Ash (fraxinus americana) (l)

General information

Designation

Fraxinus americana (L)

Typical uses

handles; oars; vehicle parts; baseball bats & other sporting & athletic

Composition overview

Compositional summary

Cellulose/Hemicellulose/Lignin/12%H2O

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

Composition detail (polymers and natural materials)

Wood	100		%

Price

Price	*	0.912	-	1.22	USD/lb
Price per unit volume	*	34.3	-	56.1	USD/ft^3

Physical properties

Density	0.0217	-	0.0267	lb/in^3

Mechanical properties

Young's modulus	*	1.73	-	2.1	10^6 psi
Yield strength (elastic limit)	*	6.89	-	8.41	ksi
Tensile strength	*	12.6	-	15.3	ksi
Elongation	*	1.97	-	2.41	% strain
Compressive strength		6.67	-	8.15	ksi
Flexural modulus		1.57	-	1.91	10^6 psi
Flexural strength (modulus of rupture)		13.5	-	16.5	ksi
Shear modulus	*	0.128	-	0.155	10^6 psi
Shear strength		1.73	-	2.1	ksi
Bulk modulus	*	0.135	-	0.151	10^6 psi
Poisson's ratio	*	0.35	-	0.4	
Shape factor		5.2			
Hardness - Vickers	*	6.07	-	7.42	HV
Hardness - Brinell	*	49	-	60	HB
Hardness - Janka	*	1.36e3	-	1.67e3	lbf
Fatigue strength at 10^7 cycles	*	4.05	-	4.95	ksi

Mechanical loss coefficient (tan delta)	* 0.0069	-	0.0084	
Differential shrinkage (radial)	* 0.17	-	0.2	%
Differential shrinkage (tangential)	* 0.28	-	0.34	%
Radial shrinkage (green to oven-dry)	4.4	-	5.4	%
Tangential shrinkage (green to oven-dry)	7	-	8.6	%
Volumetric shrinkage (green to oven-dry)	12	-	14.6	%
Work to maximum strength	1.24	-	1.52	ft.lbf/in^3

Impact & fracture properties

Fracture toughness	* 4.91	-	6.01	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	0.156	-	0.191	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	1.17e13	-	1.43e13	µohm.in
Dielectric constant (relative permittivity)	* 6.64	-	8.12	
Dissipation factor (dielectric loss tangent)	* 0.078	-	0.095	
Dielectric strength (dielectric breakdown)	* 10.2	-	15.2	V/mil

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	4.99e3	-	5.5e3	BTU/lb

Sources

0.5 MJ/kg (Ximenes, 2006); 2 MJ/kg (Ximenes, 2006); 9.1 MJ/kg (Hammond and Jones, 2008); 11.6 MJ/kg (Hubbard and Bowe, 2010); 23.7 MJ/kg (Ecoinvent v2.2); 26 MJ/kg (Ecoinvent v2.2)

CO2 footprint, primary production	0.574	-	0.633	lb/lb

Sources

0.229 kg/kg (Ecoinvent v2.2); 0.412 kg/kg (Ecoinvent v2.2); 0.862 kg/kg (Hammond and Jones, 2008); 0.909 kg/kg (Hubbard and Bowe, 2010)

Water usage	* 1.84e4	-	2.03e4	in^3/lb

Processing energy, CO2 footprint & water

Coarse machining energy (per unit wt removed)	* 516	-	570	BTU/lb
Coarse machining CO2 (per unit wt removed)	* 0.09	-	0.0995	lb/lb
Fine machining energy (per unit wt removed)	* 3.32e3	-	3.67e3	BTU/lb
Fine machining CO2 (per unit wt removed)	* 0.579	-	0.64	lb/lb
Grinding energy (per unit wt removed)	* 6.44e3	-	7.11e3	BTU/lb
Grinding CO2 (per unit wt removed)	* 1.12	-	1.24	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)	* 8.49e3	-	9.16e3	BTU/lb
Combustion CO2	* 1.69	-	1.78	lb/lb
Landfill	✓			
Biodegrade	✓			

Notes

Warning

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

Links

ProcessUniverse

Reference

Shape