Polymers Knowledge Organiser Resist ant Materials

Property	Definition	Found in
polymer	The umbrella term for synthetic materials engineered from a string of monomers.	plastics, paints, man-made fibres. DNA is an example of a natural polymer.
plastic	A synthetic polymer available in many different types, widely used in packaging, product cases, toys and the car industry.	universal applications from toys to artificial limbs
thermoplastic	A polymer material which can be deformed and reformed using heat processes.	acrylic, polystyrene, ABS, nylon
thermoset plastic	A polymer that, once set, cannot be changed using heating processes, thereby making it more resistant to heat and fire.	urea formaldehyde (UF) is one of the most common types and is used in electrical fittings such as plugs and sockets. Bakelite, now rarely used, was an early plastic used commonly in the UK.
memory plastic	Some thermoplastics can be deformed using heat and then reformed back to their original shape using heat again. The polymer chains return to their original state hence 'memory'.	high impact polystyrene (HIPS) can be reverted to its original state when vacuum forming
stiffness	A material that resists bending, remains rigid.	acrylic, UF, polystyrene
tough (durable/strong)	Able to withstand rough handling or treatment. Offers good weather resistance.	polystyrene, PVC, ABS
transparent	A polymer that is clear-offering the same visual properties as glass, but with the safety benefits of often being shatterproof.	acrylic safety glass, moulded shapes such as jet-plane canopies, cellophane product packaging
brittle	A material which, through its stiffness and other properties, has less toughness and therefore may snap or crack in some situations.	acrylic, UF, Bakelite

Thermoplastics

Acrylic: A hard, tough thermoplastic available in sheet form and as granules for moulding. In its clear form, it makes a safe alternative to glass. Stiff, hard, durable, self-finishing, scratches easily.

Used in bicycle reflectors, car lights, safety glass, clothing.

Polyethylene Terephthalate (PET): One of the most common day-to-day thermoplastic polymers, widely used in food packaging and (in fibre form) clothing. Chemical-resistant, hard, stiff, strong.

Used in drinks bottles, food packaging, cosmetic packaging.

High Impact Polystyrene (HIPS): Inexpensive and widely used in many products as it is easily moulded. Suitable for food packaging. Flammable and not widely recycled. Expanded polystyrene is used in product packaging. High-impact, easy to shape, lightweight.

Used in low strength structural applications, vacuum formed packages and casings.

Polyvinyl Chloride (PVC): Good chemical and weather resistance, stiff, hard, tough, good insulator.

Used in construction-window frames, drain pipes, guttering. Widely used in the fashion industry in the flexible form of PVC.

Polypropylene (PP): Lightweight, hard, impact resistant, chemical resistant. Waxy finish.

Used in medical equipment, syringes, chair shells, kitchenware, crates.

Thermosetting Plastics

Silicone: Heat-resistant and rubber-like, this thermoset plastic is available in liquid form in many products. It is waterproof and mouldable. It is also heatproof and non-stick.

Used in food preparation, cake moulds, medicine, prosthetic body parts, baby toys.

Epoxy Resin (ER): High strength, good chemical and wear resistance, resists heat to 250°C.

Used in castings, adhesive, laminating paper, printed circuit boards.

Melamine Formaldehyde (MF): Stiff, hard, scratch resistant, brittle and dulls easily.

Used in decorative laminates for work surfaces and flooring, tableware, electrical insulation.

Phenol Formaldehyde (PF): Retains properties at low temperature, heat-resistant, easy to shape by casting.

Used in Bakelite products, coatings, adhesives, laboratory tops.

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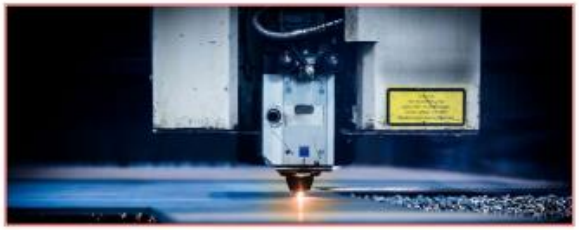
Wasting

Sheet plastics that are readily available in schools can be wasted by using the following resistant materials processes and tools:

- **Sawing:** coping saw; abra file,
- **Drilling:** hand drill and pillar drill.
- **Filing:** Most wood files.

Wasting Using CAD/CAM

Sheet plastic can also be wasted effectively using CAM, such as laser cutters and routers.



Addition

Thermoplastics can be joined using specialised adhesives, which must be handled responsibly.

Adhesives

Solvent glues (superglues) can be used to join some thermoplastics.
Heat Welding
A specialised 'gun' is used to heat both edges to be joined.

Solvent Welding

This is the most common method used in schools. A syringe is used to place a small amount of solvent on the two faces to be joined. A clean, permanent join can be created.

Fasteners

Many polymers can be joined using different fastening techniques, which may require drilling or machining. Sheet plastics such as acrylic can be laser cut with finger joints or slots to allow simple joins.

Deforming and Reforming

Thermoplastics are a resistant material but with the correct equipment, effective use of its properties can be realised.

- **Line Bender**

A thin wire is heated red hot. It is enclosed in the machine so only an exact line has heat applied to it, allowing you to make a clean bend.

- **Plastics Oven**

Allows you to heat an entire piece of plastic and then bend it by hand, or in a press, using leather gloves.