# 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 | |
| Shape factor | | 1 | | |
| 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 |

## Optical properties

| | |
|---|---|
| Transparency | Opaque |

## 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 |
| 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 | ✓ | | | |

## Links

| |
|---|
| ProcessUniverse |
| Reference |
| Shape |