Tutorial 6 – Week 7

Aims:

Upon successfully completing these tutorial exercises, students should be able to:

- Perform calculations related to the structure of polymeric materials
- Describe and explain structure-property relationships in polymeric materials

Polymers

Exercise 5.1 Analysis of a sample of polypropylene showed the molecular weight distribution given in Table 4. From this information determine:

a) The number-average molecular mass, $\overline{M_n}$
b) The weight-average molecular mass, $\overline{M_w}$
c) The number-average degree of polymerisation, DP_n
d) The weight-average degree of polymerisation, DP_w

Molecular Weight Range (g/mol)	Number Fraction x_i	Weight Fraction w_i
8,000 - 16,000	0.05	0.02
16,000 -24,000	0.16	0.10
24,000 - 32,000	0.24	0.20
32,000 - 40,000	0.28	0.30
40,000 - 48,000	0.20	0.27
48,000 – 56,000	0.07	0.11

Exercise 5.2 For a linear polymer molecule, the total chain length *L* can be determined from the bond length between chain atoms *d*, the total number of bonds in the molecule *N*, and the angle between adjacent chain atoms θ, as follows:

$$L = Nd \sin\left(\frac{\theta}{2}\right)$$

Additionally, the average end-to-end distance *r* for a polymer molecule can be calculated using:

$$r = d\sqrt{N}$$

A linear polyethylene has a number average molecular weight of 300,000 g/mol. d=0.154nm, θ=109°. Determine:

a) the number-average degree of polymerisation, DP_n
b) the average total chain length, *L*
c) the average end-to-end distance, *r*