Ash (fraxinus americana) (t)

General information

Designation

Fraxinus americana (T)

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

Physical properties

Density		0.0217	-	0.0267	lb/in^3

Mechanical properties

Young's modulus	*	0.264	-	0.294	10^6 psi
Yield strength (elastic limit)	*	0.505	-	0.618	ksi
Tensile strength		0.841	-	1.03	ksi
Elongation	*	0.94	-	1.15	% strain
Compressive strength		1.04	-	1.28	ksi
Flexural modulus		0.239	-	0.268	10^6 psi
Flexural strength (modulus of rupture)	*	0.841	-	1.03	ksi
Shear modulus	*	0.0273	-	0.0374	10^6 psi
Shear strength	*	5.16	-	6.33	ksi
Rolling shear strength	*	0.191	-	0.576	ksi
Bulk modulus	*	0.135	-	0.151	10^6 psi
Poisson's ratio	*	0.02	-	0.04	
Shape factor		5.6			
Hardness - Vickers		5.28	-	6.46	HV
Hardness - Brinell	*	3.55	-	4.35	ksi
Hardness - Janka		1.19e3	-	1.45e3	lbf
Fatigue strength at 10^7 cycles	*	0.252	-	0.309	ksi

Mechanical loss coefficient (tan delta)	* 0.018	-	0.022	
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	* 0.124	-	0.152	ft.lbf/in^3

Impact & fracture properties

Fracture toughness	* 0.451	-	0.551	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	0.0751	-	0.0982	BTU.ft/hr.ft^2.°F
Specific heat capacity	0.396	-	0.408	BTU/lb.°F
Thermal expansion coefficient	* 17	-	22.9	µstrain/°F

Electrical properties

Electrical resistivity	* 8.54e13	-	1.28e14	µohm.cm
Dielectric constant (relative permittivity)	* 3.77	-	4.61	
Dissipation factor (dielectric loss tangent)	* 0.052	-	0.063	
Dielectric strength (dielectric breakdown)	* 25.4	-	50.8	V/mil

Magnetic properties

Magnetic type	Non-magnetic

Optical properties

Transparency	Opaque

Bio-data

Food contact	Yes

Restricted substances risk indicators

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	4.99e3	-	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,

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)	* 253	-	280	BTU/lb
Coarse machining CO2 (per unit wt removed)	* 0.0441	-	0.0488	lb/lb
Fine machining energy (per unit wt removed)	* 692	-	765	BTU/lb
Fine machining CO2 (per unit wt removed)	* 0.121	-	0.133	lb/lb
Grinding energy (per unit wt removed)	* 1.18e3	-	1.3e3	BTU/lb
Grinding CO2 (per unit wt removed)	* 0.206	-	0.228	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	✓			

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

Ash (fraxinus excelsior) (t)

General information

Designation

Fraxinus excelsior (T)

Typical uses

Sports equipment; tool handles; wheelwright's work; aircraft; bent

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

Physical properties

Density		0.0224	-	0.0275	lb/in^3

Mechanical properties

Young's modulus	*	0.286	-	0.319	10^6 psi
Yield strength (elastic limit)	*	0.714	-	0.87	ksi
Tensile strength		1.19	-	1.45	ksi
Elongation	*	1.23	-	1.5	% strain
Compressive strength		1.41	-	1.72	ksi
Flexural modulus		0.26	-	0.29	10^6 psi
Flexural strength (modulus of rupture)	*	1.19	-	1.45	ksi
Shear modulus	*	0.0296	-	0.0406	10^6 psi
Shear strength	*	4.63	-	5.64	ksi
Rolling shear strength	*	0.171	-	0.512	ksi
Bulk modulus	*	0.146	-	0.164	10^6 psi
Poisson's ratio	*	0.02	-	0.04	
Shape factor		5.5			
Hardness - Vickers	*	5.08	-	6.21	HV
Hardness - Brinell		4.96	-	6.06	ksi
Hardness - Janka	*	1.14e3	-	1.4e3	lbf
Fatigue strength at 10^7 cycles	*	0.357	-	0.435	ksi

Mechanical loss coefficient (tan delta)	*	0.017	-	0.022	
Differential shrinkage (radial)		0.17	-	0.21	%
Differential shrinkage (tangential)		0.27	-	0.38	%
Radial shrinkage (green to oven-dry)		4.6	-	5	%
Tangential shrinkage (green to oven-dry)		7.4	-	9	%
Volumetric shrinkage (green to oven-dry)		12.8	-	13.6	%
Work to maximum strength	*	0.0665	-	0.081	ft.lbf/in^3

Impact & fracture properties

Fracture toughness		0.764	-	0.933	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		0.0809	-	0.0924	BTU.ft/hr.ft^2.°F
Specific heat capacity		0.396	-	0.408	BTU/lb.°F
Thermal expansion coefficient	*	17.3	-	23.2	µstrain/°F

Electrical properties

Electrical resistivity	*	2.1e14	-	7e14	µohm.cm
Dielectric constant (relative permittivity)	*	3.85	-	4.71	
Dissipation factor (dielectric loss tangent)	*	0.053	-	0.065	
Dielectric strength (dielectric breakdown)	*	25.4	-	50.8	V/mil

Magnetic properties

Magnetic type	Non-magnetic

Optical properties

Transparency	Opaque

Bio-data

Food contact	Yes

Restricted substances risk indicators

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	4.99e3	-	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,

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)	* 268	-	296	BTU/lb
Coarse machining CO2 (per unit wt removed)	* 0.0468	-	0.0517	lb/lb
Fine machining energy (per unit wt removed)	* 844	-	933	BTU/lb
Fine machining CO2 (per unit wt removed)	* 0.147	-	0.163	lb/lb
Grinding energy (per unit wt removed)	* 1.48e3	-	1.64e3	BTU/lb
Grinding CO2 (per unit wt removed)	* 0.259	-	0.286	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	✓			

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

Ash (fraxinus nigra) (t)

General information

Designation

Fraxinus nigra (T)

Typical uses

Cooperage; furniture; shipping

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

Physical properties

Density		0.0177	-	0.0217	lb/in^3

Mechanical properties

Young's modulus	*	0.144	-	0.161	10^6 psi
Yield strength (elastic limit)	*	0.374	-	0.461	ksi
Tensile strength		0.624	-	0.769	ksi
Elongation	*	1.28	-	1.56	% strain
Compressive strength		0.685	-	0.835	ksi
Flexural modulus		0.131	-	0.146	10^6 psi
Flexural strength (modulus of rupture)	*	0.624	-	0.769	ksi
Shear modulus	*	0.0148	-	0.0205	10^6 psi
Shear strength	*	4.24	-	5.16	ksi
Rolling shear strength	*	0.157	-	0.468	ksi
Bulk modulus	*	0.074	-	0.0827	10^6 psi
Poisson's ratio	*	0.02	-	0.04	
Shape factor		5.5			
Hardness - Vickers		3.4	-	4.16	HV
Hardness - Brinell	*	2.76	-	3.38	ksi
Hardness - Janka		764	-	935	lbf
Fatigue strength at 10^7 cycles	*	0.187	-	0.231	ksi

Mechanical loss coefficient (tan delta)	* 0.024	-	0.03	
Differential shrinkage (radial)	* 0.13	-	0.16	%
Differential shrinkage (tangential)	* 0.22	-	0.27	%
Radial shrinkage (green to oven-dry)	4.5	-	5.5	%
Tangential shrinkage (green to oven-dry)	7	-	8.6	%
Volumetric shrinkage (green to oven-dry)	13.7	-	16.7	%
Work to maximum strength	* 0.111	-	0.137	ft.lbf/in^3

Impact & fracture properties

Fracture toughness	* 0.333	-	0.407	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	* 0.048	-	0.0584	BTU.ft/hr.ft^2.°F
Specific heat capacity	0.396	-	0.408	BTU/lb.°F
Thermal expansion coefficient	* 15.2	-	20.8	µstrain/°F

Electrical properties

Electrical resistivity	* 2.1e14	-	7e14	µohm.cm
Dielectric constant (relative permittivity)	* 3.22	-	3.93	
Dissipation factor (dielectric loss tangent)	* 0.042	-	0.051	
Dielectric strength (dielectric breakdown)	* 25.4	-	50.8	V/mil

Magnetic properties

Magnetic type	Non-magnetic

Optical properties

Transparency	Opaque

Bio-data

Food contact	Yes

Restricted substances risk indicators

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	4.99e3	-	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,

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)	* 243	-	269	BTU/lb
Coarse machining CO2 (per unit wt removed)	* 0.0425	-	0.0469	lb/lb
Fine machining energy (per unit wt removed)	* 597	-	660	BTU/lb
Fine machining CO2 (per unit wt removed)	* 0.104	-	0.115	lb/lb
Grinding energy (per unit wt removed)	* 990	-	1.09e3	BTU/lb
Grinding CO2 (per unit wt removed)	* 0.173	-	0.191	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	✓			

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

Ash (fraxinus pennsylvanica) (t)

General information

Designation

Fraxinus pennsylvanica (T)

Typical uses

Veneer for furniture; paneling; wire-bound

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

Physical properties

Density	0.0202	-	0.0249	lb/in^3

Mechanical properties

Young's modulus	* 0.215	-	0.239	10^6 psi
Yield strength (elastic limit)	* 0.374	-	0.461	ksi
Tensile strength	0.624	-	0.769	ksi
Elongation	* 0.86	-	1.05	% strain
Compressive strength	1.18	-	1.44	ksi
Flexural modulus	0.196	-	0.218	10^6 psi
Flexural strength (modulus of rupture)	* 0.624	-	0.769	ksi
Shear modulus	* 0.0222	-	0.0305	10^6 psi
Shear strength	* 5.16	-	6.33	ksi
Rolling shear strength	* 0.191	-	0.576	ksi
Bulk modulus	* 0.11	-	0.123	10^6 psi
Poisson's ratio	* 0.02	-	0.04	
Shape factor	5.6			
Hardness - Vickers	4.8	-	5.87	HV
Hardness - Brinell	* 3.34	-	4.08	ksi
Hardness - Janka	1.08e3	-	1.32e3	lbf
Fatigue strength at 10^7 cycles	* 0.187	-	0.231	ksi

Mechanical loss coefficient (tan delta)	* 0.019	-	0.025	
Differential shrinkage (radial)	* 0.15	-	0.19	%
Differential shrinkage (tangential)	* 0.26	-	0.31	%
Radial shrinkage (green to oven-dry)	4.1	-	5.1	%
Tangential shrinkage (green to oven-dry)	6.4	-	7.8	%
Volumetric shrinkage (green to oven-dry)	11.3	-	13.8	%
Work to maximum strength	* 0.1	-	0.123	ft.lbf/in^3

Impact & fracture properties

Fracture toughness	* 0.407	-	0.497	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	* 0.0555	-	0.0676	BTU.ft/hr.ft^2.°F
Specific heat capacity	0.396	-	0.408	BTU/lb.°F
Thermal expansion coefficient	* 16.3	-	22.1	µstrain/°F

Electrical properties

Electrical resistivity	* 2.1e14	-	7e14	µohm.cm
Dielectric constant (relative permittivity)	* 3.57	-	4.36	
Dissipation factor (dielectric loss tangent)	* 0.048	-	0.059	
Dielectric strength (dielectric breakdown)	* 25.4	-	50.8	V/mil

Magnetic properties

Magnetic type	Non-magnetic

Optical properties

Transparency	Opaque

Bio-data

Food contact	Yes

Restricted substances risk indicators

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	4.99e3	-	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,

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)	* 263	-	291	BTU/lb
Coarse machining CO2 (per unit wt removed)	* 0.0459	-	0.0508	lb/lb
Fine machining energy (per unit wt removed)	* 795	-	879	BTU/lb
Fine machining CO2 (per unit wt removed)	* 0.139	-	0.153	lb/lb
Grinding energy (per unit wt removed)	* 1.39e3	-	1.53e3	BTU/lb
Grinding CO2 (per unit wt removed)	* 0.242	-	0.267	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	✓			

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

Ash (fraxinus quadrangulata) (t)

General information

Designation

Fraxinus quadrangulata (T)

Typical uses

Veneer for furniture; paneling; wire-bound

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

Physical properties

Density	0.021	-	0.0257	lb/in^3

Mechanical properties

Young's modulus	* 0.238	-	0.267	10^6 psi
Yield strength (elastic limit)	* 0.374	-	0.453	ksi
Tensile strength	* 0.624	-	0.754	ksi
Elongation	* 0.76	-	0.93	% strain
Compressive strength	1.28	-	1.56	ksi
Flexural modulus	0.216	-	0.242	10^6 psi
Flexural strength (modulus of rupture)	* 0.624	-	0.754	ksi
Shear modulus	* 0.0245	-	0.0339	10^6 psi
Shear strength	* 5.48	-	6.7	ksi
Rolling shear strength	* 0.203	-	0.609	ksi
Bulk modulus	* 0.122	-	0.136	10^6 psi
Poisson's ratio	* 0.02	-	0.04	
Shape factor	5.6			
Hardness - Vickers	* 4.43	-	5.42	HV
Hardness - Brinell	* 3.32	-	4.06	ksi
Hardness - Janka	* 996	-	1.22e3	lbf
Fatigue strength at 10^7 cycles	* 0.187	-	0.226	ksi

Mechanical loss coefficient (tan delta)	* 0.019	-	0.024	
Differential shrinkage (radial)	* 0.16	-	0.2	%
Differential shrinkage (tangential)	* 0.27	-	0.33	%
Radial shrinkage (green to oven-dry)	3.5	-	4.3	%
Tangential shrinkage (green to oven-dry)	5.9	-	7.2	%
Volumetric shrinkage (green to oven-dry)	10.5	-	12.9	%
Work to maximum strength	* 0.108	-	0.132	ft.lbf/in^3

Impact & fracture properties

Fracture toughness	* 0.429	-	0.524	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	* 0.0578	-	0.0705	BTU.ft/hr.ft^2.°F
Specific heat capacity	0.396	-	0.408	BTU/lb.°F
Thermal expansion coefficient	* 16.7	-	22.5	µstrain/°F

Electrical properties

Electrical resistivity	* 2.1e14	-	7e14	µohm.cm
Dielectric constant (relative permittivity)	* 3.67	-	4.49	
Dissipation factor (dielectric loss tangent)	* 0.05	-	0.061	
Dielectric strength (dielectric breakdown)	* 25.4	-	50.8	V/mil

Magnetic properties

Magnetic type	Non-magnetic

Optical properties

Transparency	Opaque

Bio-data

Food contact	Yes

Restricted substances risk indicators

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	4.99e3	-	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,

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)	* 266	-	294	BTU/lb
Coarse machining CO2 (per unit wt removed)	* 0.0465	-	0.0513	lb/lb
Fine machining energy (per unit wt removed)	* 825	-	912	BTU/lb
Fine machining CO2 (per unit wt removed)	* 0.144	-	0.159	lb/lb
Grinding energy (per unit wt removed)	* 1.45e3	-	1.6e3	BTU/lb
Grinding CO2 (per unit wt removed)	* 0.252	-	0.279	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	✓			

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