

Description

Image



Caption

Isoprene is used for seals, tubing, vibration mounts, grips

The material

Isoprene (or Polyisoprene) is synthetic natural rubber, and is processed in the same way as natural rubber. It has low hysteresis and high tear resistance, making it bouncy and tough.

Composition (summary)

$(\text{CH}_2\text{-C}(\text{CH}_3)\text{-CH=CH}_2)_n$

General properties

Density	930	-	940	kg/m ³
Price	* 2.3	-	3	USD/kg
Date first used	1960			

Mechanical properties

Young's modulus	0.0014	-	0.004	GPa
Shear modulus	4e-4	-	6e-4	GPa
Bulk modulus	1.45	-	1.55	GPa
Poisson's ratio	0.499	-	0.5	
Yield strength (elastic limit)	20	-	25	MPa
Tensile strength	20	-	25	MPa
Compressive strength	23	-	25	MPa
Elongation	500	-	550	% strain
Fatigue strength at 10 ⁷ cycles	* 3.45	-	7	MPa
Fracture toughness	0.07	-	0.1	MPa.m ^{0.5}
Mechanical loss coefficient (tan delta)	* 0.82	-	2	

Thermal properties

Glass temperature	-83.2	-	-78.2	°C
Maximum service temperature	96.9	-	117	°C
Minimum service temperature	-53.2	-	-43.2	°C
Thermal conductor or insulator?	Good insulator			
Thermal conductivity	0.08	-	0.14	W/m.°C
Specific heat capacity	1.8e3	-	2.5e3	J/kg.°C
Thermal expansion coefficient	150	-	450	μstrain/°C

Electrical properties

Electrical conductor or insulator?	Good insulator			
Electrical resistivity	1e15	-	1e16	μohm.cm
Dielectric constant (relative permittivity)	* 2.5	-	3	
Dissipation factor (dielectric loss tangent)	2e-4	-	0.002	
Dielectric strength (dielectric breakdown)	16	-	23	1000000 V/m

Optical properties

Transparency	Translucent			
Refractive index	1.51	-	1.53	

Critical Materials Risk

High critical material risk?	No			
------------------------------	----	--	--	--

Processability

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

Durability: water and aqueous solutions

Water (fresh)	Excellent			
Water (salt)	Excellent			
Soils, acidic (peat)	Excellent			
Soils, alkaline (clay)	Excellent			
Wine	Excellent			

Durability: acids

Acetic acid (10%)	Acceptable			
Acetic acid (glacial)	Limited use			
Citric acid (10%)	Acceptable			
Hydrochloric acid (10%)	Acceptable			
Hydrochloric acid (36%)	Limited use			
Hydrofluoric acid (40%)				

	Limited use
Nitric acid (10%)	Acceptable
Nitric acid (70%)	Unacceptable
Phosphoric acid (10%)	Acceptable
Phosphoric acid (85%)	Acceptable
Sulfuric acid (10%)	Acceptable
Sulfuric acid (70%)	Unacceptable

Durability: alkalis

Sodium hydroxide (10%)	Excellent
Sodium hydroxide (60%)	Acceptable

Durability: fuels, oils and solvents

Amyl acetate	Unacceptable
Benzene	Unacceptable
Carbon tetrachloride	Unacceptable
Chloroform	Unacceptable
Crude oil	Unacceptable
Diesel oil	Unacceptable
Lubricating oil	Unacceptable
Paraffin oil (kerosene)	Unacceptable
Petrol (gasoline)	Unacceptable
Silicone fluids	Excellent
Turpentine	Unacceptable
Vegetable oils (general)	Unacceptable
White spirit	Unacceptable

Durability: alcohols, aldehydes, ketones

Acetaldehyde	Limited use
Acetone	Excellent
Ethyl alcohol (ethanol)	Excellent
Ethylene glycol	Excellent
Formaldehyde (40%)	Excellent
Glycerol	Excellent
Methyl alcohol (methanol)	Excellent

Durability: halogens and gases

Chlorine gas (dry)	Unacceptable
Fluorine (gas)	Unacceptable
O2 (oxygen gas)	Unacceptable
Sulfur dioxide (gas)	Unacceptable

Durability: built environments

Industrial atmosphere	Excellent
Rural atmosphere	Excellent
Marine atmosphere	Excellent
UV radiation (sunlight)	Poor

Durability: flammability

Flammability	Highly flammable
--------------	------------------

Durability: thermal environments

Tolerance to cryogenic temperatures	Unacceptable
Tolerance up to 150 C (302 F)	Acceptable
Tolerance up to 250 C (482 F)	Unacceptable
Tolerance up to 450 C (842 F)	Unacceptable
Tolerance up to 850 C (1562 F)	Unacceptable
Tolerance above 850 C (1562 F)	Unacceptable

Primary material production: energy, CO2 and water

Embodied energy, primary production	* 99.1	-	110	MJ/kg
CO2 footprint, primary production	* 5.11	-	5.65	kg/kg
Water usage	* 139	-	153	l/kg

Material processing: energy

Polymer molding energy	* 15.2	-	16.8	MJ/kg
Grinding energy (per unit wt removed)	* 6.33	-	6.99	MJ/kg

Material processing: CO2 footprint

Polymer molding CO2	* 1.22	-	1.34	kg/kg
Grinding CO2 (per unit wt removed)	* 0.474	-	0.524	kg/kg

Material recycling: energy, CO2 and recycle fraction

Recycle	✗			
Recycle fraction in current supply	0.1		%	
Downcycle	✓			
Combust for energy recovery	✓			
Heat of combustion (net)	* 42.5	-	44.6	MJ/kg
Combustion CO2	* 3.15	-	3.31	kg/kg
Landfill	✓			
Biodegrade	✗			
Toxicity rating	Non-toxic			
A renewable resource?	✗			

Environmental notes

Isoprenes are thermosets, and thus cannot be recycled. Their disposal creates an environmental

Supporting information**Design guidelines**

Isoprene has low hysteresis and high tear resistance, making it bouncy and tough.

Typical uses

Car tires and inner tubes, seals, belts, anti-vibration mounts, electrical insulation, tubing, rubber lining pipes and pumps, shoes.

Links

Reference

ProcessUniverse

Producers
