Butyl rubber (IIR)

Description

Image

Caption

Butyl rubber is one of the most important materials for inner tubes. © Granta Design

The material

Butyl Rubbers (IIR) are synthetics that resemble natural rubber (NR) in properties. They have good resistance to abrasion, tearing and flexing, with exceptionally low gas permeability and useful properties up to 150 C. They have low dielectric constant and loss, making them attractive for electrical applications.

Composition (summary)

(CH2-C(CH3)-CH-(CH2)2-C(CH3)2)n

General properties

Density	56.2	-	57.4	lb/ft^3
Price	* 1.77	-	2.04	USD/lb
Date first used	1937			

Mechanical properties

Young's modulus	1.45e-4	-	2.9e-4	10^6 psi
Shear modulus	4.35e-5	-	8.7e-5	10^6 psi
Bulk modulus	* 0.196	-	0.21	10^6 psi
Poisson's ratio	0.499	-	0.5	
Yield strength (elastic limit)	0.29	-	0.435	ksi
Tensile strength	0.725	-	1.45	ksi
Compressive strength	0.319	-	0.479	ksi
Elongation	400	-	500	% strain
Fatigue strength at 10^7 cycles	* 0.131	-	0.196	ksi
Fracture toughness	0.0637	-	0.091	ksi.in^0.5
Mechanical loss coefficient (tan delta)	* 0.89	-	2.1	

Thermal properties

Glass temperature	-99.7	-	-81.7	°F
Maximum service temperature	206	-	242	°F
Minimum service temperature	-60.1	-	-45.7	°F
Thermal conductor or insulator?	Good insulator			
Thermal conductivity	0.0462	-	0.0578	BTU.ft/h.ft^2.F
Specific heat capacity	0.43	-	0.597	BTU/lb.°F
Thermal expansion coefficient	66.7	-	167	µstrain/°F

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Electrical properties

Electrical conductor or insulator?		Poor insulator		
Electrical resistivity		1e15	- 1e16	µohm.cm
Dielectric constant (relative permittivity)	*	2.8	- 3.2	
Dissipation factor (dielectric loss tangent)		0.001	- 0.01	
Dielectric strength (dielectric breakdown)		406	- 584	V/mil

Optical properties

Transparency	Translucent		
Refractive index	1.5	- 1.52	

Processability

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

Eco properties

Embodied energy, primary production	*	1.21e4	- 1.34e4	kcal/lb
CO2 footprint, primary production	*	6.29	- 6.95	lb/lb
Recycle		✗		

Supporting information

Design guidelines

Natural rubber is an excellent, cheap, general-purpose elastomer with large stretch capacity and useful properties from -50 C to 115 C, but with poor oil, oxidation, ozone and UV resistance. It has low hysteresis - and is thus very bouncy

Typical uses

Inner tubes, seals, belts, anti-vibration mounts, electrical insulation, tubing, brake pads, rubber lining pipes and pumps.

Links

Reference

ProcessUniverse

Producers