

Description

Image



Caption

1. Rubber trees in Kerala, India © M.arunprasad at en.wikipedia - (CC BY-SA 3.0) 2. Rubber bands in different colors. © Bill Ebbesen at en.wikipedia - (CC BY-SA 3.0)

The material

Natural Rubber was known to the natives of Peru many centuries ago, and is now one of Malaysia's main exports. It made the fortune of Giles Macintosh who, in 1825, devised the rubber-coated waterproof coat the still bears his name. Latex, the sap of the rubber tree, is cross-linked (vulcanized) by heating with sulfur; the amount of the cross-linking determines the properties. It is the most widely used of all elastomers - more than 50% of all produced.

Composition (summary)

$(CH_2-C(CH_3)-CH-CH_2)_n$

General properties

Density	57.4	-	58.1	lb/ft ³
Price	* 1.61	-	1.77	USD/lb
Date first used	1751			

Mechanical properties

Young's modulus	2.18e-4	-	3.63e-4	10 ⁶ psi
Shear modulus	8.7e-5	-	1.16e-4	10 ⁶ psi
Bulk modulus	* 0.203	-	0.218	10 ⁶ psi
Poisson's ratio	0.499	-	0.5	
Yield strength (elastic limit)	2.9	-	4.35	ksi
Tensile strength	3.19	-	4.64	ksi
Compressive strength	3.19	-	4.79	ksi
Elongation	500	-	800	% strain
Fatigue strength at 10 ⁷ cycles	0.609	-	0.653	ksi
Fracture toughness	0.137	-	0.228	ksi.in ^{0.5}
Mechanical loss coefficient (tan delta)	* 0.8	-	1.9	

Thermal properties

Glass temperature	-109	-	-81.7	°F
Maximum service temperature	156	-	224	°F
Minimum service temperature	-69.1	-	-45.7	°F
Thermal conductor or insulator?	Good insulator			
Thermal conductivity	0.0578	-	0.0809	BTU.ft/h.ft ² .F
Specific heat capacity	0.43	-	0.597	BTU/lb.°F
Thermal expansion coefficient	83.3	-	250	µstrain/°F

Electrical properties

Electrical conductor or insulator?	Good insulator		
Electrical resistivity	1e15	-	1e16 μohm.cm
Dielectric constant (relative permittivity)	3	-	4.5
Dissipation factor (dielectric loss tangent)	7e-4	-	0.003
Dielectric strength (dielectric breakdown)	406	-	584 V/mil

Optical properties

Transparency	Translucent		
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Processability

Castability	4	-	5
Moldability	4	-	5
Machinability	2	-	3
Weldability	1		

Eco properties

Embodied energy, primary production	* 6.96e3	-	7.69e3 kcal/lb
CO2 footprint, primary production	* 1.97	-	2.18 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

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

Links

Reference

ProcessUniverse

Producers