

Product design (d) thermoforming and thermosetting polymers

Thermoforming Polymers

- **These are materials that can be heated and shaped repeatedly, and are able to be recycled.**

Acrylic is hard with good plasticity when heated, so it can be bent and folded easily. Acrylic resists weather well, but it is easy to scratch and can be brittle. It is popular for car headlights, protective visors and baths.

Polypropylene (PP) is a lightweight polymer that is strong and tough, with good heat and chemical resistance. It is used to make computer game cases, patio chairs, children's toys and food wrapping film.

Polyvinyl chloride (PVC) is a low-cost polymer. It can be flexible or rigid, glossy or matt, and has good strength, chemical and weather resistance. It is used to make window and door frames, guttering and building cladding.

High density polythene (HDPE) is a stiff and lightweight polymer that provides excellent chemical resistance. It has good plasticity when heated, perfect for buckets, bottles, pipes and washing up bowls.

Polystyrene (PS) is an inexpensive sheet or foamed polymer. It is available in a range of opaque colours as well as transparent. It is used in schools for vacuum forming.

Thermosetting Polymers

- **These are materials that are formed once and cannot be recycled.**

Melamine formaldehyde has excellent resistance to heat, moisture, scratching and staining, making it perfect for kitchen worktops and tableware.

Epoxy resin is supplied in two parts, the resin and the hardener. Once mixed, they create a very strong adhesive, with good chemical and heat resistance and excellent thermal insulation.

Urea formaldehyde is a hard, stiff polymer with excellent electrical insulation properties, making it suitable for switches, plugs and electrical fittings.

Polyester resin forms with a reaction of acids and alcohol. It is commonly used in sheet moulding compound, and in toner of laser printers.

Sources of polymers

Polymers can be made from natural and synthetic resources.

- Synthetic polymers are made from crude oil by scientists and engineers.
- Natural polymers are made using a variety of materials like silk, wool, cellulose and proteins.

Properties of polymers

There are many different polymers and the selection of specific polymers for particular purposes can relate to cost, resistance to corrosion, strength, strength/weight ratio, conductivity, elasticity, stiffness or malleability.

Differences between thermoforming and thermosetting polymers

The main difference is that a thermosetting polymer will strengthen when heated, and cannot be remoulded or heated after the initial forming. A thermoplastic can be reheated, remoulded and cooled as needed without causing a chemical change.

Availability of polymers

Polymers are available in a variety of forms including pellets, granules, foams, films, filaments, sheets, rods and bars.

Finishing of polymers

Some polymers that are formed in a mould are self-finishing. This means that the surface of the mould is smooth and that dictates the finish on the polymer.

If a polymer has been cut from its original stock form, for example a piece of acrylic cut from a sheet, the edges that have been cut will be rough, and they will need to be finished.

Other finishes can be applied to polymers. These include paint spraying, rubberising sprays and heat transfer printing.

Sometimes, decals and detailing can be added to polymers including vinyl cut graphics, flocking, and laser etching.