15-7 2×CSTR $V = 1{,}8\ m^3$ $A \equiv C_6H_5CH{=}CH_2$ $M_A = 104{,}15\ g/mol$

$\eta_A = 23\%$ $A \rightarrow$ polymer

$r = k C_A^{3/2}$ $E_A = 97{,}1\ kJ/mol$ $T = 373\ K$ $k_\infty = 3.3 \cdot 10^{11}\ \frac{m^{1,5}}{kmol^{0.5}\,h}$

$\rho = 850\ kg/m^3 = konst$

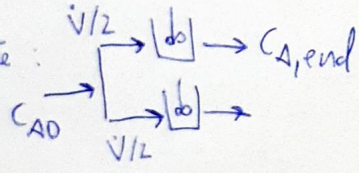
$w_{A0} = 92\%$ kg-A/kg-roztok

$$c_{A0} = \frac{w_{A0}\rho}{M_A} = \left(0{,}92\ \frac{kg\text{-}A}{kg\text{-}směs}\right)\left(850\ \frac{kg\text{-}směs}{m^3\text{-}směs}\right)\cdot\left(\frac{1}{104{,}15}\ \frac{kmol\text{-}A}{kg\text{-}A}\right)$$

$c_{A0} = 7{,}508\ kmol/m^3$

$c_{A,end} = (1-0{,}23)\,c_{A0} = 5{,}7815\ \frac{kmol}{m^3}$

a) Paralelně:



$$c_{A0}(\dot V/2) - k c_A^{3/2} V = c_A(\dot V/2)$$

$k = k_\infty \exp(-E_A/RT) = 3.3\cdot 10^{11} \exp(-97100/[8{,}314\cdot 373])$

$k = 0{,}008322\ m^{1,5}/kmol^{0,5}h$

$$7{,}508(\dot V/2) - 0{,}008322 \cdot 5{,}7815^{3/2} \cdot 1{,}8 = 5{,}7815\cdot(\dot V/2)$$

$1{,}7265(\dot V/2) = 0{,}2082$

$\dot V = 0{,}2412\ m^3/h$

str 2 (15-7)

b) kaskáda: $\xrightarrow{\dot V,\ c_{A0}}$ [do] $\xrightarrow{\dot V,\ c_{A1}}$ [do] $\xrightarrow{\dot V,\ c_{A,end}}$

① $c_{A0}\dot V - k c_{A1}^{3/2} V = c_{A1}\dot V$

② $c_{A1}\dot V - k c_{A,end}^{3/2} V = c_{A,end}\dot V$

$\downarrow$

① $c_{A0} - k c_{A1}^{3/2}\tau = c_{A1}$

② $c_{A1} - k c_{A,end}^{3/2}\tau = c_{A,end}$

$\downarrow$

$c_{A1} = 5{,}7815 + 0{,}008322 \cdot 5{,}7815^{7/2}\tau = 5{,}7815 + 0{,}1157\tau$

$c_{A0} - k\left[5{,}7815 + 0{,}1157\tau\right]^{3/2}\tau = 5{,}7815 + 0{,}1157\tau$

$1{,}7265 - 0{,}008322\left[5{,}7815 + 0{,}1157\tau\right]^{3/2}\tau - 0{,}1157\tau = 0$

iterace pot. nástiel $\tau_{guess} = \frac{7{,}118}{0{,}2372} = 7{,}5\ hod$

$= V/\dot V = 1{,}8/0{,}24$

$\tau = 6{,}75\ hod$

$\dot V = \frac{V}{\tau} = \frac{1{,}8}{6{,}75} = 0{,}2667\ m^3/h$

str 3 (15-7) $T' = 373 + 10 = 383$

c) $k'_2 = k_\infty \exp\left(-\frac{E_A}{RT'}\right) = 0{,}01885 \; m^{1{,}5}/kmol^{0{,}5}h$

$$c_{A0} - k\, c_{A1}^{3/2}\, \tau' = c'_{A1}$$

$$c'_{A1} - k'\, c_{A,ind}^{3/2}\, \tau' = c_{A,ind}$$

↳ iterace / numerické řešení viz 6)

$\dot{V} = 0{,}43 \; m^3/h$

U15-07

```
clear
rho=850;        % kg-smes/m3-smes
wA0=0.92;       % kg-A/kg-smes
MA =104.15;     % kg-A/kmol-A
cA0=wA0*rho/MA  % kmol-A/m3-smes
```

```
cA0 = 7.5084
```

```
XA=0.23;
cAend=cA0*(1-XA)
```

```
cAend = 5.7815
```

```
k8=3.3e11; % m^1.5 / kmol^0.5 h
EA=97.1e3; % J/mol
T = 373;   % K
k=k8*exp(-EA/8.314/T)
```

```
k = 0.0083
```

```
V=1.8;     % m3
```

Paralelne

```
syms VdotA
VdotAsol=eval(solve(...
    cA0*(VdotA/2)-k*cAend^(3/2)*V==cAend*(VdotA/2))) % m3/h
```

```
VdotAsol = 0.2412
```

Kaskada

```
syms VdotB cA1
eq1 = cA0*VdotB - k*cA1^1.5*V == cA1*VdotB;
eq2 = cA1*VdotB - k*cAend^1.5*V == cAend*VdotB;
sol=vpasolve([eq1,eq2],[VdotB,cA1],[VdotAsol;cA0/2+cAend/2])
```

```
sol = struct with fields:
    VdotB: 0.266414937790440518193761345204 02
      cA1: 6.563066161304119407576143845597 7
```

```
VdotBsol = eval(sol.VdotB) % m3/h
```

```
VdotBsol = 0.2664
```

Kaskada, druhy T2=T+10

```
k2=k8*exp(-EA/8.314/(T+10)) % m^1.5 / kmol^0.5 h
```

```
k2 = 0.0188
```

```
syms VdotC cA2
eq3 = cA0*VdotC - k*cA2^1.5*V == cA2*VdotC;
eq4 = cA2*VdotC - k2*cAend^1.5*V == cAend*VdotC;
sol=vpasolve([eq3 eq4],[VdotC cA2],[VdotBsol;cA0/2+cAend/2])
```

```
sol = struct with fields:
    VdotC: 0.42959786106697118395460561968397
      cA2: 6.879277236441538600081221157700 9
```

```
VdotCsol = eval(sol.VdotC) % m3/h
```

```
VdotCsol = 0.4296
```