 L volume tank, $\xi_{Af} = 0.977$, and for two stages with 250 L volume tanks, $\xi_{Af} = 0.995$

56. a) $V = 252.7 \text{ L}$ for each reactor; b) $T_{01} = 346.7 \text{ K}$; c) $A_2 = 0.195 \text{ m}^2$, $A_3 = 0.091 \text{ m}^2$

57. $T_{01} = 295.6 \text{ K}$

58. a) $V_{CSTR} = 839 \text{ L}, \text{ cost} = 1936 \text{ €}$; b) $V_{CSTR} = 136 \text{ L}, \text{ cost} = 128 \text{ €}$; c) $V_{CSTR} = 97 \text{ L}, \text{ cost} = 88 \text{ €}$; d) $V_{PFR} = 81 \text{ L}, \text{ cost} = 87 \text{ €}$; e) optimal arrangement: $CSTR+PFR$: $V_{CSTR} = 45 \text{ L}, \xi_{A1} = 0.587, \text{ cost}_{CSTR} = 43 \text{ €}$; $V_{PFR} = 23 \text{ L}, \xi_{A2} = 0.85, \text{ cost}_{PFR} = 29 \text{ €}$; total cost = 72 €

59. a) $T = 404.1 \text{ K}, V = 74.4 \text{ L}$; b) $Q = 5.9 \times 10^7 \text{ J/min}$; c) $A = 8.72 \text{ m}^2$; d) $V = 45.4 \text{ L}, T = 407.1 \text{ K}$

60. a) $V = 1.20 \text{ m}^3$ (each one); b) $V = 5.44 \text{ m}^3$