Sisal

General information

Overview

Sisal fiber is derived from an agave, Agave sisalana. Sisal is valued for cordage use because of its strength, durability, ability to stretch, affinity for certain dyestuffs, and resistance to deterioration in saltwater.

Designation

Sisal

Typical uses

Sisal is used by industry in three grades, according to www.sisal.ws. The lower grade fiber is processed by the paper industry because of its high content of cellulose and hemicelluloses. The medium grade fiber is used in the cordage industry for making: ropes, baler and binders twine. Ropes and twines are widely employed for marine, agricultural, and general industrial use. The higher-grade fiber after treatment is converted into yarns and used by the carpet industry. Sisall is now used as a reinforcement in polymer-matrix composites.

Composition overview

Compositional summary

Cellulose 70 wt% and lignin 12 wt %.

Form		Fiber		
Material family		Natural		
Base material		Cellulose		
Renewable content		100		%

Composition detail (polymers and natural materials)

Natural material		100		%

Price

Price	*	0.272	-	0.318	USD/lb

Physical properties

Density		0.0522	-	0.0542	lb/in^3

Mechanical properties

Young's modulus		1.36	-	3.19	10^6 psi
Yield strength (elastic limit)	*	66.7	-	83.5	ksi
Tensile strength		74.1	-	92.8	ksi
Elongation		2	-	7	% strain
Flexural modulus	*	1.36	-	3.19	10^6 psi
Shear modulus	*	0.532	-	1.33	10^6 psi
Poisson's ratio	*	0.359	-	0.374	
Fatigue strength at 10^7 cycles	*	31.9	-	45.8	ksi
Mechanical loss coefficient (tan delta)	*	0.00407	-	0.00753	

Impact & fracture properties

Fracture toughness		17.8	-	92	ksi.in^0.5

Thermal properties

Glass temperature	*	716	-	734	°F
Maximum service temperature	*	752	-	788	°F
Thermal conductivity	*	0.144	-	0.202	BTU.ft/hr.ft^2.°F
Specific heat capacity		0.287	-	0.291	BTU/lb.°F
Thermal expansion coefficient	*	8.33	-	16.7	µstrain/°F

Magnetic properties

Magnetic type	Non-magnetic			

Bio-data

RoHS (EU) compliant grades?	✓			

Absorption & permeability

Water absorption @ 24 hrs	* 2	-	2.4	%
Water absorption @ sat	10	-	12	%
Humidity absorption @ sat	* 3.33	-	4	%

Durability

Water (fresh)	Excellent
Water (salt)	Excellent
Weak acids	Acceptable
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	* 4.09e3	-	4.51e3	BTU/lb
CO2 footprint, primary production	* 1.52	-	1.68	lb/lb
NOx creation	0.00257	-	0.00284	lb/lb
SOx creation	0.00656	-	0.00725	lb/lb
Water usage	* 2.18e5	-	2.41e5	in^3/lb

Processing energy, CO2 footprint & water

Fabric production energy	* 1.07e3	-	1.17e3	BTU/lb
Fabric production CO2	* 0.198	-	0.218	lb/lb
Fabric production water	* 28.5	-	42.9	in^3/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)	* 8.28e3	-	8.7e3	BTU/lb
Combustion CO2	* 1.5	-	1.58	lb/lb
Landfill	✓			
Biodegrade	✓			

Geo-economic data for principal component

Principal component	Sisal			
Annual world production	3.57e5	-	3.94e5	ton/yr

Main mining areas (metric tonnes per year)

Brazil, China, Haiti, Kenya, Madagascar, Mexico, Morocco, United Republic of Tanzania, Venezuela

Eco-indicators for principal component

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

Links

ProcessUniverse

Reference

Shape