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Example 1: *Crystallinity*

Calculate the density of a sample of polyethylene given that its crystallinity is 60% and that the density of totally amorphous polyethylene is 0.870 g/cm^3 and the density of totally crystalline polyethylene is 0.998 g/cm^3.

Example 2: *Mechanical Properties*

The tensile strength and number-average molecular weight for two polymethyl methacrylate materials are as follows:

Tensile Strength (MPa)	*Number Average Molecular Weight (g/mol)*
107	40,000
170	60,000

Estimate the tensile strength at a numberaverage molecular weight of 30,000 g/mol.

Example 3: *Glass Transition Temp.*

From the polymers listed below, which one(s) would be suitable for the fabrication of cups to contain hot coffee.

Material	*Glass Transition Temperature* [°C (°F)]	*Melting Temperature* [°C (°F)]
Polyethylene (low density)	−110 (−165)	115 (240)
Polytetrafluoroethylene	−97 (−140)	327 (620)
Polyethylene (high density)	−90 (−130)	137 (279)
Polypropylene	−18 (0)	175 (347)
Nylon 6,6	57 (135)	265 (510)
Polyester (PET)	69 (155)	265 (510)
Polyvinyl chloride	87 (190)	212 (415)
Polystyrene	100 (212)	240 (465)
Polycarbonate	150 (300)	265 (510)

Example 4: *Properties of Polymers*

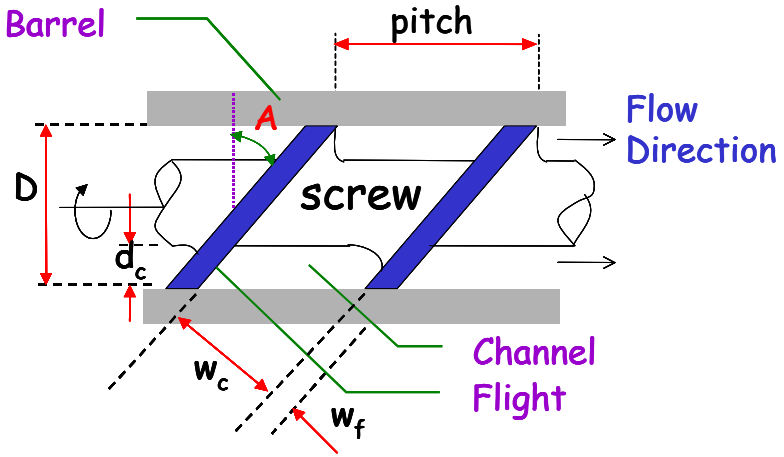
i- Elastomers and thermosetting polymers are both cross- linked. Why are their properties so different?

ii- Describe the difference in mechanical properties as a function of temperature between a highly crystalline thermoplastic and an amorphous thermoplastic.

iii- Discuss some of the defects that can occur in plastic injection molding.

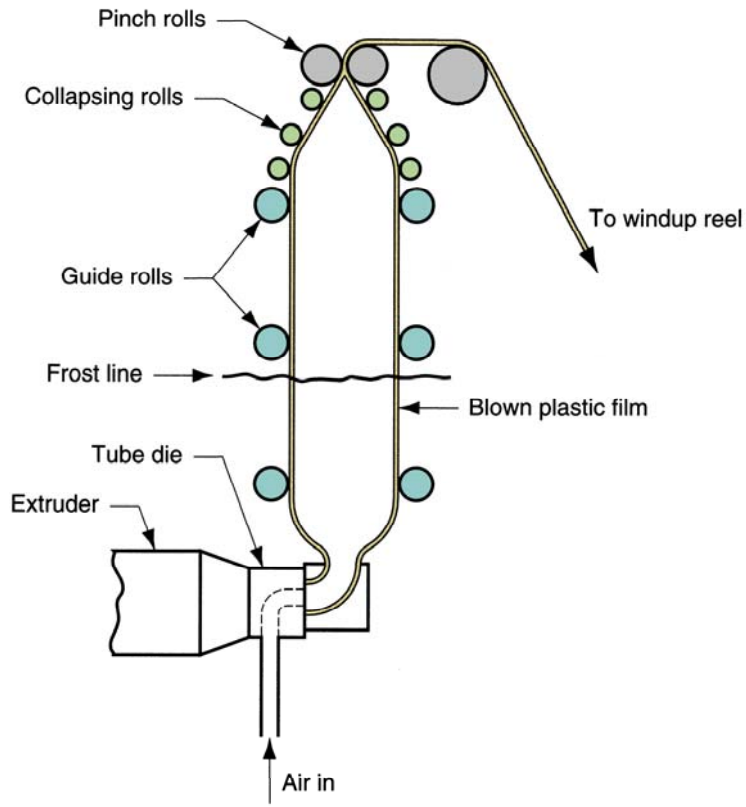
Example 5: *Extrusion*

An extruder has a barrel diameter = 4.0 in and length = 5.0 ft. The extruder screw rotates at 80 rev/min. It has a channel with depth = 0.15 in and flight angle = 20°. The polymer melt has a shear viscosity = 60 x 10^{-4} lb- sec/in^2 at the operating temperature of the process. The specific gravity of the polymer is 1.2. (a) Find the equation for the extruder characteristic. If a T-shaped cross-section is extruded at a rate of 0.13 lb/sec, determine: (b) the operating point (Q and p), and (c) the die characteristic that is indicated by the operating point.



Example 6: *Film Blowing*

Assume that a typical plastic shopping bag, made by blown film, has a lateral (width) dimension of 400 mm. (a) what should be the extrusion die diameter? (b) These bags are relatively strong. How is this strength achieved?



Example 7: *Polymer Processing*

a) Cite four factors that determine what fabrication techniques that are used to form polymeric materials.

b) Why must fiber materials that are melt spun and then drawn be thermoplastic?

c) Which of the following polyethylene thin films would have the better mechanical characteristics: the one formed by blowing, or by extrusion and then rolled? Why?

Next time:

Machining