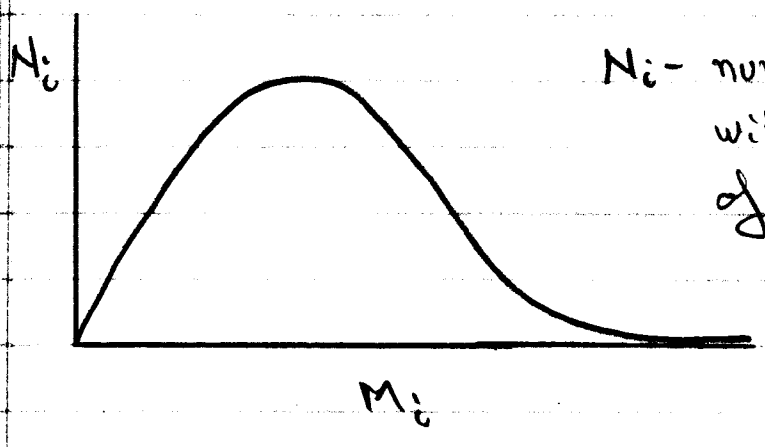
CHE 112

Molecular Weight

Synthetic polymers comprise of a distribution of chain lengths. The exact form of the molecular-weight distribution depends upon the specific conditions of polymerization. It is often convenient to define an average molecular weight for a MW distribution as given below.



N_i - number of moles of molecules with a molecular weight of M_i

$$\bar{M} = \frac{\sum_i N_i M_i^{\alpha}}{\sum_i N_i M_i^{\alpha-1}}$$

$\bar{M}$ - average molecular weight
α - weighting factor

$w_i = N_i M_i$, weight of molecules with molecular weight M_i

Number average Molecular Weight, $\bar{M}_n$ ($\alpha = 1$)
Weight average Molecular Weight, $\bar{M}_w$ ($\alpha = 2$)
Z- average Molecular Weight, $\bar{M}_z$ ($\alpha = 3$)

the average molecular weight can be calculated from either a discrete or a continuous distributions as given below

$$\bar{M}_n = \frac{\sum_{i=1}^{N_T} N_i M_i}{\sum_{i=1}^{N_T} N_i}$$

N_T - total number of discrete MW fractions

$$\bar{M}_w = \frac{\sum_{i=1}^{N_T} N_i M_i^2}{\sum_{i=1}^{N_T} N_i M_i}$$

or

$$\bar{M}_n = \int_0^\infty NM\,dM \Big/ \int_0^\infty N\,dM$$

$$\bar{M}_w = \int_0^\infty NM^2\,dM \Big/ \int_0^\infty NM\,dM$$

where $N = N(M)$

<u>problem 1</u>: Given the MW distribution below calculate the following: (a) number-average MW; (b) weight-average MW; and (c) the z-average MW