General information

Designation

Polyamideimide (Unfilled)

Tradenames

Duratron, Quadrant, Tecator, Torlon

Typical uses

Valves; bearings; electrical connectors; gears; parts for jet engines and internal combustion engines; printed circuit boards

Composition overview

Compositional summary

(-N-[CO2]-C6H3-CO-NH-R)n

Material family	Plastic (thermoplastic, amorphous)
Base material	PAI (Polyamide-imide)
Polymer code	PAI

Composition detail (polymers and natural materials)

Polymer	100			%

Price

Price	*	45.5	-	48.3	USD/kg
Price per unit volume	*	6.37e4	-	7e4	USD/m^3

Physical properties

Density	1.4e3	-	1.45e3	kg/m^3

Mechanical properties

Young's modulus		4.78	-	5.02	GPa
Yield strength (elastic limit)		38	-	42	MPa
Tensile strength		182	-	202	MPa
Elongation		13.9	-	16.1	% strain
Compressive modulus		3.9	-	4.1	GPa
Compressive strength	*	210	-	230	MPa
Flexural modulus		4.88	-	5.12	GPa
Flexural strength (modulus of rupture)		228	-	252	MPa
Shear modulus	*	1.65	-	1.73	GPa
Shear strength		122	-	134	MPa
Poisson's ratio		0.44	-	0.46	
Shape factor		9.42			
Hardness - Vickers		11	-	13	HV

Hardness - Rockwell M	105	-	115	
Hardness - Rockwell R	* 120	-	130	
Fatigue strength at 10^7 cycles	* 73	-	81	MPa
Mechanical loss coefficient (tan delta)	* 0.008	-	0.00832	

Impact & fracture properties

Fracture toughness	3.68	-	4.48	MPa.m^0.5
Impact strength, notched 23 ℃	13.3	-	14.7	kJ/m^2
Impact strength, unnotched 23 ℃	90.9	-	110	kJ/m^2

Thermal properties

Glass temperature	264	-	286	℃
Heat deflection temperature 0.45MPa	* 278	-	340	℃
Heat deflection temperature 1.8MPa	250	-	306	℃
Maximum service temperature	200	-	220	℃
Minimum service temperature	* -195	-	-185	℃
Thermal conductivity	0.25	-	0.27	W/m.℃
Specific heat capacity	994	-	1.03e3	J/kg.℃
Thermal expansion coefficient	29.8	-	31.4	µstrain/℃

Electrical properties

Electrical resistivity	2e22	-	2e24	µohm.cm
Dielectric constant (relative permittivity)	3.8	-	4.3	
Dissipation factor (dielectric loss tangent)	0.026	-	0.031	
Dielectric strength (dielectric breakdown)	22.8	-	24.8	MV/m
Comparative tracking index	100	-	250	V

Magnetic properties

Magnetic type	Non-magnetic

Optical properties

Refractive index	1.65	-	1.66	
Transparency	Opaque			

Critical materials risk

Contains >5wt% critical elements?	No

Absorption & permeability

Water absorption @ 24 hrs	0.31	-	0.35	%
Water absorption @ sat	3.8	-	4.2	%
Humidity absorption @ sat	2.6	-	3	%

Processing properties

Polymer injection molding	Limited use			
Polymer extrusion	Limited use			
Polymer thermoforming	Unsuitable			
Linear mold shrinkage	* 0.025	-	0.03	%
Melt temperature	305	-	370	℃
Mold temperature	* 200	-	215	℃
Molding pressure range	40	-	55	MPa

Durability

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

Primary production energy, CO2 and water

Embodied energy, primary production	* 274	-	302	MJ/kg
CO2 footprint, primary production	* 15.2	-	16.8	kg/kg
Water usage	* 700	-	774	l/kg

Processing energy, CO2 footprint & water

Polymer extrusion energy	* 5.85	-	6.46	MJ/kg
Polymer extrusion CO2	* 0.439	-	0.485	kg/kg
Polymer extrusion water	* 4.84	-	7.26	l/kg
Polymer molding energy	* 19.4	-	21.5	MJ/kg
Polymer molding CO2	* 1.46	-	1.61	kg/kg
Polymer molding water	* 12.9	-	19.4	l/kg
Coarse machining energy (per unit wt removed)	* 1.94	-	2.14	MJ/kg
Coarse machining CO2 (per unit wt removed)	* 0.146	-	0.161	kg/kg
Fine machining energy (per unit wt removed)	* 15.1	-	16.7	MJ/kg
Fine machining CO2 (per unit wt removed)	* 1.13	-	1.25	kg/kg
Grinding energy (per unit wt removed)	* 29.8	-	32.9	MJ/kg
Grinding CO2 (per unit wt removed)	* 2.23	-	2.47	kg/kg

Recycling and end of life

Recycle	✓			
Embodied energy, recycling	* 92.9	-	103	MJ/kg
CO2 footprint, recycling	* 5.16	-	5.7	kg/kg
Recycle fraction in current supply	0.1			%
Downcycle	✓			
Combust for energy recovery	✓			
Heat of combustion (net)	* 25	-	26.3	MJ/kg
Combustion CO2	* 2.44	-	2.56	kg/kg
Landfill	✓			
Biodegrade	✗			

Notes

Other notes

Torlon PAI grades must be cured by heat treatment after molding to achieve full mechanical properties.

Links

ProcessUniverse

Producers

Reference

Shape