Redwood (sequoia sempervirens (young)) (l)

General information

Designation

Sequoia sempervirens (L)

Typical uses

Siding; sash; doors; blinds; finish; casket stock; containers; cooling towers; tanks; silos; wood-stave pipe; outdoor furniture; agricultural equipment; bridges; trestles; posts; fences; veneer; decorative plywood.

Composition overview

Compositional summary

Cellulose/Hemicellulose/Lignin/12%H2O

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

Composition detail (polymers and natural materials)

Wood		100		%

Price

Price	*	0.304	-	0.608	USD/lb

Physical properties

Density		0.0126	-	0.0155	lb/in^3

Mechanical properties

Young's modulus	*	1.09	-	1.33	10^6 psi
Yield strength (elastic limit)	*	4.61	-	5.63	ksi
Tensile strength	*	6.61	-	8.08	ksi
Elongation	*	1.63	-	2	% strain
Compressive strength		4.7	-	5.74	ksi
Flexural modulus		0.986	-	1.2	10^6 psi
Flexural strength (modulus of rupture)		7.11	-	8.69	ksi
Shear modulus	*	0.0812	-	0.0986	10^6 psi
Shear strength		1	-	1.22	ksi
Bulk modulus	*	0.0276	-	0.0305	10^6 psi
Poisson's ratio	*	0.35	-	0.4	
Shape factor		5.2			
Hardness - Vickers	*	1.81	-	2.21	HV
Hardness - Brinell	*	4.73	-	5.79	ksi
Hardness - Janka	*	407	-	497	lbf
Fatigue strength at 10^7 cycles	*	2.13	-	2.61	ksi
Mechanical loss coefficient (tan delta)	*	0.0087	-	0.0106	
Differential shrinkage (radial)		0.09	-	0.1	%
Differential shrinkage (tangential)		0.17	-	0.21	%
Radial shrinkage (green to oven-dry)		2	-	2.4	%
Tangential shrinkage (green to oven-dry)		4.4	-	5.4	%
Volumetric shrinkage (green to oven-dry)		6.3	-	7.7	%
Work to maximum strength		0.39	-	0.476	ft.lbf/in^3

Impact & fracture properties

Fracture toughness	*	2.18	-	2.64	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	*	0.104	-	0.121	BTU.ft/hr.ft^2.°F
Specific heat capacity		0.396	-	0.408	BTU/lb.°F
Thermal expansion coefficient	*	1.11	-	6.11	µstrain/°F

Electrical properties

Electrical resistivity	*	6e13	-	2e14	µohm.cm
Dielectric constant (relative permittivity)	*	4.16	-	5.09	
Dissipation factor (dielectric loss tangent)	*	0.044	-	0.054	
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?	✓

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		4.51e3	-	4.99e3	BTU/lb

Sources

2.5 MJ/kg (Ximenes, 2006); 3.4 MJ/kg (Ximenes, 2006); 5.7 MJ/kg (Ximenes, 2006); 5.88 MJ/kg (Hammond and Jones, 2008); 6.1 MJ/kg (Ximenes, 2006); 6.5 MJ/kg (Ximenes, 2006); 6.68 MJ/kg (Puettmann, Wagner and Johnson, 2010); 6.7 MJ/kg (Ximenes, 2006); 7.1 MJ/kg (Ximenes, 2006); 7.37 MJ/kg (Athena Sustainable Materials Institute, 2009 (5)); 7.72 MJ/kg (Puettmann, Bergman, Hubbard, Johnson, Lippke, Oniel and Wagner, 2010); 8.17 MJ/kg (Bergman and Bowe, 2010); 8.6 MJ/kg (Ximenes, 2006); 9.05 MJ/kg (Puettmann, Bergman, Hubbard, Johnson, Lippke, Oniel and Wagner, 2010); 9.19 MJ/kg (Joseph and Tretsiakova-McNally, 2010); 9.96 MJ/kg (Puettmann, Bergman, Hubbard, Johnson, Lippke, Oniel and Wagner, 2010); 13.3 MJ/kg (Ximenes, 2006); 13.4 MJ/kg (Lenzen and Treloar, 2002); 14 MJ/kg (Ximenes, 2006); 17.5 MJ/kg (Ximenes, 2006); 19.3 MJ/kg (Ximenes, 2006); 24 MJ/kg (Ecoinvent v2.2); 25.9 MJ/kg (Ximenes, 2006); 27.6 MJ/kg (Ecoinvent v2.2)

CO2 footprint, primary production		0.348	-	0.384	lb/lb

Sources

0.174 kg/kg (Joseph and Tretsiakova-McNally, 2010); 0.199 kg/kg (Ecoinvent v2.2); 0.271 kg/kg (Athena Sustainable Materials Institute, 2009 (5)); 0.296 kg/kg (Puettmann, Wagner and Johnson, 2010); 0.476 kg/kg (Ecoinvent v2.2); 0.564 kg/kg (Bergman and Bowe, 2010); 0.579 kg/kg (Hammond and Jones, 2008)

NOx creation		0.00257	-	0.00284	lb/lb
SOx creation		0.00656	-	0.00725	lb/lb
Water usage	*	1.84e4	-	2.03e4	in^3/lb

Processing energy, CO2 footprint & water

Coarse machining energy (per unit wt removed)	*	581	-	643	BTU/lb
Coarse machining CO2 (per unit wt removed)	*	0.101	-	0.112	lb/lb
Fine machining energy (per unit wt removed)	*	3.98e3	-	4.39e3	BTU/lb

Fine machining CO2 (per unit wt removed)	* 0.693	-	0.766	lb/lb
Grinding energy (per unit wt removed)	* 7.75e3	-	8.56e3	BTU/lb
Grinding CO2 (per unit wt removed)	* 1.35	-	1.49	lb/lb

Recycling and end of life

Recycle	✗			
Recycle fraction in current supply	8.55	-	9.45	%
Downcycle	✓			
Combust for energy recovery	✓			
Heat of combustion (net)	* 8.89e3	-	9.52e3	BTU/lb
Combustion CO2	* 1.76	-	1.85	lb/lb
Landfill	✓			
Biodegrade	✓			

Eco-indicators for principal component

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

Notes

Warning

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

Links

ProcessUniverse

Reference

Shape