Polyvinylchloride (tpPVC)

Description

Image

Caption

These boat fenders illustrate that PVC is tough, weather resistant and easy to form and

The material

PVC - Vinyl - is one of the cheapest, most versatile and - with polyethylene - the most widely used of polymers and epitomizes their multi-facetted character. In its pure form - as a thermoplastic, tpPVC - it is rigid, and not very tough; its low price makes it a cost-effective engineering plastic where extremes of service are not encountered. Incorporating plasticizers creates flexible PVC, elPVC, a material with leather-like or rubber-like properties, and used a substitute for both. By contrast, reinforcement with glass fibers gives a material that is sufficiently stiff, strong and tough to be used for roofs, flooring and building panels. Both rigid and flexible PVC can be foamed to give lightweight structural panels, and upholstery for cars and domestic use. Blending with other polymers extends the range of properties further: vinyl gramophone records were made of a vinyl chloride/acetate co-polymer; blow molded bottles and film are a vinyl chloride/acrylic copolymer.

Compositional summary

(CH2CHCl)n

General properties

Density	81.2	-	98.6	lb/ft^3
Price	* 0.762	-	0.93	USD/lb
Date first used	1940			

Mechanical properties

Young's modulus	0.31	-	0.6	10^6 psi
Shear modulus	0.111	-	0.216	10^6 psi
Bulk modulus	0.682	-	0.711	10^6 psi
Poisson's ratio	0.383	-	0.407	
Yield strength (elastic limit)	5.13	-	7.56	ksi
Tensile strength	5.9	-	9.45	ksi
Compressive strength	6.16	-	13	ksi
Elongation	11.9	-	80	% strain

Hardness - Vickers	10.6	-	15.6	HV
Fatigue strength at 10^7 cycles	2.35	-	3.78	ksi
Fracture toughness	1.33	-	4.66	ksi.in^0.5
Mechanical loss coefficient (tan delta)	0.00966	-	0.0187	

Thermal properties

Glass temperature	167	-	221	°F
Maximum service temperature	140	-	158	°F
Minimum service temperature	-190	-	-99.7	°F
Thermal conductor or insulator?	Good insulator			
Thermal conductivity	0.0849	-	0.169	BTU.ft/h.ft^2.F
Specific heat capacity	0.324	-	0.345	BTU/lb.°F
Thermal expansion coefficient	55.6	-	83.3	µstrain/°F

Electrical properties

Electrical conductor or insulator?	Good insulator			
Electrical resistivity	1e20	-	1e22	µohm.cm
Dielectric constant (relative permittivity)	3.1	-	4.4	
Dissipation factor (dielectric loss tangent)	0.03	-	0.1	
Dielectric strength (dielectric breakdown)	351	-	500	V/mil

Optical properties

Transparency	Translucent			
Refractive index	1.54	-	1.56	

Processability

Castability	1	-	2	
Moldability	4	-	5	
Machinability	3	-	4	
Weldability	5			

Eco properties

Embodied energy, primary production	*	6e3	-	6.63e3	kcal/lb
CO2 footprint, primary production	*	2.37	-	2.62	lb/lb
Recycle	✓				

Recycle mark

Supporting information

Design guidelines

In its pure form, PVC is heavy, stiff and brittle. Plasticizers can transform it from a rigid material to one that is almost as elastic and soft as rubber. Plasticized PVC is used as a cheap substitute for leather, which it can be made to resemble in color and texture. It is less transparent than PMMA or PC, but it also costs much less, so it is widely used for transparent, disposable containers. PVC is available as film, sheet or tube. It can be joined with polyester, epoxy or polyurethane adhesives. It has excellent resistance to acids and bases and good barrier properties to atmospheric gasses, but poor resistance to some solvents.

Technical notes

PVC can be a thermoplastic or a thermoset. There are many types of PVC: expanded rigid PVC, type I, type II, CPVC, acrylic/PVC blend, clear PVC.

Typical uses

tpPVC: pipes, fittings, profiles, road signs, cosmetic packaging, canoes, garden hoses, vinyl flooring, windows and cladding, vinyl records, dolls, medical tubes. elPVC: artificial leather, wire insulation, film, sheet, fabric, car upholstery.

Tradenames

Conoco, Dural, Ethyl, Flexalloy, Geon, Hy-vin, Keysor, Locovyl, Novatemp, Oxyclear, Polyvin, Satinflex, Sicron, Solvic, Solvin, Superkleen, Trosiplast, Unichem, Vestolit, Vinoflex, Vistel

Links

Reference

ProcessUniverse

Producers