

A GUIDE TO THE STRUCTURE Y PROPERTIES OF RESINS.

Biological properties of plastics.

Most of the plastics used in our plasticware are biologically inert. Polyethylenes, polypropylene, polycarbonate, polystyrene, and teflon FEP have been shown to have no effect on tissue cultures. Distilled water for preparing culture media can be controlled and stored safely in polyethylene containers.

Polyolefins.

These resins are break-resistant, nontoxic, noncontaminating.

They are only plastics lighter than water/ They easily withstand exposure to nearly all chemicals at room temperature for up to 24 hours. Strong oxidizing agents eventually cause embrittlement. All polyolefins can be damaged by long exposure to ultraviolet light.

Polyethylene. The polymerizations of ethylene results an essentially straight-chained, high molecular weight hydrocarbon. Branching (side chain formation) occurs to an extent and can be controlled. Minimum branching results in high-density polyethylene (HDPE), also called linear polyethylene because of its closely packed molecular chains.

More branching gives a less compact solid known as low-density or conventional polyethylene (LDPE). In general, HDPE has greater chemical resistance, than LDPE, and is more rigid. Polyethylene is chemically unreactive: Strong oxidizing agents eventually cause some oxidation; some solvents cause softening or swelling, but no solvent is known for polyethylenes at room temperatures.

Polypropylene. (PP) is similar to polyethylene, but each unit of the chains has a methyl group attached. It is translucent, autoclavable, and has no known solvent at room temperature. It is slightly more susceptible to strong oxidizing agents than conventional polyethylene because of its many branches (methyl groups).

Polymethylpentene. (PMP or TPX) is similar to polypropylene, but has an isobutyl group attached to each unit of the chain instead of a methyl group. Its chemical resistance is closer to that of PP. It is more easily softened by some hydrocarbons and chlorinated solvents, and strong oxidizing agents will attack it over a period of time. Its excellent transparency, rigidity, and chemical resistance, plus its resistance to impact and to high temperatures, make PMP a superior material for labware. PMP withstands repeated autoclaving, even at 150 ° C. It can be used intermittently to 175°.

Polycarbonate (PC)

Toughest of all thermoplastics, polycarbonate is window-clear, amazingly strong and rigid, autoclavable, and non-toxic. Polycarbonate is a special type of polyester in which dihydric phenols are joined through carbonate linkages. These linkages are subject to chemical reaction with bases and concentrated acids, hydrolytic attack at elevated temperatures (e.g., during autoclaving), and make PC soluble in various organic solvents. The transparency and unusual strength make PC ideal for high-speed centrifuge ware.

Polysulfone (PSF)

Clear, strong, nontoxic and virtually unbreakable. Unlike polycarbonate, polysulfone will hydrolyze during autoclaving and has a natural straw-colored cast. PSF is resistant to acids, bases, aqueous solutions, aliphatic hydrocarbons and alcohols. PSF is composed of phenylene units linked by three different chemical groups—*isopropylidene*, ether and sulfone. Each of the three linkages imparts specific properties to the polymer... chemical resistance, temperature resistance and impact strength.

Polystyrene (PS)

Rigid, with excellent dimensional stability.

Polystyrene has good chemical resistance to aqueous solutions. This extremely clear material is commonly used for disposable laboratory products.

Polyvinyl Chloride (PVC)

Similar in structure to polyethylene, but each unit contains a chlorine atom. The chlorine atom renders it vulnerable to some solvents, but also makes it more resistant in many applications. (PVC has extremely good resistance to oils and very low permeability to most gases.) PVC is transparent and has a slight bluish tint.

Narrow-mouth bottles made of PVC are relatively thin-walled and can be flexed slightly. When blended with phthalate ester plasticizers, PVC becomes soft and pliable... ideal for laboratory tubing.

Fluorocarbons

Remarkable chemical resistance is typical of Teflon tetrafluoroethylene (TFE) and fluorinated ethylene propylene (FEP).

Teflon TFE. Is opaque white. Has the lowest friction coefficient of any solid. It makes superb stopcock and separatory funnel plugs because of its low friction and tight seal.

Teflon FEP. Is flexible, translucent, has a slight bluish cast and a heavy feel because of its higher density. It resists all known chemicals except molten alkali metals, elemental fluorine and fluorine precursors at elevated temperatures. It should not be used with concentrated perchloric acid. FEP withstands temperatures from -270° to $+205^{\circ}$ C, and may be sterilized repeatedly by all known chemical and thermal methods. It can even be boiled in nitric acid.

Teflon PFA. Is an opaque plastic with higher mechanical strength at elevated temperatures than TFE or FEP. Maximum continuous service temperature is $+500^{\circ}\text{F}$ ($+260^{\circ}$).

Tefzel ETFE. Is translucent white and slightly flexible, shares the remarkable chemical and temperature resistance of Teflon TFE and FEP, and has even greater mechanical strength and impact resistance.