Polymer blend and Composite

(Lecture 3)

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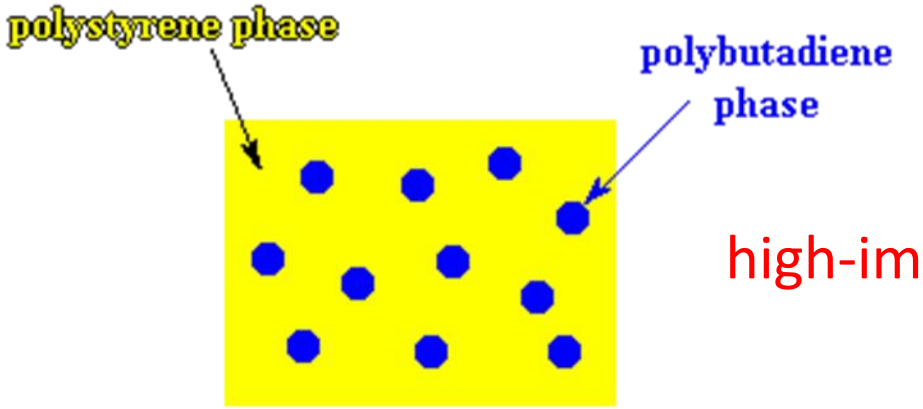
Polymer Blends

- Combination of two or more polymers or copolymers.
- 3 types:
- Immiscible (heterogeneous) polymer blends:
- example:



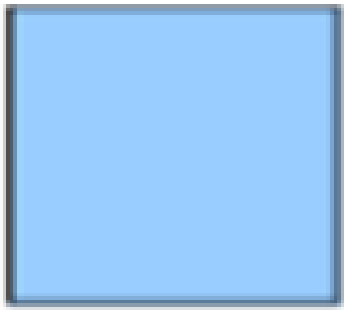
high-impact polystyrene

2. Compatible polymer blends

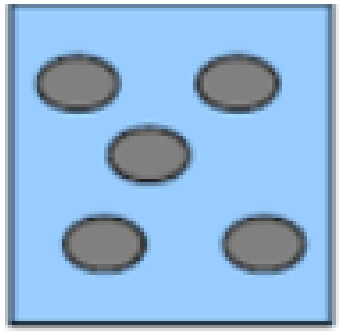
- Blends that miscible in a certain useful range of composition and temperature, but immiscible in others.
- Example: PC/ABS blends (Poly carbonate-Acrylonitrile butadiene styrene)

- 3. Miscible polymer blends (homogeneous) : Single phase structure.

- Example: PET-PBT (Poly ethylene terephthalate-Polybutylene terephthalate



Miscible PB



Immiscible PB

Properties

- Appear as separate phases, when viewed under a microscope.
- Between different polymer chains, only vander waals forces or hydrogen bonding exists.
- The properties are closely related to the properties of the individual components.
- Sensitive component of a blend may be protected from degradation by blending.
- Eg. PMMA is degraded by gamma-radiation. But its blend with styrene-acrylonitrile copolymer reduces the rate of degradation.
- Blending increases the properties like flame retardence, abrasive resistance etc.

Application

- Polycarbonate – Acrylonitrile butadiene styrene (PC-ABS) blend is used for making machine parts.
- Nylon 6-PC blend is used for making sport equipments and transport containers.
- Polydimethylphenylene –polystyrene (PDP-PS) blend possesses low water absorption, resistance to hydrolysis. Its used in electrical industries, radio and TV parts and automobile parts.
- ABS plastics(Acrylonitrile styrene with Butadiene styrene rubber). Posses high impact strength and high mouldability. ABS products are used in automobile industry for making panels, door bands, door covers etc.

COMPOSITES

- Material made from two or more constituent materials with significantly different physical or chemical properties that, when combined, produce a material with characteristics different from the individual components.
- The components do not dissolve or merge completely into each other but act together , while retaining their identities.

- Made up of individual materials (constituent materials).

1. Matrix (Polyester, vinyl ester, polyamides etc)

2. reinforcement (Eg; fibre)

- The matrix surrounds and supports the reinforcement material.
- The **reinforcement** impart their special mechanical and physical properties to enhance the matrix properties.

Classification

- Fiber reinforced composites:- Composed of fibers embedded in the Matrix material. Eg; glass reinforced plastic.
- Layered composites:- Composed of layers of materials held together by matrix (sandwich structures).eg; plywood
- Particulate composites:- Composed of particles distributed or embedded in a matrix body. The particles may be flakes or in powder form. Eg:- concrete

Materials Used in Polymer Composites

- Generally include fibre reinforced composites.
- The materials generally include Fibres: Glass fibres, Carbon fibres.
- Resins

    a) Thermosetting: Polyesters

    b) Thermoplastic: Polycarbonates, Polyacetals etc.

Properties

- Light in weight
- High strength
- Good corrosion resistance
- High temperature resistance
- Stronger and durable

USES (Applications)

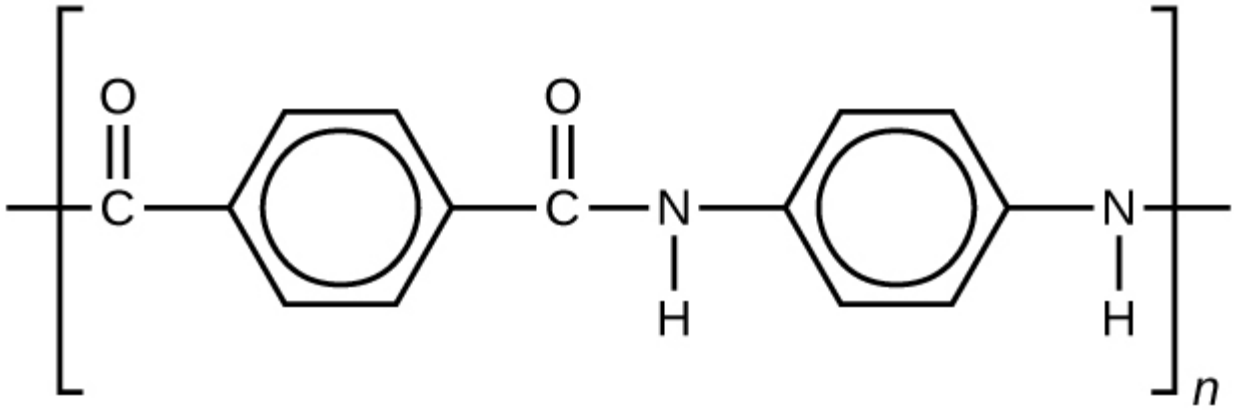
- Composites of phenolic resins and nylon are used in heat shields for space crafts.
- Also used for construction works
- Used to produce parts of aircrafts
- Used to produce parts for automobiles, trucks, rail etc.

Example of Polymer Composites

1. Fiber Reinforced Plastics (FRP)

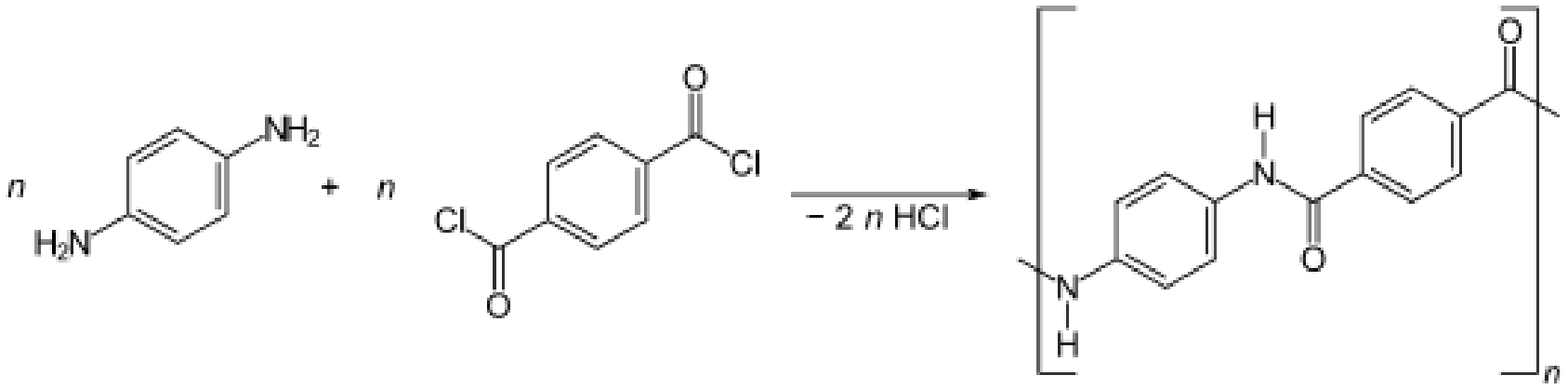
- Composed of fibers and a polymer matrix.
- Fibers are the main source of strength and the polymer matrix ‘glues’all the fibers together in shape.
- Common fiber reinforcing agents:glass, quartz, steel etc.
- Polymer matrix:-nylon, PE,, PP (Thermoplastic), Polyester, polyurethane etc (thermosetting)
- Providing strength to materials used in car engine components, aeroplane components etc.

Kevlar



- Aromatic polyamide
- Chemical composition is poly (para-phenylene terephthalamide.
- Used as a reinforcement material for some car tyres and bicycle tyres. It helps dramatically reduce puncture rates.

Preparation



polymerisation of 1,4-phenelene diamine and terephthaloyl chloride through a condensation reaction with the liberation of HCl as a byproduct.

Merits

- Light weight and high strength
- Thermally stable
- Very resistant to abrasion damage.
- Can be mixed with graphite in hybrid fabrics to provide damage resistance.

Demerits

- **Fibre of Kevlar Absorb moisture, so more sensitive to environment.**
- **Difficult to cut and drill..**

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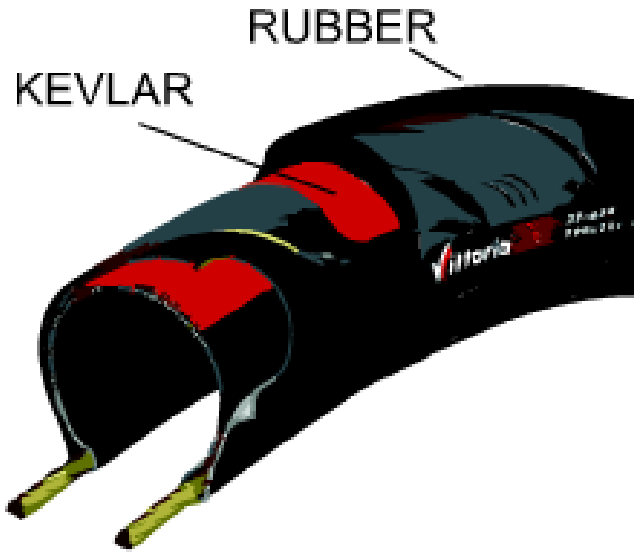
BICYCLE TYRE



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Kevlar

Applications

- Kevlar is used to manufacture gloves, jackets etc.
- Used in puncture resistant tyres, parts of aircrafts etc..
- Used to make industrial equipments such as hoses, belts etc.
- Used to make military equipments like bulletproof vests, helmets etc.

Crinkled Nylon