Industry wise, typical applications of polymers are summarized in Table 22.1.

Table 22.1

End-Use Industry	*Characteristics Required*	*Typical examples*	*Polymers*
Electrical Industry	Excellent insulation properties, flame retardant characteristics, toughness, durability	Plugs, sockets, wire and cable insulation	PE, PVC
Building Industry	Economical, Durable, Aesthetics	Piping, Guttering and conduit, flooring, window frames	PVC
Packaging Industry	Light, Aesthetics, Protection	Films –For Food –For Textile Bottles –For cola drinks –For oils, squashes Containers for chemicals	(HDPE) (PP) (PET) (PVC) PVC
Automotive Industry	Light weight (Fuel economy), Safety, economy in manufacture, ease of maintenance, Aesthetics	Electrical equipments (batteries, flex, plug, switches) Under the bonnet applications (Radiator fans, drain plugs, petrol tubing and coolant water reservoirs) Bumpers, radiator grills etc.	"Speciality Plastics"
Leisure industry	Performance, Aesthetics, Durability	Photographic film Audio tapes, CD's Rackets (sports)	PET (PS) (PC) (glass or carbon fiber reinforced materials)

The World of Plastics and Polymers

In 1907 Leo Bakeland patented Bakelite®, the first fully synthetic polymer. This hard plastic was used as an electrical insulator and paved the way for the more than 60,000 different synthetic plastics on the market today. Each year companies manufacture more than 30 million tons of plastics that are used in myriad of applications. We wear clothes containing polyester and nylon fibers, eat food packaged in polyethylene containers, drink water delivered through polyvinyl chloride pipes, walk on carpets made of polyolefin fibers, and sleep on mattresses made of polyurethane foam. The variety of applications of synthetic polymers is mind-boggling. The table lists some of the major classes of polymers and describes some of their useful properties and uses.

Uses of Polymers

Polymer	Properties	Applications
neoprene	very chemical resistant, rubbery	shoe soles, hoses, radiator hoses, wetsuits
polyamide (nylon)	fibrous, strong, durable, moisture resistant	parachutes, carpet, ropes, form-fitting skiwear, hosiery, swimware, boat sails
polyacrylonitrile	resinous, fibrous, or rubbery, combines with butadiene and styrene to form hard, tough ABScopolymer	ABS plumbing pipe, structural panels, kettle handles, housewares; Orlon® fabric
polychloro-trifluoroethylene	can be molded by extrusion, chemically resistant	gaskets, linings for containers, parts for valves and pumps
polyester	fibers recover quickly after extension and absorb very little moisture.	filters, conveyor belts, sleeping bag insulation, coat insulation, tire cords. Brand name polymers include:

		Dacron® , Fortrel® , Terylene® ; Mylar® & Lexan® .
polyethylene (high-density) HDPE	can be easily formed into lightweight containers	milk, water, and juice containers; toys, liquid detergent bottles
polyethylene (low-density)LDPE	can be stretched into fine, tough, films.	bread bags, frozen food bags, grocery bags
polyethylene terephthalate (PET, PETE)	strong, easily moldable, chemically resistant, light-weight	soft drink bottles, peanut butter jars, salad dressing bottles, nonbreakable bottles
polyolefin	fiber composed of at least 85% polyethylene or polypropylene	hosiery, sportswear, undergarments, pile fabrics, upholstery, outdoor furniture, indoor carpeting, indoor-outdoor rugs and carpets, filters, marine cordage, automobile seat covers, electrical insulation, carpet backing
polystyrene	thermoplastic; resists attack by acids, alkalis, and many solvents, does not absorb water; excellent electrical insulator.	Styrofoam® cups, grocery store meat trays, fast-food sandwich containers, video cassette cases, compact disk jackets, cafeteria trays, refrigerator insulation
polysulfone	tough, strong, stiff, chemically and thermally resistant	household and plumbing items, various automotive parts, wire coatings

polytetrafluoro-ethylene (PTFE)	strong, tough, waxy, nonflammable, chemically resistant, slippery surface, thermally stable	· Viton® : gaskets, bearings, linings for containers and pipes. · Teflon® : non-stick cookware, cooking utensils, pump valves, plumbing tape.
polyurethane	flexible foams, highly elastic quick drying fibers, or hard-drying films	· flexible foams: upholstery material, mattresses · rigid foams: cores for airplane wings · fibers: spandex clothing fiber, support hosiery; Lycra® , Numa® , Spandelle® , and Vyrene®. · hard films: polyurethane varnishes
polyvinyl alcohol	colorless, water-soluble, flammable resin	component in: adhesives, emulsifiers, lacquers, coatings, and films
polyvinyl chloride	rigid when unplasticized; flexible when plasticized	· unplasticized form: water pipe, plumbing fittings, phonograph records, synthetic floor tiles, credit cards · plasticized form: raincoats, shower curtains, and packaging films.
polyvinyl fluoride	resistant to attack by chemicals or by weathering	protective films for: building sidings, pipes, corrosive chemical containers
polyvinylacetate	water-insoluble resin	carpet backings; film-forming ingredient of water-based (latex) paints, adhesives, lacquers, and cements

30.12. POLYMERS IN MEDICINE

Polymers are increasingly used day-by-day in making biomaterials. **Biomaterials are** those materials which can be implanted in the body, for diagnostic, surgical and therapeutic purposes, **without causing any adverse effect** on the body. Certain metals, alloys, ceramics and polymers have been used as biomaterials, among them polymers are most important because they can be imparted properties more similar to the body. A polymer used in medical applications should be bio-compatible and should adhere to following characteristics.

(*i*) It should be pure and reproducible.

(*ii*) It should have optimum physical and chemical properties.

(*iii*) It can be fabricated into the desired shape, without alteration in its properties.

(*iv*) It should be easily sterilised.

(*v*) It should not adversely affect the blood and tissues of the body.

Two most widely used polymers in medical applications are silicone rubber (polydimethyl siloxane) and polyurethanes. Important applications of these two polymers are tabulated below.

Table 30.4. Polymers in Medical Use

	Polymer	*Applications*
1.	Polyurethane	Heart valves, blood filters, artificial heart, vascular tubing etc.
2.	Silicone rubber	Heart valves, drain tubes etc.
3.	Polymethyl methacrylate	Contact lenses, dental restoratives etc.
4.	Polyvinyl chloride	Disposable syringes etc.
5.	Polyethylene	Disposable syringes etc.
6.	Polypropylene	Heart valves, blood filters etc.