Properties of Polymers   Homework #2   Due on 12 June 2019

1. Do Problem 19.1. For the derivation of (b), you need to remember that the strain in the elastic range is small.
2. Do Problem 20.2 and 20.3.
3. Do Problem 21.2. The two-dimensional extension means the biaxial extension with $\lambda_1 = \lambda_2 = \lambda$ and $\lambda_3 = 1/\lambda^2$.
4. Do Problems 22.2. Refer to the discussion on p538-539 of the texstbook.
5. Do Problems 22.4. The stress condition (σ_1 and σ_2) where crazing and yielding occurs simultaneously is the intersection of the two criteria. Estimate it graphically. plane stress condition? $\sigma_3 = 0$.
6. Do Problem 23.1. In Table 23.2, b is the breadth, which is much larger than a to give a/b ≈ 0.
7. Do Problem 24.1, 24.2, 24.3, and 24.4.
8. Using the creep curve given below (Note that the strain is given in %);

(a) Construct the 1-day isochronous stress-strain curve.

(b) Estimate the Young's modulus after 1 year (~ 3 x 10^7 s) upon the stress of 20 MPa.

(c) For the polymer rod with the dimensions of 10 mm x 10 mm x 100 mm, what would be the cross-sectional area after 1 year upon the stress of 20 MPa along the 100-mm direction? Use the Poisson's ratio of 0.4.

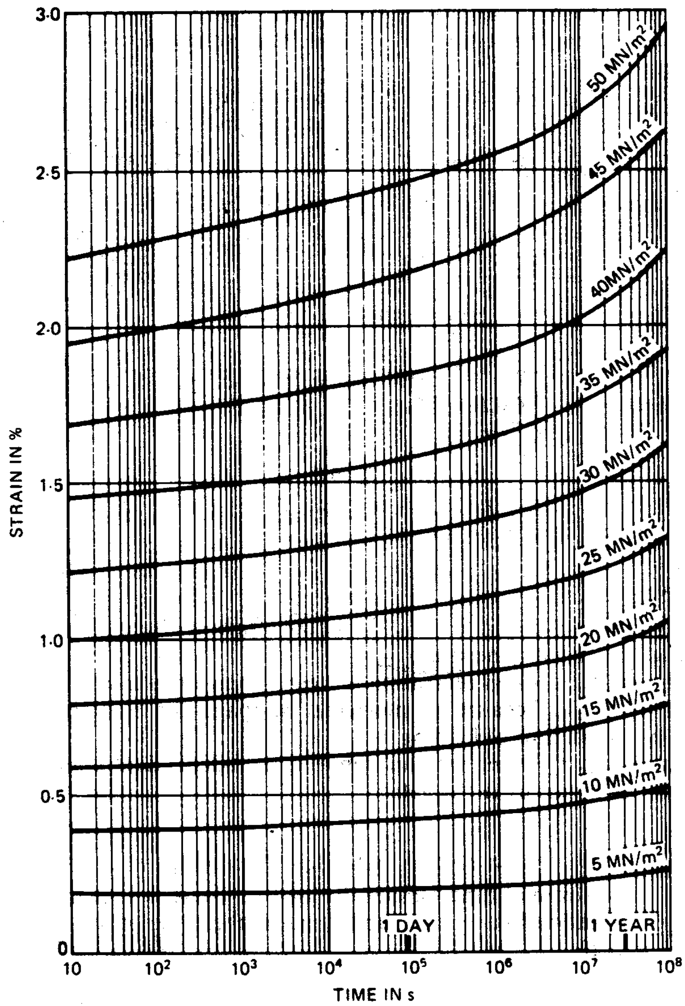
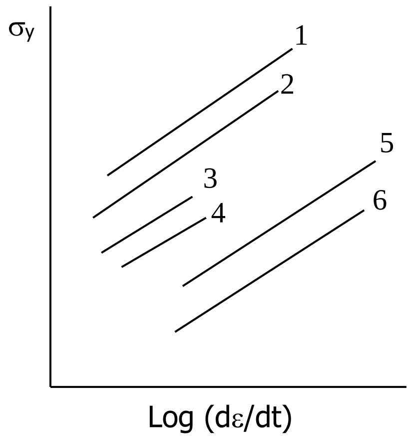


Figure 9.9. Curves for creep in tension of a commercial polysulphone (Polyethersulphone 300P–ICI) at 20°C. (From ICI Technical Service Note PES 101, reproduced by permission of ICI Plastics Division)

9. Yield stress of a polymer is plotted against strain rate as shown on the right.



(a) Line 1 – 4 were obtained from the following four different experiments on the same polymer;

A ~ uniaxial tension (true stress),

B ~ uniaxial tension (engineering stress),

C ~ uniaxial compression (true stress), and

D ~ uniaxial compression (engineering stress).

Relate line 1 – 4 to A – D, and explain your answer.

(b) Line 5 and 6 were obtained in experiments at a different temperature than the experiments for line 1 and 2. A higher or a lower temperature? Explain.