EXOS :

$A \longrightarrow 2B$. $r = k\, C_A$ $(k = 12\, min^{-1})$

ordre 1

φ_{gaz} $-r_A = r = k\, C_A$

1- Dans un réacteur Agité ouvert R.A.O, P = cte, T = cte.

A est pur et $Q_0 = 30\, l/min$ et $X_A = 0{,}92$ (92%).

on calcul le $V_{R.A.O}$.

$-r_A = r = k\, C_A$, $C_A = \frac{F_A}{Q}$ en φgaz :

$$C_A = \frac{F_{A0} - F_{A0} X_A}{Q_0 \beta (1 + \varepsilon_A X_A)} \qquad \beta = 1 \equiv \beta = \frac{P_0 T}{P\, T_0} \begin{cases} P = cte \\ T = cte \end{cases}$$

$$\boxed{C_A = \frac{C_{A0}(1 - X_A)}{(1 + \varepsilon_A X_A)}} \quad \text{car } \frac{F_{A0}}{Q_0} = C_{A0} \text{ et } \beta = 1.$$

$$\begin{cases} F_A = F_{A0} - F_{A0} X_A \\ F_A = F_{A0} - F_0 X \end{cases} \; ; \text{ A est pur } \boxed{F_0 = F_{A0}}$$

$$F_{A0} X_A = F_0 X \Rightarrow \boxed{X_A = X}$$

* $\varepsilon_A X_A = \varepsilon X \Rightarrow \varepsilon_A = \varepsilon \frac{X}{X_A} = \varepsilon$ car A est pur $X_A = X$

$\varepsilon_A = \varepsilon = \frac{\Delta\alpha}{1 + I} = \Delta\alpha = 2 - 1 = 1$

Pas d'inerte $I = \frac{F_{I0}}{F_0} = 0$

$$\boxed{\varepsilon_A = \varepsilon = 1}$$

R.A.O. $\tau_{R.A.O} = \frac{V_{R.A.O}}{Q_0} = \frac{C_{A0} X_A}{-r_A} = \frac{C_{A0} X_A}{k\, C_A}$

$$\tau_{R.A.O} = \frac{V_{R.A.O}}{Q_0} = \frac{C_{A0} X_A}{\frac{k\, C_{A0}(1 - X_A)}{(1 + \varepsilon_A X_A)}} = \frac{X_A (1 + \varepsilon_A X_A)}{k(1 - X_A)}$$

$$\boxed{V_{RAO} = \frac{Q_0}{k} \frac{X_A(1+X_A)}{(1-X_A)}}$$

A.N : $V_{RAO} = \frac{30}{12} \cdot \frac{0,92\,(1+0,92)}{(1-0,92)}$

$$\boxed{V_{R,AO} = 55,2\,l}$$

2 - Dans le cas d'un R.E.P. pour A = pur, $X_A = 0,92$

$Q_0 = 30\ l/min$ en V_{gaz} $(P, T = cte)$: même conditions

ici aussi $C_A = \frac{C_{A0}(1-X_A)}{(1+X_A)}$ et $\varepsilon_A = 1$.

$$\tau_{REP} = \frac{V_{REP}}{Q_0} = C_{A0} \int_0^{X_A} \frac{dX_A}{-r_A} = C_{A0} \int_0^{X_A} \frac{dX_A}{k\,C_A}$$

$$\Rightarrow V_{REP} = Q_0\, C_{A0} \int_0^{X_A} \frac{dX_A}{k\, C_{A0} \frac{(1-X_A)}{(1+\varepsilon X_A)}}$$

$$V_{REP} = \frac{Q_0}{k} \int_0^{X_A} \frac{(1+\varepsilon_A X_A)\, dX_A}{(1-X_A)} \quad \text{avec} \begin{cases} X_A = 0,92 \\ \varepsilon_A = 1 \end{cases}$$

Math. $\int_0^x \frac{1+\varepsilon x}{1-x} = \left[(1+\varepsilon)\ln\left(\frac{1}{1-x}\right) - \varepsilon x\right]_0^x$

$$\Rightarrow V_{REP} = \frac{Q_0}{k}\left[(1+\varepsilon_A)\ln\left(\frac{1}{1-X_A}\right) - (\varepsilon_A X_A)\right]$$

A.N : $X_A = 0,92$ et $\varepsilon_A = 1$.

$$\Rightarrow V_{R.E.P} = \frac{30}{12}\left[2\ln\left(\frac{1}{1-0,92}\right) - (1\cdot 0,92)\right]$$

$$\boxed{V_{REP} = 10,328\,l}$$

3- Cas d'un R.A.D en φgaz. alimentant par $\left\{\begin{array}{l}70\%\,A\\10\%\,B\\20\%\,I\end{array}\right\}$ molaire, quel sera X_A?? dans les conditions $\left\{\begin{array}{l}Q_0 = 30\,l/min\\k = 12\,min^{-1}\\V_R = 55{,}2\,l\end{array}\right.$

φgaz : $C_A = \dfrac{C_{A0}(1 - X_A)}{\beta(1 + \varepsilon_A X_A)} = \dfrac{C_{A0}(1 - X_A)}{1 + \varepsilon_A X_A}$ car $\beta = 1$ (T = cte, P = cte)

$\varepsilon_A X_A = \varepsilon X \Rightarrow \boxed{\varepsilon_A = \dfrac{\varepsilon X}{X_A}}$

$\varepsilon = \dfrac{\Delta\alpha}{1 + I}$ $\Delta\alpha = 2 - 1 = 1$

$I = \dfrac{F_{I0}}{F_0} \Rightarrow$

$I = \dfrac{20\%}{70\% + 10\%} = \dfrac{1}{4}$

$\varepsilon = \dfrac{\Delta\alpha}{1 + I} = \dfrac{1}{1 + \frac{1}{4}} = \boxed{\dfrac{4}{5} = \varepsilon}$

$\left.\begin{array}{l}F_A = F_{A0} - F_{A0} X_A\\F_A = F_{A0} - F_0 X\end{array}\right\} \Rightarrow F_{A0} X_A = F_0 X$

$\Rightarrow \dfrac{X}{X_A} = \dfrac{F_{A0}}{F_0} =$

$\dfrac{X}{X_A} = \dfrac{70\%}{70\% + 10\%} = \dfrac{7}{8} \Rightarrow \boxed{\dfrac{X}{X_A} = \dfrac{7}{8}}$

$\varepsilon_A = \dfrac{\varepsilon X}{X_A} = \left(\dfrac{4}{5}\right)\left(\dfrac{7}{8}\right) = \dfrac{7}{10}$

$\boxed{\varepsilon_A = 0{,}7}$

$$C_A = \frac{C_{A0}(1-X_A)}{1+\varepsilon_A X_A} = \boxed{\frac{C_{A0}(1-X_A)}{1+0{,}7X_A}}$$

Calcul de X_A ??

* R.A.O : $\tau_{RA.O} = \frac{V_{RAO}}{Q_0} = \frac{C_{A0} X_A}{-r_A} = \frac{X_A(1+\varepsilon_A X_A)}{k(1-X_A)}$ (déjà vu).

$$\tau_{R.AO} = \frac{V_{RAO}}{Q_0} = \frac{55{,}2}{30} = 1{,}84 \text{ min}$$

$$\tau_{RAO} = \frac{X_A(1+\varepsilon_A X_A)}{k(1-X_A)} \Rightarrow k\tau_{RAO}(1-X_A) = X_A(1+\varepsilon_A X_A)$$

$$\Rightarrow X_A + \varepsilon_A X_A^2 = k\tau_{RAO} - k\tau_{RAO} X_A$$

$$\Rightarrow \varepsilon_A X_A^2 + X_A(1+k\tau_{RA.O}) - k\tau_{R.A.O} = 0$$

On divise par ε_A.

$$X_A^2 + \left(\frac{1+k\tau_{RA.O}}{\varepsilon_A}\right) X_A - \left(\frac{k\tau_{R.A.O}}{\varepsilon_A}\right) = 0$$

A.N. $X_A^2 + \left(\frac{1+12 \cdot 1{,}84}{0{,}7}\right) X_A - \left(\frac{12 \cdot 1{,}84}{0{,}7}\right) = 0$

$$\boxed{X_A^2 + (32{,}97) X_A - 31{,}54 = 0}$$

$\Delta = b^2 - 4ac = 1087{,}021 + 126{,}16 = 1213{,}181$

$\sqrt{\Delta} = 34{,}831$

$X_{A_1} = \frac{-b-\sqrt{\Delta}}{2a} = \frac{-32{,}97-34{,}831}{2} < 0$

$X_{A_2} = \frac{-b+\sqrt{\Delta}}{2a} = \frac{-32{,}97+34{,}831}{2} = 0{,}9305$

$X_A = 0{,}9305 = 93{,}05\,\%$