



MATERIAL SUMMARY

Linen

Category

Natural Fiber

Material Form

Fiber

Conventional / Standard Material

Linen, Hemp, Cotton

Highlights

IMPACT AREA	ATTRIBUTE
Land Use Intensity	Fast growing rotation crop.
Water	Low maintenance crop which requires few chemical input during the growing season.
Chemistry/Toxicity	Solely rain fed.

Feedstock Description

Flax fibers are found in the stalk of the flax plant. The plants are sown densely and uniformly so that the stalks grow straight, resist wind, and produce the best quality long fibers. The long fibers used in textiles are located on the outer part of the stalk which covers a woody core.

Process Description

Flax crops are harvested by pulling them from the ground with the roots to preserve the full length of the fiber, measuring approximately 80 centimeters. The stalks are then retted; a process to eliminate the pectin (a mixture of polysaccharides found in plant cell walls) that binds fibers and woody matter in the plant stalk. There are different retting techniques existing. Field retting (dew retting) is the only technique used in Western Europe, which accounts for 85 percent of world flax fiber production. With field retting, the stalks are left in the fields for 6 to 10 weeks allowing rain, sun, and wind to create the necessary fermentation. In other parts of the world, water retting is performed. In natural water retting the stalks are placed in natural pools or slow moving natural water sources to rot the stalks. Water retting can also be performed in tanks. Water retting is faster, but requires fresh water, and chemical or enzymatic treatments can be used to further speed up the process.

The retting process is followed by scutching, a mechanical process used to separate fibers and wood, and then by combing to orient the fibers, and finally yarn spinning.

Sustainability Attributes

LAND-USE INTENSITY

Flax is an excellent rotation crop and grows quickly. It generally follows a cereal crop in rotation, most frequently wheat. The flax is harvested approximately 100 days after planting. Flax naturally produces optimal soil quality, through crop rotation, reduced fertilizer and pesticide requirements, and erosion protection, thereby increasing returns on the following crops.¹

Yields can vary considerably from one year to the other as well as one country to another seasonal weather changes and geographic soil conditions.



WATER INTENSITY

Flax requires a cool and relatively humid climate. It is a rain-fed crop that generally doesn't require irrigation and is mainly treated with mechanical processes. Flax generally requires about 700 mm of annual rainfall, preferably well distributed throughout the 100 days and the retting process.

If water retting is used instead of dew retting, the water footprint would be higher and large amount of wastewater would subsequently be generated.

WASTE

All flax by-products are used so waste is minimal. The seeds are sold for sowing or used in oils, varnishes, cosmetics, etc. The shive (woody matter left over from the stalk after the fiber is removed) are used as soil amendments for gardening and horse beds, and the shorter fibers are used to produce blends with other fibers or in paper production and insulation.

BIODIVERSITY

As very few fertilizers and pesticides are used, flax protects the soils and the rivers. The proliferation of algae favored by an excessive concentration of nutrients in the water is limited. The ecosystem balance and biodiversity of flax are, therefore, favored over crops that require more chemical inputs.

CHEMISTRY

Flax growing requires little or no pesticides or fertilizers. Even though these chemical applications can be required, the quantities are much lower than those used for conventional cotton production.² Flax is susceptible to competition by weeds in its early phase, so good weed control (through mechanical or chemical means) is essential. Once the crop reaches 12-15 centimeters, the high plant density provides good soil cover, and weeds have difficulty in establishing themselves.

TOXICITY

The use of limited agrochemical inputs leads to overall low levels of polluting emissions. The biggest toxicity risk during fiber preparation is the retting process. Dew retting, as practiced in Western Europe, should be favored over water retting with or without chemicals or enzymes. If water retting is used, it is important to ensure that tanks are used instead of ponds and that waste water is treated effectively before being released into waterways.

ENERGY USE

The energy consumption during fiber preparation is low. The last step in the process, scutching (mechanical removal of straw stem), requires the most energy input.

GREENHOUSE GAS EMISSIONS

Greenhouse gas emissions are essentially linked to chemical inputs and to the consumption of electricity and heat produced by fossil energy sources. Both are low for the preparation of flax fibers.

ANIMAL WELFARE

Not applicable.

ETHICAL/SOCIAL CHARACTERISTICS

In Europe, farmers and industries are committed to complying with the requirements of the International Labour Organization governing wages, working conditions, and the employment of minors. Flax growing and processing are qualified labor-intensive procedures, contributing to the preservation of social fabric in rural zones.

Performance and Processing

FUNCTIONAL ATTRIBUTES

Flax fibers and the resulting linen fabrics have unique thermo-regulating properties, providing insulation in the winter and good breathability and a cool feeling in summer. They also exhibit high moisture absorbency.

MECHANICAL ATTRIBUTES

Compared to other textile fibers, linen offers unique mechanical strength performance. The tenacity of linen fiber can typically range from 5.5 to 6.5 gram/denier compared to cotton which can typically range from 3.0-4.9 gram/denier.

AESTHETIC AND SENSORY ATTRIBUTES

Linen textiles contain long fibers which make them supple and resistant without causing pilling or distortion. The more they are used, the softer they become.

A characteristic often associated with linen fabrics is the presence of slubs, which present as small knots that occur randomly along its length or have thick and thin effects. The finest linen often has very consistent yarn diameters with no slubs at all.

TEXTILE PROCESSING

Linen fabrics have a high natural luster; their natural color ranges between shades of ivory, ecru, tan, and grey. Pure white linen has normally undergone a bleaching process. Linen has good dyeing affinity, resulting in subtle yet vibrant colors with high colorfastness properties.

COMMON APPLICATIONS

Flax produces a versatile fiber. It can be used in 100 percent composition or with other fibers in blends. Linen can be used in all densities from ultra-light, transparent batiste to the heaviest canvases. Most linen fabrics are currently woven, but knit qualities are becoming increasingly available.

Linen fabrics are suitable for apparel as well as bed linens and home textiles applications.

Availability

Flax is a rare product which represents less than 1 percent of all textile fibers consumed worldwide. 85 percent of the world's production of scutched flax fibers originates in Europe, primarily France, Belgium, and The Netherlands. France is the world's largest producer of flax fiber. Today, approximately 200 hectares of organic flax is grown in France.

The production of linen fabrics was once concentrated in Europe. All stages of production and processing are still located there, but today most of the fiber is exported to Asia, especially China, for further processing and textile manufacturing.

Flax production in the United States is increasing due in part to CRAiLAR flax fiber produced by Naturally Advanced Technologies (profiled in a separate snapshot). The CRAiLAR process relies on an enzyme process to create fibers with softness comparable to cotton.

Certification/Verification

Organic linen is made from flax that is grown without the use of any synthetic chemicals. Though supplies are limited, it is currently available on the market.

Organic linen is subject to regular organic farm certification. The national laws governing organic production are EEC Organic Regulation 834/2007 in Europe, USDA NOP in the United States and JAS in Japan.

In addition, a certification for the product's chain of custody needs to be in place which could follow the Global Organic Textile Standard (GOTS) or the Organic Content Standard (OCS).

- The European Flax® label guarantees flax and linen products made from 100 percent European produced flax fiber.
- The Club Masters of Linen® label guarantees linen textiles 100 percent Made in Europe, from plant to yarn to fabric.

Key Stakeholders

- European linen and hemp: <http://www.mastersoflinen.com/>
- Flax Council of Canada: <http://www.flaxcouncil.ca/>
- Ameriflax: <http://www.ameriflax.com/>

Questions to ask when sourcing this material

- Where is the fiber coming from?
- Which retting technique has been used?
- If organic linen is sourced, ask for certification documentation to garment level.
- Is the fiber compliant to chemical management requirements?

Cost

Cost varies depending on yarn and fabric quality and source country. Also the fact that flax is a commodity crop means the price can be influenced by market factors.



FOR MORE INFORMATION

Solutions@TextileExchange.org

SOURCES

1. http://eiha.org/attach/643/11-05-13_Ecological_benefits_of_hemp_and_flax.pdf
2. http://eiha.org/attach/643/11-05-13_Ecological_benefits_of_hemp_and_flax.pdf
3. <http://www.mastersoflinen.com/eng/celc/5-club-masters-of-linen>

Eco-profile of a linen shirt and comparative analysis of linen and cotton shirt (Bio Intelligence service – 2008)

DEFRA Report: The role and business case for existing and emerging fibers in sustainable clothing (2010)

Life Cycle Analysis of Hemp Textile Yarn (Turunen and van der Werf – 2006)

The environmental impacts of the production of hemp and flax textile yarn ((Turunen and van der Werf – 2007)

www.mastersoflinen.com

msi.apparelcoalition.org

http://eiha.org/attach/643/11-05-13_Ecological_benefits_of_hemp_and_flax.pdf

<http://www.iccm-central.org/Proceedings/ICCM17proceedings/Themes/Behaviour/SUSTAIN%20GREEN%20COMP/F23.2%20Dissanayake.pdf>

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