PVC (chlorinated, molding and extrusion)

General information

Designation

Poly Vinyl Chloride (Chlorinated, Molding and Extrusion); CPVC

Tradenames

Boltaron, Geon, Protherm, Unitec

Typical uses

Hot water piping; fibers;

Composition overview

Compositional summary

Compound of chlorinated PVC: (CH2CHCl)n with additional random substitution of H by Cl. 63-66% chlorine compared to 56.7% in standard PVC.

Material family	Plastic (thermoplastic, amorphous)
Base material	PVC-C (Polyvinyl chloride, chlorinated)
Polymer code	PVC-C

Composition detail (polymers and natural materials)

Polymer	100			%

Price

Price	*	0.83	-	1.21	USD/lb
Price per unit volume	*	75	-	118	USD/ft^3

Physical properties

Density	0.0524	-	0.0564	lb/in^3

Mechanical properties

Young's modulus		0.316	-	0.495	10^6 psi
Yield strength (elastic limit)		7.69	-	8.41	ksi
Tensile strength		6.67	-	8.41	ksi
Elongation		20	-	50	% strain
Elongation at yield		4	-	7	% strain
Compressive modulus	*	0.316	-	0.495	10^6 psi
Compressive strength	*	7.25	-	9.72	ksi
Flexural modulus		0.318	-	0.405	10^6 psi
Flexural strength (modulus of rupture)		11.9	-	13.1	ksi
Shear modulus	*	0.113	-	0.177	10^6 psi
Bulk modulus	*	0.621	-	0.652	10^6 psi
Poisson's ratio		0.35	-	0.38	
Shape factor		5.3			

Hardness - Vickers	*	14	-	17	HV
Hardness - Rockwell M	*	72	-	90	
Hardness - Rockwell R	*	113	-	132	
Fatigue strength at 10^7 cycles	*	2.64	-	3.2	ksi
Mechanical loss coefficient (tan delta)	*	0.0122	-	0.017	

Impact & fracture properties

Fracture toughness	*	3.22	-	3.52	ksi.in^0.5
Impact strength, notched 23 °C		0.00581	-	0.00801	BTU/in^2
Impact strength, unnotched 23 °C		0.361	-	0.367	BTU/in^2

Thermal properties

Glass temperature		216	-	244	°F
Heat deflection temperature 0.45MPa		216	-	246	°F
Heat deflection temperature 1.8MPa		201	-	234	°F
Vicat softening point	*	216	-	246	°F
Maximum service temperature		185	-	212	°F
Minimum service temperature	*	-59.8	-	-23.8	°F
Thermal conductivity		0.0768	-	0.0832	BTU.ft/hr.ft^2.°F
Specific heat capacity	*	0.309	-	0.321	BTU/lb.°F
Thermal expansion coefficient		62	-	78	µstrain/°F

Electrical properties

Electrical resistivity		3.94e20	-	7.87e21	µohm.in
Dielectric constant (relative permittivity)		3	-	3.2	
Dissipation factor (dielectric loss tangent)		0.0189	-	0.0208	
Dielectric strength (dielectric breakdown)		599	-	625	V/mil

Magnetic properties

Magnetic type	Non-magnetic

Optical properties

Transparency	Opaque

Critical materials risk

Contains >5wt% critical elements?	No

Absorption & permeability

Water absorption @ 24 hrs		0.02	-	0.15	%
Permeability (O2)		3.76e-8	-	7.49e-8	ft^2/day.atm

Processing properties

Polymer injection molding	Acceptable			
Polymer extrusion	Acceptable			
Polymer thermoforming	Acceptable			
Linear mold shrinkage	0.3	-	0.7	%
Melt temperature	360	-	441	℉
Mold temperature	104	-	158	℉
Molding pressure range	14.9	-	39.9	ksi

Durability

Water (fresh)	Excellent			
Water (salt)	Excellent			
Weak acids	Excellent			
Strong acids	Excellent			
Weak alkalis	Excellent			
Strong alkalis	Excellent			
Organic solvents	Limited use			
Oxidation at 500C	Unacceptable			
UV radiation (sunlight)	Fair			
Flammability	Self-extinguishing			

Primary production energy, CO2 and water

Embodied energy, primary production	2.12e4	-	2.34e4	BTU/lb
Sources 51.8 MJ/kg (Franklin Associates,				
CO2 footprint, primary production	* 1.78	-	1.97	lb/lb
Water usage	* 5.48e3	-	6.06e3	in^3/lb

Processing energy, CO2 footprint & water

Polymer extrusion energy	* 2.47e3	-	2.73e3	BTU/lb
Polymer extrusion CO2	* 0.431	-	0.476	lb/lb
Polymer extrusion water	* 133	-	199	in^3/lb
Polymer molding energy	* 7.07e3	-	7.81e3	BTU/lb
Polymer molding CO2	* 1.23	-	1.36	lb/lb
Polymer molding water	* 322	-	484	in^3/lb
Coarse machining energy (per unit wt removed)	* 361	-	399	BTU/lb
Coarse machining CO2 (per unit wt removed)	* 0.063	-	0.0697	lb/lb
Fine machining energy (per unit wt removed)	* 1.78e3	-	1.96e3	BTU/lb
Fine machining CO2 (per unit wt removed)	* 0.31	-	0.342	lb/lb
Grinding energy (per unit wt removed)	* 3.35e3	-	3.7e3	BTU/lb
Grinding CO2 (per unit wt removed)	* 0.584	-	0.645	lb/lb

Recycling and end of life

Recycle	✓			
Embodied energy, recycling	* 7.18e3	-	7.95e3	BTU/lb
CO2 footprint, recycling	* 0.605	-	0.669	lb/lb
Recycle fraction in current supply	1.43	-	1.58	%
Downcycle	✓			
Combust for energy recovery	✓			
Heat of combustion (net)	* 5.52e3	-	5.8e3	BTU/lb
Combustion CO2	* 1.08	-	1.13	lb/lb
Landfill	✓			
Biodegrade	✗			

Links

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Reference
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