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	*	0.6	- 0.7	USD/kg
Price per unit volume	*	867	- 1.05e3	USD/m^3

Physical properties

Density		1.45e3	- 1.5e3	kg/m^3

Mechanical properties

Young's modulus		9.4	- 22	GPa
Yield strength (elastic limit)	*	460	- 576	MPa
Tensile strength		511	- 640	MPa
Elongation		2	- 7	% strain
Flexural modulus	*	9.4	- 22	GPa
Shear modulus	*	3.67	- 9.17	GPa
Poisson's ratio	*	0.359	- 0.374	
Shape factor		1		

Fatigue strength at 10^7 cycles	* 220	-	316	MPa
Mechanical loss coefficient (tan delta)	* 0.00407	-	0.00753	

Impact & fracture properties

Fracture toughness	19.6	-	101	MPa.m^0.5

Thermal properties

Glass temperature	* 380	-	390	℃
Maximum service temperature	* 400	-	420	℃
Thermal conductivity	* 0.25	-	0.35	W/m.℃
Specific heat capacity	1.2e3	-	1.22e3	J/kg.℃
Thermal expansion coefficient	* 15	-	30	µstrain/℃

Magnetic properties

Magnetic type	Non-magnetic

Optical properties

Transparency	Opaque

Critical materials risk

Contains >5wt% critical elements?	No

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	* 9.52	-	10.5	MJ/kg
CO2 footprint, primary production	* 1.52	-	1.68	kg/kg

Water usage	* 7.88e3	-	8.71e3	l/kg

Processing energy, CO2 footprint & water

Fabric production energy	* 2.48	-	2.73	MJ/kg
Fabric production CO2	* 0.198	-	0.218	kg/kg
Fabric production water	* 1.03	-	1.55	l/kg

Recycling and end of life

Recycle	✗			
Recycle fraction in current supply	8.55	-	9.45	%
Downcycle	✓			
Combust for energy recovery	✓			
Heat of combustion (net)	* 19.3	-	20.2	MJ/kg
Combustion CO2	* 1.5	-	1.58	kg/kg
Landfill	✓			
Biodegrade	✓			

Links

ProcessUniverse

Reference

Shape