CHAPTER 6:

Entanglement: - main reason why plastics have mechanical properties
- reason why polymer solutions are thick

Crystalline: - resists dissolving because it is harder to penetrate the tightly bound, highly ordered, crystalline regions

Amorphous: - often soluble in at least a few solvents

VISCOSITY:

- polymers are used to control viscosity
    - in shampoos, paints, glues, engine oil

common ingredient: PEO
- prepared by ring opening of ethylene oxide
- step-growth of ethylene glycol(PEG)
- when wet PEO/PEG feels slippery
- added to hair conditioner
- lubricating strip on a safety razor
- has a molar mass in the millions

- viscosity of a polymer will depend upon the concentration of the polymer in that solution

- viscosity also depends on its molar mass
    - higher molar mass means greater chain entanglement

- viscosity is also dependent upon temperature
    - increase in temperature decreases viscosity

ex. oil viscosity: 5W to 140W

multiviscosity
- changes less throughout the temperature change
- ultilizes a diblock copolymer in which one of the blocks forms an insoluble dispersion at low temperature but dissolves at higher temperatures increasing the viscosity

GELS:

- a chemically or physically crosslinked polymer that is highly swollen by solvent. The solvent is held tightly by the polymer network and does not flow. If the solvent is water it is called hydrogel.

- sodium polyacrylate

  - the sodium carboxylate acts like an ionic crosslinking agent

  - adding a small amount of an ionic compound breaks up the crosslink by osmosis

Other Gels:

1) Gelatin
- very dilute aqueous mixtures of natural polymer
- dissolve in water but interact strongly with each other and set-up or establish a network of physical crosslinks
- crosslinks can be broken down by heating

2) Polysaccharides
- Pectin: help gels jams
    - between the primary walls of adjacent plant cells is the ***middle lamella***
        - glues the cells together
        - thin layer rich in sticky polysaccharides (Pectin)

- Alginic acid (from brown algae)
    - contains many carboxylic acid groups
    - the sodium salt (sodium alginate) is soluble in water and is used as a thickener in ice cream

- Agar
    - from red algae

Other Uses for Gels:

1) Hydrogel: soft contact lenses
2) Polydimethylsiloxane - newer contact lenses

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Newtonian Fluids:

-the flow of a fluid depends directly upon the pressure behind it
- the viscosity remains constant and is independent of the pressure

NonNewtonian Fluids:

- when subject to some force, their viscosities can change

Shear Force:

- stirring or spreading

1) Shear thinning - ex. mayonnaise, paint, ballpoint pen ink, catsu
- viscous as they sit
- stirring decreases viscosity

2) Shear thickening - ex. starch solutions, wet sand, quicksand
- stirring or moving them increases viscosity

- for some materials, the amount of the viscosity increases or decreases depends upon how the shear force was applied
- once the force is removed, the original viscosity returns

Thixotropic

- the longer you shear the material, the runnier it becomes a the longer it remains so
- ex. latex paint, catsup, shaving cream, margarine

<u>CHAPTER 5/6 REVIEW</u>:

Chain Growth:
- initiator
- C=C

In + C=C --> intermediate
↓
radical

acid - cationic (effective with EDG on vinyl monomer)

stabilizes the carbocation
- isobutylene - good

base - anionic (nucleophile) - EWG
- acrylonitrile
- methylmethacrylate
- styrene (butyllithium catalyst)

Free Radical Example:

BzO•

Cationic Example:

$BF_3 + H_2O$

Anionic Example:

Superglue: solution of methyl α - cyanoacrylate

- small amounts of water or base is sufficent enough to initiate polymerization

Step-growth:

- 2 difunctional reactants

ex. Nylon 66

ex. polycarbonates

ex. polyurethane

Viscoelastic Fluids:

- fluids that undergo viscosity changes on shearing and are elastic

ex. silly putty
- hold upright: viscous liquid - slow shear force
- bounce it: rubbery - shear faster
- pull quickly: brittle/break - rapid shear

Films:
- polymer solution of appropriate viscosity is spread evenly onto a substrate and the solvent is allowed to evaporate at a controlled rate

Coating:
- 3 ingredients
  a) binder - polymer
  b) pigment - fine solid particles; may or may not provide color
  c) liquid - provide fluidity and allows even spreading and penetration into most intricate crevices

reasons for coating:
- improves their finish
- protest from corrosion or physical damage

ex. automobile body:
- polyester and pigment = primer
- dye containing middle coats
- acrylic or polyurethane as a clear top coat

2 kinds of solventless coating
1) powder coatings
- electrostatically applied to the surface and subsequent heat fused

2) solvent liquid oligomers
- polymer of 10 or fewer repeating units
- can be cured or set to the surface by exposure to either UV radiation or an electron beam

Adhesives: special type of coating

- should have:
  1) low volatility:
     will not dry too quickly
  2) high viscosity:
     allow control during application
  3) low surface tension:
     will not form spherical-shaped droplets on the surface
     fill in irregularities of the surface

2 types:

1) Specific:
   - pressure sensitive
     - flows under pressure and wets the surface and forms chemical bond with each surface
     - ex: silicon, superglues
     - triggered by atmospheric moisture

2) Mechanical:
   - gluing porous materials together
   - mechanically fastens the objects together

   ex. phenol/formaldehyde resins
   - makes laminates such as Formica