ENGINEERING CHEMISTRY

Department of Science and Humanities

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Functional materials-Polymers

Class content:

- ***Structure –property relationship***
  - ***Crystallinity***
  - ***Tensile strength***
  - ***Elasticity***
  - ***Chemical resistance***
  - ***Plastic deformation***

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Chemical resistance:

- Resistance to **swell, dissolve and get degraded** in the presence of a solvent or chemical
- It depends on the **chemical nature of monomeric units** and their **molecular arrangement**

- **Presence of polar and non-polar groups**: Like dissolves like - A polymer is more soluble in a solvent of similar chemical structure
  - Polymers having **polar groups** (–OH or –COOH groups) are usually attacked or **dissolved by polar liquids** such as water or alcohols. (e.g. PVA dissolves in water)
  - Polymers with **non-polar groups** such as $–CH_3$ and $–C_6H_5$ are not easily attacked by polar solvents but they easily **swell and sometimes dissolve in non-polar solvents** such as petrol, benzene and carbon tetrachloride

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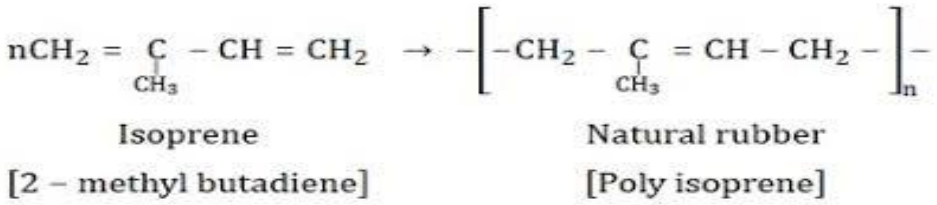
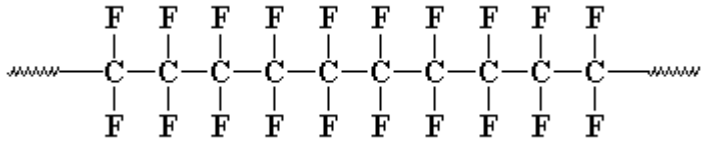
- **Residual unsaturation** leads to oxidative degradation: polymers with residual double bonds get attacked and degraded in air and UV light

e.g.,natural rubber



Source:https://www.embibe.com/study/natural-rubber-vulcanization-of-natural-rubber-concept?entity_code=KTBP50

- **Packing:** Dense packing does not allow the solvent to penetrate between the layers hence resistance increases, for example Teflon



Source:https://pslc.ws/macrog/ptfe.htm

- **Molecular mass:** For a given polymer, the swelling character decreases with the increase in the molecular mass
- **Degree of cross linking:** Greater the degree of cross linking lesser is the solubility

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Plastic deformation :

Property of a polymer by which on application of heat it becomes soft and flexible and on cooling it becomes hard and brittle is called **plasticity or plastic deformation**

Based on their **response to heat** two kinds of polymers are:

- **Thermoplastic** - A thermoplastic polymer is one which softens on heating and becomes hard on cooling. It can be remoulded into new shapes, e.g., Polyethylene, polypropylene, polystyrene

- **Thermosetting** - A thermosetting polymer becomes hard on heating. It cannot be remoulded, its structure instead undergoes a total degradation on heating, e.g.,Bakelite, Aniline aldehyde resin, urea formaldehyde resin

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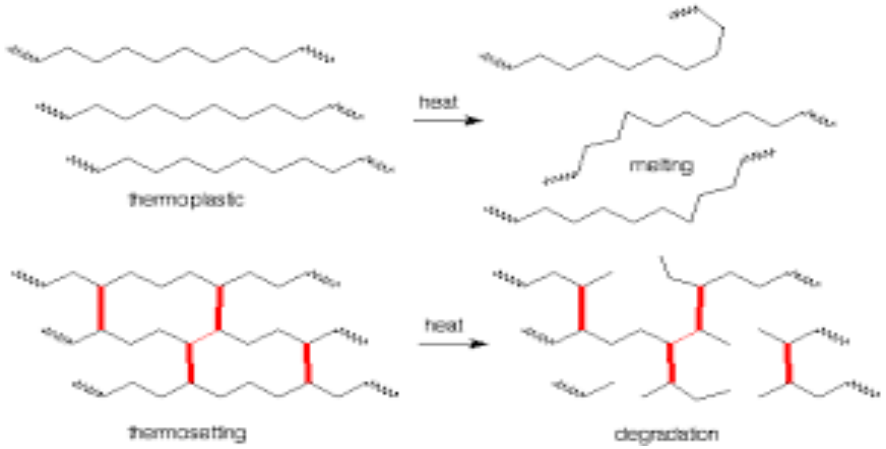
The reason for the **difference** in the thermal behaviour is:

•Thermoplastics have **relatively weak forces of attraction** like van der Waals forces, dipole-dipole attraction or H-bonding between the chains, which are overcome when the material is heated

• Thermosetting plastics have the **cross-linking** between the chains is by strong covalent bonds cannot be broken easily. On strong heating will result in charring and degradation



Source:http://chemistry2.csudh.edu/rpendarvis/Polymer.html

THANK YOU

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