Lignumvitae (t)

General information

Designation

Guaiacum spp. (T)

Typical uses

Bearing & bushing blocks; lining of stern tubes for steamship propeller shafts; underwater use; mallets; pulley sheaves; caster wheels; stencil; chisel block; turned articles; brush backs.

Composition overview

Compositional summary

Cellulose/Hemicellulose/Lignin/12%H2O

Material family	Natural			
Base material	Wood (tropical)			
Renewable content	100			%

Composition detail (polymers and natural materials)

Wood	100			%

Price

Price	* 6.7	-	10.8	USD/kg
Price per unit volume	* 7.44e3	-	1.45e4	USD/m^3

Physical properties

Density	1.11e3	-	1.35e3	kg/m^3

Mechanical properties

Young's modulus	* 11.2	-	12.5	GPa
Yield strength (elastic limit)	* 4.32	-	5.28	MPa
Tensile strength	* 7.2	-	8.8	MPa
Elongation	* 0.19	-	0.23	% strain
Compressive strength	* 21.8	-	26.6	MPa
Flexural modulus	10.1	-	11.3	GPa
Flexural strength (modulus of rupture)	* 7.2	-	8.8	MPa
Shear modulus	* 1.15	-	1.59	GPa
Shear strength	* 62.1	-	75.9	MPa
Rolling shear strength	* 2.3	-	6.9	MPa
Bulk modulus	* 5.19	-	5.85	GPa
Poisson's ratio	* 0.02	-	0.04	
Shape factor	5.7			
Hardness - Vickers	18	-	22	HV
Hardness - Brinell	* 68.2	-	83.3	HB

Hardness - Janka		18	-	22	kN
Fatigue strength at 10^7 cycles	*	2.16	-	2.64	MPa
Mechanical loss coefficient (tan delta)	*	0.007	-	0.009	
Differential shrinkage (radial)	*	0.32	-	0.39	%
Differential shrinkage (tangential)	*	0.53	-	0.65	%
Radial shrinkage (green to oven-dry)	*	3.2	-	7	%
Tangential shrinkage (green to oven-dry)	*	6.8	-	11.5	%
Volumetric shrinkage (green to oven-dry)	*	11	-	18	%
Work to maximum strength	*	21.4	-	26.1	kJ/m^3

Impact & fracture properties

Fracture toughness	*	1.23	-	1.5	MPa.m^0.5

Thermal properties

Glass temperature		77	-	102	℃
Maximum service temperature		120	-	140	℃
Minimum service temperature	*	-73	-	-23	℃
Thermal conductivity		0.22	-	0.27	W/m.℃
Specific heat capacity		1.66e3	-	1.71e3	J/kg.℃
Thermal expansion coefficient	*	46.1	-	59	µstrain/℃

Electrical properties

Electrical resistivity	*	2.1e14	-	7e14	µohm.cm
Dielectric constant (relative permittivity)	*	6.45	-	7.89	
Dissipation factor (dielectric loss tangent)	*	0.1	-	0.122	
Dielectric strength (dielectric breakdown)	*	1	-	2	MV/m

Magnetic properties

Magnetic type	Non-magnetic

Optical properties

Transparency	Opaque

Critical materials risk

Contains >5wt% critical elements?	No

Durability

Water (fresh)	Limited use
Water (salt)	Limited use
Weak acids	Limited use
Strong acids	Unacceptable
Weak alkalis	Acceptable

Strong alkalis	Unacceptable
Organic solvents	Acceptable
Oxidation at 500C	Unacceptable
UV radiation (sunlight)	Good
Flammability	Highly flammable

Primary production energy, CO2 and water

Embodied energy, primary production	* 11.6	-	12.8	MJ/kg
CO2 footprint, primary production	* 0.574	-	0.633	kg/kg
Water usage	* 665	-	735	l/kg

Processing energy, CO2 footprint & water

Coarse machining energy (per unit wt removed)	* 0.662	-	0.732	MJ/kg
Coarse machining CO2 (per unit wt removed)	* 0.0496	-	0.0549	kg/kg
Fine machining energy (per unit wt removed)	* 2.34	-	2.59	MJ/kg
Fine machining CO2 (per unit wt removed)	* 0.176	-	0.194	kg/kg
Grinding energy (per unit wt removed)	* 4.21	-	4.66	MJ/kg
Grinding CO2 (per unit wt removed)	* 0.316	-	0.349	kg/kg

Recycling and end of life

Recycle	✗			
Recycle fraction in current supply	8.55	-	9.45	%
Downcycle	✓			
Combust for energy recovery	✓			
Heat of combustion (net)	* 19.8	-	21.3	MJ/kg
Combustion CO2	* 1.69	-	1.78	kg/kg
Landfill	✓			
Biodegrade	✓			

Notes

Warning

All woods have properties which show variation; they depend principally on growth conditions and moisture

Links

ProcessUniverse
Reference
Shape