[7-11] trubkový r.   A → B

$c_A = 0.1 \cdot c_{A0}$

$\dot{V} = 10 \ dm^3/min$

$k = 0.23 \ min^{-1}$

$V = ?$

$c_A = c_{A0} \cdot (1 - z) \Rightarrow z = 1 - \dfrac{c_A}{c_{A0}} = 1 - 0.1 = 0.9$

$\tau = \dfrac{V}{\dot{V}}$

doba
zdržení v reaktoru

$AKUM = VSTUP - VÝSTUP + ZDROJ$

$\dfrac{dn_A}{d\tau} = -1 \cdot r \cdot V$

$V \cdot \dfrac{dc_A}{d\tau} = -k \cdot c_A \cdot V$

$-V \cdot c_{A0} \cdot \dfrac{dz}{d\tau} = -k \cdot c_{A0} \cdot (1-z) V$

$\displaystyle\int_0^z \dfrac{dz}{1-z} = \int_0^\tau k \cdot d\tau = k \cdot \tau = -\ln(1-z)$

$\tau = -\dfrac{1}{k} \ln(1-z)$

$= -\dfrac{1}{0.23} \cdot \ln(1-0.9) = 10.01 \ min$

$X \equiv 1-z$
$dX = -dz \rightarrow \displaystyle\int_{X_1}^{X_2} -\dfrac{dX}{X} = -\Big[\ln X\Big]_{X_1}^{X_2} = -\Big[\ln(1-z)\Big]_0^z = \ln\dfrac{1-0}{1-z} = -\ln(1-z)$

objem reaktoru

$V = \tau \cdot \dot{V} = 10.01 \cdot 10 = 100.1 \ dm^3$

zdvojnásobení reaktoru => zdvojnásobení τ

$\tau_2 = -\dfrac{1}{k} \ln(1-z_2)$ $\tau_2 = 2 \cdot \tau_1 = 2 \cdot 10.01 \ min$

$\exp(-k \cdot \tau_2) = 1 - z_2$

$z_2 = 1 - \exp(-k \cdot \tau_2)$

$z_2 = 1 - \exp(-0.23 \cdot 2 \cdot 10.01) = 1 - 0.0102 = 0.99 = 99\%$