

Polymer Science 2025/26

Exercise 13

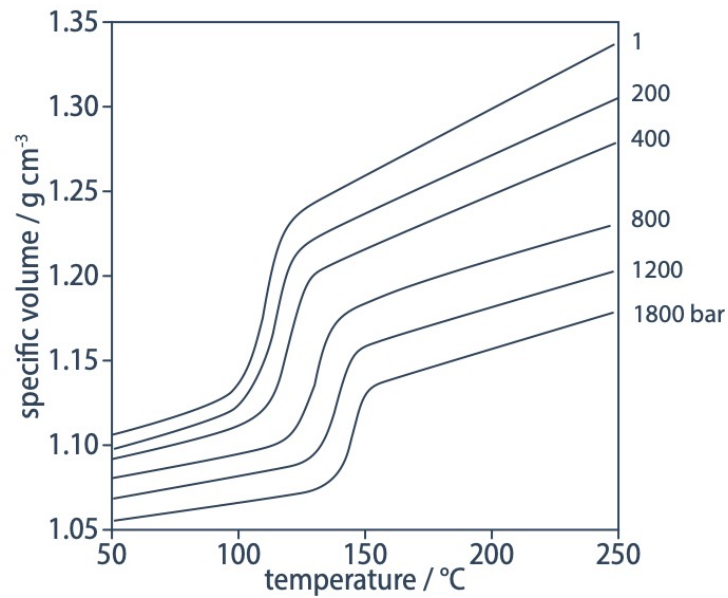
1. The least expensive semicrystalline polymers (iPP, HDPE, LDPE) are relatively ductile, but often not rigid enough for engineering applications. Other semicrystalline polymers such as PET, PPS, or PEEK show much higher stiffness and heat resistance and are therefore widely used as engineering materials.
 - a) What is the fundamental difference between these two groups of semicrystalline polymers?
 - b) Polyoxymethylene (POM, polyacetal) has a glass transition below 0 °C, yet it behaves as an engineering polymer. Draw its repeating unit and explain why its crystallization behavior compensates for the low T_g .

2. Polycarbonate (PC) can crystallize, yet in practice it is used almost exclusively as a fully amorphous polymer. Why is PC not considered a semicrystalline engineering polymer? Why is PC nevertheless classified as an engineering polymer, unlike inexpensive glassy polymers such as PS and PMMA?
 Tip: revisit the Chapter 5.3.

3. PET has excellent mechanical and barrier properties at low cost.
 - a) Why is PET not widely used in injection molding of large-series articles?
 - b) Why do these arguments not apply to PET bottles produced by injection stretch blow molding?
 - c) Copolyesters such as PETG (copolymers of terephthalic acid with ethylene glycol and cyclohexane dimethanol) are similar in price to PET. Could PETG substitute PET in all applications?

4. A manufacturer wants a dimensionally stable, high-heat styrenic material for electrical housings. Which material is more suitable: PPE/HIPS (Noryl-like blends) or SBS? Give a reason.

5. A PVT diagram shows isobars at 1, 200, 400, 800, 1200 and 1800 bar.
 - a) Does the diagram belong to an amorphous or semicrystalline polymer?



- b) The polymer is injected into a closed mold at 200 °C under 1800 bar. At what temperature should the pressure be released to minimize shrinkage? What happens if the pressure is released too early? (You can sketch the ideal change in specific volume versus temperature in the diagram above.)
- c) In real molds, temperature and pressure vary spatially. What consequences does this have for the microstructure of an injection-molded semicrystalline polymer?