Bamboo (longitudinal)

General information

Designation

Bamboo (L)

Typical uses

Building & construction; scaffolding; furniture; pulp & paper making; ropes; reinforcement for concrete; frames for early aircraft.

Composition overview

Compositional summary

Cellulose/Hemicellulose/Lignin/12% H2O

Material family	Natural	
Base material	Wood (other: monocot, bark)	
Renewable content	100	%

Composition detail (polymers and natural materials)

Wood	100	%

Price

Price	*	0.608	-	0.912	USD/lb

Physical properties

Density		0.0217	-	0.0289	lb/in^3

Mechanical properties

Young's modulus		2.18	-	2.9	10^6 psi
Yield strength (elastic limit)	*	5.21	-	6.37	ksi
Tensile strength		23.2	-	46.4	ksi
Elongation	*	2.88	-	3.52	% strain
Compressive strength		8.7	-	14.5	ksi
Flexural modulus		2.47	-	3.19	10^6 psi
Flexural strength (modulus of rupture)		11.6	-	23.2	ksi
Shear modulus	*	0.175	-	0.197	10^6 psi
Shear strength		1.45	-	2.9	ksi
Bulk modulus	*	0.112	-	0.149	10^6 psi
Poisson's ratio		0.32	-	0.46	
Shape factor		5.6			
Hardness - Brinell		11.5	-	12.8	ksi
Fatigue strength at 10^7 cycles		4.25	-	5.7	ksi
Mechanical loss coefficient (tan delta)		0.012	-	0.022	
Radial shrinkage (green to oven-dry)		6.6	-	7.2	%
Tangential shrinkage (green to oven-dry)		4.1	-	8.2	%
Volumetric shrinkage (green to oven-dry)		10.9	-	15.8	%
Work to maximum strength		1	-	1.23	ft.lbf/in^3

Impact & fracture properties

Fracture toughness	*	5.19	-	6.37	ksi.in^0.5

Thermal properties

Glass temperature		171	-	216	°F
Maximum service temperature		248	-	284	°F
Minimum service temperature	*	-99.4	-	-9.4	°F
Thermal conductivity		0.0924	-	0.104	BTU.ft/hr.ft^2.°F

Specific heat capacity	0.396	-	0.408	BTU/lb.°F
Thermal expansion coefficient	1.44	-	2.28	µstrain/°F

Electrical properties

Electrical resistivity	* 6e13	-	2e14	µohm.cm
Dielectric constant (relative permittivity)	* 9	-	11	
Dissipation factor (dielectric loss tangent)	* 0.18	-	0.22	
Dielectric strength (dielectric breakdown)	* 10.2	-	15.2	V/mil

Optical properties

Transparency	Opaque

Magnetic properties

Magnetic type	Non-magnetic

Bio-data

RoHS (EU) compliant grades?	✓
Food contact	Yes

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	6.15	-	6.79	BTU/lb
Sources				
0.015 MJ/kg (Reiner, Pitterle and Whitaker, 2007)				
CO2 footprint, primary production	0.00194	-	0.00214	lb/lb
Sources				
0.00204 kg/kg (Reiner, Pitterle and Whitaker, 2007)				
NOx creation	* 0.00118	-	0.0013	lb/lb
SOx creation	* 0.00283	-	0.00312	lb/lb
Water usage	* 1.84e4	-	2.03e4	in^3/lb

Processing energy, CO2 footprint & water

Coarse machining energy (per unit wt removed)	* 661	-	730	BTU/lb
Coarse machining CO2 (per unit wt removed)	* 0.115	-	0.127	lb/lb
Fine machining energy (per unit wt removed)	* 4.77e3	-	5.27e3	BTU/lb
Fine machining CO2 (per unit wt removed)	* 0.832	-	0.92	lb/lb
Grinding energy (per unit wt removed)	* 9.34e3	-	1.03e4	BTU/lb
Grinding CO2 (per unit wt removed)	* 1.63	-	1.8	lb/lb

Recycling and end of life

Recycle	✗			
Recycle fraction in current supply	1.34	-	1.48	%
Downcycle	✓			
Combust for energy recovery	✓			

Heat of combustion (net)	* 8.49e3	-	9.16e3	BTU/lb
Combustion CO2	* 1.69	-	1.78	lb/lb
Landfill	✓			
Biodegrade	✓			

Geo-economic data for principal component

Principal component	Bamboo			
Annual world production	1.18e9	-	1.31e9	ton/yr

Main mining areas (metric tonnes per year)

China, India, Myanmar, Nigeria

Eco-indicators for principal component

Eco-indicator 95	2.99			millipoints/lb
Eco-indicator 99	0.213			millipoints/lb
EPS value	62.7	-	69.3	

Notes

Warning

Properties depend strongly on moisture content.

Links

ProcessUniverse

Reference

Shape