National Chung Hsing University / Polymer Synthesis / Spring 2013
Quiz 2

Name______________________

1. Calculate the minimum number of moles of ethylene glycol (HO-CH2-CH2-OH) needed to produce a gel when reacted with 2 moles of difunctional acid and 1 mole of tetrafunctional acid. (5 points)

2. Dow Chemicals wishes to limit chain length in their linear polycondensation reaction by adding monofunctional BC to the equimolar AA, BB reactant mix. Obtain an expression for the maximum number-average chain length possible at 100% conversion, $(\bar{x}_n)_{max}$, when N_B moles of B are added per mole of AA or BB. (5 points)

$n_x/N = P^{(x-1)}(1-P)$; $\bar{x}_n = 1/(1-P)$; $\bar{x}_n = (r+1)/(-2rP_A+r+1)$; $PDI = \bar{x}_w / \bar{x}_n$

$w_x/W = (x\, n_x) / (\bar{x}_n N) = x\, P^{(x-1)}(1-P)^2$; $\bar{x}_w = (1+P)/(1-P)$

$\alpha = (P_A P_B \rho)/[1 - P_A P_B (1-\rho)]$; $\alpha_c = 1/(f-1)$

1、

令 2. HO−CH₂−CH₂−OH A

$P_A \to 1$.

$$\frac{1}{3} = \frac{r \cdot 1^2 \cdot 0.5}{1 - r \cdot 1^2 (1-0.5)}$$

$$= \frac{0.5r}{1-0.5r}$$

$$\Rightarrow 1 - 0.5r = 1.5r$$

$$\Rightarrow r = \frac{1}{2} \Rightarrow \frac{N_{A0}}{N_{B0}} = \frac{1}{2} = \frac{2 \times \text{HO-CH}_2\text{-CH}_2\text{-OH moles}}{2 \times 2 + 1 \times 4}$$

$\Rightarrow$ $HO-CH_2-CH_2-OH$ 為 2 moles.

1、 $\alpha_c = \dfrac{1}{f-1} = \dfrac{1}{3}$ 令 $HO-CH_2-CH_2-OH$ B

$$\rho = \frac{1\times 4}{1\times 4 + 2\times 2} = \frac{1}{2}$$

$$\Rightarrow \frac{1}{3} = \frac{r \cdot P_A^2 \rho}{1 - r P_A^2 (1-\rho)} = \frac{P_B^2 \rho}{r - P_B^2 (1-\rho)}$$

for min. b-B-b needed $\Rightarrow P_B = 1$

$$\Rightarrow \frac{1}{3} = \frac{1^2 \cdot \frac{1}{2}}{r - 1^2 (1 - \frac{1}{2})} = \frac{\frac{1}{2}}{r - \frac{1}{2}}$$

$$\Rightarrow \frac{1}{3} r - \frac{1}{6} = \frac{1}{2}$$

$$\Rightarrow \frac{1}{3} r = \frac{4}{6} = \frac{2}{3}$$

$$\Rightarrow r = 2 = \frac{N_{A0}}{N_{B0}} = \frac{2\times 2 + 1\times 4}{2\times \text{b-B-b mole}}$$

$\Rightarrow$ b-B-b 為 2 moles

2. $\overline{X}_n = \dfrac{r+1}{-2rP_A+r+1}$

$$(\overline{X}_n)_{max} = \frac{r+1}{-2r+r+1} \quad (P_A \to 100\%)$$

$$= \frac{r+1}{-r+1} \qquad r = \frac{1}{1+(N_B/2)}$$

$$\Rightarrow (\overline{X}_n)_{max} = \frac{\frac{1}{1+(N_B/2)}+1}{-\frac{1}{1+(N_B/2)}+1} = \frac{4+N_B}{N_B} = 1+\frac{4}{N_B}$$