EXO2:

Un bassin d'eau usée $V = 300 m^3$; $Q_0 = 36 m^3/h$.

$A \xrightarrow{\text{Liquide}} \text{Produit}$; $C_{A0} = 1 mol/m^3$.

$k = 0,36\ h^{-1}$ (= ordre 1 : $-r_A = r = k C_A$.)

1- Si la concentration à la sortie $C_{As} = 0,18\ mol/m^3$, calculer X. (avancement généralisé)

$\begin{cases} F_A = F_{A0} - F_{A0} X_A \\ F_A = F_A - F_0 X \end{cases}$ ici $F_{A0} = F_0$ et donc $X = X_A$ car A est pur.

calculer X revient à calculer X_A.

$$C_A = \frac{F_A}{Q} = \frac{F_A}{Q_0} = \frac{F_{A0} - F_{A0} X_A}{Q_0} = \begin{cases} C_{A0}(1 - X_A) \\ \text{et} \\ X = X_A \end{cases}$$

Calcul de $(X = X_A)$; $C_A = C_{A0} - C_{A0} X_A \Rightarrow X_A = X = \frac{C_{A0} - C_A}{C_{A0}}$

$X_A = X = \frac{1 - 0,18}{1} = 0,82$ $\boxed{X = X_A = 0,82}$

2- Si le bassin est un R.A.O :

a- Calcul de V_{RAO} pour un $X = X_A = 0,82$.

$\tau_{R.AO} = \frac{V_{RAO}}{Q_0} = \begin{cases} \frac{C_{A0} X_A}{-r_A} \\ \text{ou} \\ \frac{C_0 X}{r} \end{cases}$ ici $\begin{cases} C_0 = C_{A0} \\ X = X_A \end{cases}$ car A est pur

$r = -r_A = k C_A$.

$$\frac{V_{RAO}}{Q_0} = \frac{C_0 X}{r} = \frac{C_{A0} X_A}{k C_A} = \frac{C_{A0} X_A}{k C_{A0}(1 - X_A)} = \frac{X_A}{k(1 - X_A)}$$

$$V_{R.A.O} = Q_0 \frac{X_A}{k(1 - X_A)} = Q_0 \frac{X}{k(1 - X)} = \frac{36 \cdot 0,82}{0,36(1 - 0,82)}$$

$\boxed{V_{RAO} = 455,55 m^3} = 4,55 \cdot 10^5\ A.m^3$.

b- La Conversion (l'Avancement X) Si On garde $V_e = 300\ m^3$

$$\tau_{REA} = \frac{V_{REA}}{Q_0} = \frac{X_A}{k.(1-X_A)} \Rightarrow \frac{V_{REA}.k}{Q_0} = \lambda = \frac{X_A}{(1-X_A)}$$

$$\Rightarrow \lambda = \frac{X_A}{1-X_A} \qquad \lambda = \frac{300.936}{36} = 3.$$

$$\Rightarrow \lambda(1-X_A) = X_A \Rightarrow \lambda - \lambda X_A = X_A \Rightarrow \lambda = X_A(1+\lambda)$$

$$\boxed{X_A = \frac{\lambda}{1+\lambda}} \quad ; \quad X_A = \frac{3}{4} = 0,75$$

ici $X = X_A = 0,75$; l'Avancement generalisé

$$\boxed{\alpha = X_A = 0,75}$$

3- Si le bassin est un REP (réacteur à ecoulement Piston.

a- Calcul du V_{REP} ?

$$\tau_{REP} = \frac{V_{REP}}{Q_0} = C_0 \int_0^{\alpha} \frac{dX}{r} = C_{A0} \int_0^{X_A} \frac{dX_A}{-r_A}$$

mais $\begin{cases} C_0 = C_{A0} \\ \epsilon = X_A \end{cases}$ car A est pur. de plus $-r_A = r = kC_A$.

et $C_A = C_{A0}(1-X_A)$.

Calcul X revient à calculer X_A car $X_A = X$.

$$\frac{V_{REP}}{Q_0} = C_{A0} \int_0^{X_A} \frac{dX_A}{kC_A} = C_{A0} \int_0^{X_A} \frac{dX_A}{kC_{A0}(1-X_A)} = \frac{1}{k} \int_0^{X_A} \frac{dX_A}{1-X_A}$$

$$\frac{V_{REP}}{Q_0} = \frac{1}{k} \left[-\ln(1-X_A) \right]_0^{X_A} \Rightarrow \boxed{V_{REP} = \frac{Q_0}{k} \left[-\ln(1-X_A) \right]}$$

A.N: $V_{REP} = \frac{36}{3,6}\left[-\ln(1-0,82)\right] \Rightarrow \boxed{V_{REP} = 171,48\ m^3} = 1,7148.10^5\ m^3$

b. Avancement generalisé à la sortie pour $V_{REP} = 300\ m^3$

$$V_{REP} = \frac{Q_0}{k}\left[-\ln(1-X_A)\right] \quad \text{et } X_A = X.$$

$$\Rightarrow -\ln(1-X_A) = \frac{V_{REP}.k}{Q_0} = \lambda = \frac{300.0,36}{36} = 3.$$

$$\Rightarrow -\ln(1-X_A) = \lambda \Rightarrow \ln(1-X_A) = -\lambda$$

$$\Rightarrow 1-X_A = \exp(-\lambda) \Rightarrow X_A = 1-\exp(-\lambda)$$

$$X_A = X = 1-\exp(-\lambda) = 1-\exp(-3) =$$

$$\boxed{X = X_A = 0,9502} \Rightarrow \begin{cases} X = 0,9502 \\ X_A = 95,02\% \end{cases}$$