PVC (rigid, molding and extrusion)

General information

Designation

Poly Vinyl Chloride (Rigid, Molding); Type I

Tradenames

Acvitron; Advex; Alphacan; Apex; Apiflex; Arlinyl; Asnil; Benvic; Boltaron; Celtec; Certavin; Clealite; Crossvinil; Crylac; Decelith; Dural; Duromix; Ecolvin; Ecovil; Epivyl; EslonPlate; Etinox; Evicom; Evilon; Fiberloc; Formolon; Geon; GeonFiberloc; Hishiplate; Hy-Vin; Indovin; Kaneka; Lacovyl; Lajavinyl; Lucalor; Marvelate; Marvylan; Mazpound; Mecian; Mron; Nakan; NanYa; Neralit; Nipolit; Nordvil; Norvinyl; Novablend; Novacycle; Novatemp; Nuvin; Oxyclear; OxyVinyls; Palvinyl; Petvinil; Pevikon; Polanvil-S; Polyvin; Reon; Rimtec; Simona; Sinvoprene; Slovanyl; SolVin; Sumilite; Sunprene; Superkleen; Suvyl; Sylvin; Tanegum; Tarvinyl-S; Tecavinyl; Tefanyl; Treglum; Trocal; Tygon; Unichem; Vinidur; Vinika; Vinnolit; Vinoflex; Vintec; Vinuran; Vinycel; Vinychlon; Vinyfoil; Vistel

Typical uses

Pipe and pipe fittings; building products; bottles; film; records; floor tiling.

Composition overview

Compositional summary

Compound of PVC, (CH2CHCl)n, with stabilizer (commonly tin-based)

Material family	Plastic (thermoplastic, amorphous)
Base material	PVC (Polyvinyl chloride, rigid, unplasticized)
Polymer code	PVC

Composition detail (polymers and natural materials)

Polymer		100			%

Price

Price	*	0.913	-	1.01	USD/lb

Physical properties

Density		0.047	-	0.0538	lb/in^3

Mechanical properties

Young's modulus		0.36	-	0.479	10^6 psi
Yield strength (elastic limit)		6	-	7.64	ksi
Tensile strength		6	-	7.64	ksi
Elongation		40	-	80	% strain
Compressive modulus	*	0.35	-	0.479	10^6 psi
Compressive strength	*	5.37	-	6.43	ksi
Flexural modulus		0.392	-	0.493	10^6 psi
Flexural strength (modulus of rupture)		12	-	13.3	ksi
Shear modulus	*	0.128	-	0.172	10^6 psi
Poisson's ratio	*	0.395	-	0.405	
Shape factor		6.7			
Hardness - Vickers	*	12.4	-	15.8	HV
Hardness - Rockwell M	*	72	-	90	
Hardness - Rockwell R		105	-	130	
Hardness - Shore D		80	-	85	
Fatigue strength at 10^7 cycles	*	2.4	-	3.06	ksi
Mechanical loss coefficient (tan delta)	*	0.00966	-	0.0166	

Impact & fracture properties

Fracture toughness	*	3.3	-	3.5	ksi.in^0.5
Impact strength, notched 23 °C		0.00232	-	0.0033	BTU/in^2
Impact strength, notched -30 °C					

	*	6.11e-4	-	0.00122	BTU/in^2
Impact strength, unnotched 23 °C		0.361	-	0.367	BTU/in^2

Thermal properties

Glass temperature		176	-	190	°F
Heat deflection temperature 0.45MPa		154	-	169	°F
Heat deflection temperature 1.8MPa		149	-	163	°F
Vicat softening point	*	154	-	169	°F
Maximum service temperature		122	-	149	°F
Minimum service temperature		14	-	32	°F
Thermal conductivity		0.0849	-	0.121	BTU.ft/hr.ft^2.°F
Specific heat capacity		0.239	-	0.263	BTU/lb.°F
Thermal expansion coefficient		50	-	100	µstrain/°F

Electrical properties

Electrical resistivity		1e20	-	1e22	µohm.cm
Dielectric constant (relative permittivity)		3	-	3.2	
Dissipation factor (dielectric loss tangent)		0.02	-	0.03	
Dielectric strength (dielectric breakdown)		351	-	500	V/mil
Comparative tracking index		400	-	600	V

Optical properties

Refractive index		1.53	-	1.54	
Transparency		Transparent			

Magnetic properties

Magnetic type		Non-magnetic			

Bio-data

RoHS (EU) compliant grades?		✓			
Food contact		Yes			

Absorption & permeability

Water absorption @ 24 hrs		0.04	-	0.4	%
Water vapor transmission		0.836	-	0.924	g.mm/m².day
Permeability (O2)		8.86	-	17.7	cc.mil/day.(100.in^2).atm

Processing properties

Polymer injection molding		Acceptable			
Polymer extrusion		Excellent			
Polymer thermoforming		Limited use			
Linear mold shrinkage		0.2	-	0.6	%
Melt temperature		351	-	390	°F
Mold temperature		68	-	104	°F
Molding pressure range		9.98	-	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)	Good			
Flammability	Self-extinguishing			

Primary production energy, CO2 and water

Embodied energy, primary production	2.46e4	-	2.72e4	BTU/lb

Sources

50.8 MJ/kg (Franklin Associates, 2008); 50.9 MJ/kg (Franklin Associates, 2008); 52.4 MJ/kg (Song, Youn, Gutowski, 2009); 53 MJ/kg (Song, Youn, Gutowski, 2009); 53.2 MJ/kg (Patel, 2003); 56.1 MJ/kg (PlasticsEurope, 2010); 56.7 MJ/kg (PlasticsEurope, 2010); 57 MJ/kg (Kemna et al. 2005); 57.2 MJ/kg (Potting and Blok, 1996); 59.2 MJ/kg (Thiriez and Gutowski, 2006); 65.9 MJ/kg (PlasticsEurope, 2010); 77.2 MJ/kg (Hammond and Jones, 2008); 92.6 MJ/kg (Stripple, Westman, Holm, 2008)

CO2 footprint, primary production	2.79	-	3.08	lb/lb

Sources

1.6 kg/kg (PlasticsEurope, 2010); 1.9 kg/kg (PlasticsEurope, 2010); 2.16 kg/kg (Kemna et al. 2005); 2.5 kg/kg (PlasticsEurope, 2010); 3.1 kg/kg (Hammond and Jones, 2008); 6.33 kg/kg (Voet, van der and Oers, van, 2003)

NOx creation	0.0152	-	0.0168	lb/lb
SOx creation	0.0124	-	0.0137	lb/lb
Water usage	* 5.45e3	-	6.03e3	in^3/lb

Processing energy, CO2 footprint & water

Polymer extrusion energy	* 2.43e3	-	2.69e3	BTU/lb
Polymer extrusion CO2	* 0.424	-	0.469	lb/lb
Polymer extrusion water	* 132	-	198	in^3/lb
Polymer molding energy	* 6.01e3	-	6.64e3	BTU/lb
Polymer molding CO2	* 1.05	-	1.16	lb/lb
Polymer molding water	* 294	-	441	in^3/lb
Coarse machining energy (per unit wt removed)	* 323	-	357	BTU/lb
Coarse machining CO2 (per unit wt removed)	* 0.0564	-	0.0623	lb/lb
Fine machining energy (per unit wt removed)	* 1.39e3	-	1.54e3	BTU/lb
Fine machining CO2 (per unit wt removed)	* 0.243	-	0.268	lb/lb
Grinding energy (per unit wt removed)	* 2.58e3	-	2.85e3	BTU/lb
Grinding CO2 (per unit wt removed)	* 0.45	-	0.498	lb/lb

Recycling and end of life

Recycle	✓			
Embodied energy, recycling	* 8.34e3	-	9.24e3	BTU/lb
CO2 footprint, recycling	* 0.947	-	1.05	lb/lb
Recycle fraction in current supply	1.43	-	1.58	%
Downcycle	✓			
Combust for energy recovery	✓			
Heat of combustion (net)	* 7.52e3	-	7.9e3	BTU/lb
Combustion CO2	* 1.37	-	1.44	lb/lb
Landfill	✓			
Biodegrade	✗			

Recycle mark

Geo-economic data for principal component

Principal component	PVC (rigid)			
Annual world production	4.67e7	-	5.17e7	ton/yr
Reserves	6.46e8	-	7.14e8	l. ton

Eco-indicators for principal component

Eco-indicator 95	122			millipoints/lb
Eco-indicator 99	77.2			millipoints/lb
EPS value	564	-	624	

Links

ProcessUniverse

Producers

Reference

Shape