

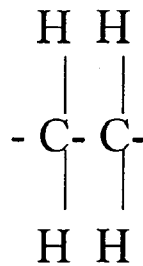
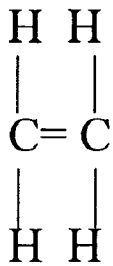
## Polymeric Materials

A polymeric solid material may be considered to be one that contains many chemically bonded parts or units which themselves are bonded together to form a solid. Plastics can be divided into two classes, thermoplastics and thermosetting, depending on how they are structurally chemically bonded.

Thermoplastic: Require heat to make them formable and after cooling, retain the shape they were formed into. These materials can be reheated and reform into a new shapes a number of times without significant change in their properties. Most thermoplastics consist of very long main chains of carbon atoms covalently bonded together.

Thermosetting plastic: Formed into a permanent shape and cured or 'set' by a chemical reaction cannot be remelted and reformed into another shape but decompose upon being heated to too high temperature. Thus, thermosetting plastics cannot be recycle.

Polymerisation In this process many small molecules are covalently bonded together to form very long molecular chains called monomers. The chemical process by which the monomers are chemically combined into long-chain molecular polymers is called chain-growth polymerisation. Ethylene molecule is activated so that the double bond between the two carbon atoms is "opened up" the double covalent bond is replaced by a single covalent bond.



**Polyethylene(PE)** Most extensively used plastic material(40% of total plastic. PE is a clear to whitish translucent, with the use of colorants a wide variety of colored products is obtained. There are two types of polyethylene, (1) low density (LDPE) (with lower strength) and high density (HDPE) (higher strength).

### **Properties**

- 1- Maximum use temperature is 82-110 C<sup>0</sup>.
- 2- Low cost
- 3- Good toughness at room temperature.
- 4- Good flexibility
- 5- Excellent corrosion resistance

**Application:** chemical tubing, houseware, blow-molding bottles, films for packing and material handling.

**Polyvinyl Chloride (PVC):** The presence of the large chlorine atom on every other carbon atom of the main chain of polyvinyl chloride. Second largest sales tonnage after PE.

**Properties:**

- 1-high strength and brittleness.
- 2- medium heat deflection temperature (57- 82 ° C)
- 3-high solvent resistance

**Polyvinyl chloride compounding**

- 1- Plasticizers imparts flexibility to polymeric materials.
- 2- Heat stabilizers prevent thermal degradation during processing and improve the life of product.
- 3- Lubricants aid the melt flow of PVC compounds during processing.
- 4- Pigments are used color, opacity and weatherability.

**Polypropylene** is the third most important plastic from a sales tonnage standpoint

Stronger, less flexible with higher melting point(165-177 C) than polyethylene. Has good chemical, moisture, and heat resistance along with low density.

Application, Housewares, laboratory ware and bottles of various types.

**Polystyrene** is the fourth largest tonnage thermoplastic. It is transparent and brittle unless modified. It has low chemical resistance and weatherability, good electrical properties and easily processed at low cost.

Applications automobile interior parts.

**ABS** Acrylonitrile, butadiene, and styrene. ABS materials are noted for their engineering properties such as good impact and mechanical strength combined with ease of processing. Acrylonitril contributes to heat and chemical resistance and toughness, butadien provides impact strength, and styrene provides surface gloss rigidity, and ease of processing.

Application pipe and fittings, automotive parts, refrigerator door liners, computer and telephone housing and cover.

**Polymethyl Methacrylate (PMMA) (trade name Plexiglass or lucite)** is very hard and rigid transparent with outdoor weatherability and more impact resistance than glass.

Application, glazing aircraft and boats, advertising sign, safety shield.

**Polytetrafluoroethylene (PTFE)(Teflon)** has an exceptional resistance to chemicals, impact strength and high temperature (300 °C). PTFE is slippery and waxy to the touch and has a low coefficient of friction.

Application: chemically resist pipe and pump parts, high temperature cable insulation, non stick coating, gaskets, seals, and O rings.

**Polyamides (Nylons)** has high strength, heat-deflection temperatures, good chemical resistance, low surface friction and good abrasion resistance.

Application; Unlubricated gears, bearings, Mechanical parts that must function at high temperatures and resist to

hydrocarbons and solvents, electrical parts subjected to high temperatures, It has high strength and rigidity. Automobile application(speedometer, windshield wiper gears. Glass-reinforced nylon is used for engine fan blades, brake fluid reservoirs. Electrical connectors, plugs, antenna mounts.

**Polycarbonate** has high strength, toughness and dimensional stability. Good electrical insulation properties. Application; aircraft components, electrical relay covers, helmets, boat propellers, traffic light housing.

### **Thermosetting Plastic**

- 1- High thermal stability
- 2- High rigidity
- 3- High dimensional stability
- 4- Resistance to creep and deformation under load
- 5- Light weight
- 6- High electrical and thermal insulating properties.

Usually processed by using compression or transfer molding. However, in some cases thermoset injection-molding techniques have been developed(for lowering the cost).

**Phenolics** ,low cost and have good electrical and heat insulating properties along with good mechanical properties (limited in color , black or brown).

Applications; electrical switchgear, connectors. Handles, knobs.

**Epoxy Resins** are used for wide variety of protective and decorative coatings.

**Unsaturated Polyesters** are used for making automobile panels and body parts, building panels, bathroom components, and tanks where good corrosion resistance are required.