

The *Lotus Live* Guide to *Eco-Fabrics*

In this guide, Lotus Live presents the collective knowledge of our members and of many reliable internet and print sources regarding the eco-effectiveness of all the major fibers and fabrics on the market currently. The guide is divided into three sections: **known culprits**, which should be avoided, for a variety of environmental, social, or health reasons, **better but not best**, which are not fully without issues, but are generally accepted as good, and can be used without feeling too bad about the materials and processing, and **passive positives**, the fabrics that have no discernible downsides.

Known Culprits:

- **Acrylic:** Acrylic fibers are produced from acrylonitrile, a petrochemical, and various other synthetic chemicals that allow it to accept dye and that stop fibrillation (“pilling”).¹ Acrylonitrile is a suspected carcinogen.²
- **Cashmere/Pashmina:** The sole source of cashmere is the wool of Cashmere goats in northern China. As demand for this soft fabric has increased over the years, goat populations have stomped the region into an infertile dust bowl. Dust from these goat fields (and many other emission sources) is carried across the Pacific Ocean on the wind, and contributes to air pollution here in the western United States.³
- **Lastex:** Lastex is a fiber of elastic rubber wound with rayon, nylon, silk, or cotton threads. It’s eco-effectiveness depends largely on what type of rubber, and what type of fiber are being used.
- **Leather (including suede):** Originating from cowhides, leather is a very energy-intensive “fabric,” and a contributor to methane emissions. In addition, most tanning processes, which turn the hide into a usable material, are environmentally damaging and unhealthy. The leather may be tanned with chromium-3/6 (known carcinogens), aluminum (heavy metal toxin), toxic -aldehydes, which may rub off on the wearer when they sweat, and are frequently dumped into waterways of less-regulated countries. Vegetable tannin may be used for a healthier leather, but this does not negate leather’s other issues⁴

¹ [Fiber Source: Acrylic](#)

² [DHHS 11th Report on Carcinogens: Acrylonitrile](#)

³ [Osno, Evan. "Your Cheap Sweater's Real Cost." Chicago Tribune 16 Dec 2006.](#)

⁴ [Lazy Environmentalist Textile Glossary](#)

- **Nylon:** Nylon is made from petrochemical polymers, and is not biodegradable⁵. It is less toxic than other manmade fibers, but does not qualify as ecologically sound.
- **Polyester:** Polyester is made from the same material as soda bottles--polyethylene terephthalate, a petrochemical⁶. Polyester is usually coated in a formaldehyde resin to prevent wrinkling and shrinkage. As this formaldehyde (a known carcinogen⁷) off-gasses, even after many washings, it may cause tiredness, insomnia, headaches, respiratory problems, coughing, watery eyes, excessive thirst, and can aggravate asthma, as well as causing skin rashes upon contact.⁸
- **Silk:** Silk is a natural fiber harvested from silkworm cocoons, made of digested cellulose. Unfortunately, however, in order to obtain uncompromised silk threads, the silkworms must be killed before they exit the cocoon--2,600 of them for each pound of silk. It's a tricky situation, as after thousands of years of silk production, we have altered the silkworm so much that it can no longer survive in the wild, so the silk industry is all that keeps the species alive. At Lotus Live, we support biomimicry, not the exploitation of nature, and therefore prefer cellulose-based fibers like lyocell and modal, for which humans process the cellulose. The production of silk is natural, and technically sustainable, but we cannot promote it as an ecologically sound fiber. Organic silk certification will be available soon, and "peace silk" (lower quality silk from cocoons of silkworms allowed to live) is available, but these solutions are still not without issues.⁹
- **Spandex:** Spandex is a synthetic fiber made from polyurethane, a processed petrochemical, made from MDI, a toxic allergy sensitizer, and TDI, a suspected carcinogen and irritant. While makers of Spandex are closely regulated, and Spandex itself is generally accepted to be safe, it is not eco-effective.¹⁰
- **Wool, Conventional:** Wool is a natural, renewable fiber from the fur of sheep (or various other animals). Conventional wool is exposed to large amounts of pesticides (while on the sheep), which is dangerous for the environment, and the wearer (both the sheep, and the human). Treatment of the animals is also of concern, as well as methane emissions.¹¹

⁵ [Fiber Source: Nylon](#)

⁶ [Fiber Source: Polyester](#)

⁷ [IARC: Formaldehyde Reclassified as Carcinogenic](#)

⁸ [Formaldehyde in Polyester Q&A](#)

⁹ [Organic Clothing: Raw & Organic Silk](#)

¹⁰ [Cotton, Nylon, Lycra Spandex Allergies](#)

¹¹ [Textile Fibers: Wool](#)

Better But Not Best:

- **Acetate:** Acetate is a regenerated cellulose fiber in which purified cellulose from wood pulp (usually from sustainably managed forests) is chemically digested, and dissolved in acetone before being extruded.¹² The acetone is recycled in a closed loop cycle.¹³ Acetone¹⁴ (and the other chemicals used for digestion, namely acetic acid¹⁵, acetic anhydride¹⁶, and sulfuric acid) are not 100% benign, but are non-carcinogenic, require high exposures to cause problems, and all components except sulfuric acid are readily biodegradable.¹⁷ Acetate competes with polyester to be the shiny lining inside jackets and coats.
- **Bamboo:** Bamboo is another type of regenerated cellulose fiber that is particularly interesting. While the manufacturing process is the same as that of other regenerated cellulose fibers, bamboo is the fastest growing source of cellulose we have, and requires little or no pesticides, so besides the fiber manufacturing chemicals, it is very appealing in an ecological sense.¹⁸ Bamboo is also naturally antibacterial, and one of the softest fibers around.¹⁹ Bamboo shirts, and bamboo sheets are becoming commonly available.
- **Cotton, Conventional (including denim, flannel):** Cotton is the most widely known natural fiber. Unfortunately, cotton is not the most environmentally friendly crop to grow. Conventional cotton represents just 3% of the world's crops, but accounts for 25% of pesticide use, and 11% of herbicide use.²⁰ In addition, the vast majority of cotton (76% in the U.S. in 2004) is genetically modified to try to reduce pesticide requirements.²¹ It is, however, natural, and when cost and widespread availability are paramount, cotton may still be a better option than synthetic fibers for health reasons. Cotton is used for almost anything.
- **Ingeo and Sorona:** These two fibers are made from corn inputs which are fermented to form either poly lactic acid (PLA) in the case of Ingeo, or bio-PDO in the case of Sorona, from which the fibers are extruded. They are said to provide the performance of synthetic fibers, while being derived from renewable resources, and are compostable

¹² [Fiber Source: Acetate](#)

¹³ [Acetate World: Acetate: A Greener Fiber](#)

¹⁴ [ToxFAQS: Acetone](#)

¹⁵ [BP Acetic Acid FAQs](#)

¹⁶ [Acetic Anhydride: Material Safety Data Sheet](#)

¹⁷ [DuPont Sulfur Products](#)

¹⁸ [Lazy Environmentalist Textile Glossary](#)

¹⁹ [Bamboo Fiber Manufacturing Process](#)

²⁰ [Lazy Environmentalist Textile Glossary](#)

²¹ [Genetically Modified Crops in the U.S.](#)

in commercial facilities.²² These fibers face the same issues as ethanol, however--high pesticide and energy inputs, and the area of corn required to make a meaningful contribution to the market.

- **Lyocell (TENCEL):** Lyocell is a newer regenerated cellulose fiber, apparently designed with the environment in mind. It is made from the pulp from eucalyptus trees, which require less pesticides, less water, and are up to ten times more productive per hectare than cotton.²³ Lyocell is advertised as using a cleaner manufacturing process, in which 99.6% of the solvent used to convert pulp to fiber is recycled in a closed loop process. The finished fiber is 100% biodegradable.²⁴ Lyocell is currently used for a small amount of clothing.
- **Modal:** Modal is another form of regenerated cellulose fiber, made from Beechwood trees. The specific chemical process by which modal is made is not widely known, but is likely similar to acetate and rayon--not 100% benign, but not directly harmful--better than synthetic fibers, but not the best. Modal is being used for appropriate for clothing and sheets.
- **Rayon:** Rayon is the most widely known regenerated cellulose fiber. To make rayon, wood cellulose is bathed in sodium hydroxide²⁵, and reacted with carbon disulfide²⁶, and treated with sodium sulfate, sulfuric acid, and zinc before regeneration and extrusion of the fiber.²⁷ As with other regenerated cellulose fibers, it is renewable and biodegradable, but not completely benign.
- **Wool, Organic:** Organic wool comes from sheep that have not been exposed to pesticides, either through feed, fields, or dipping of the wool. It is a more humane, healthier fiber, and is completely natural and renewable. Methane emissions could still be a concern.²⁸
- *With all of these products, and with most fabrics in general, depending on the garment manufacturer, finished garments may or may not have been subjected to traditional chemical processes to dye them and prevent fibrillation, so individual investigation of designers and retailers should be conducted.*²⁹

²² [The Future and Sustainability of Clothing and Textiles in the U.K.](#)

²³ [Lenzing Fibers](#)

²⁴ [The Future and Sustainability of Clothing and Textiles in the U.K.](#)

²⁵ [ToxFAQs: Sodium Hydroxide](#)

²⁶ [ToxFAQs: Carbon Disulfide](#)

²⁷ [FiberSource: Rayon](#)

²⁸ [Organic Wool Fact Sheet](#)

²⁹ [Tencel: Sustainable but Not Necessarily Healthy](#)

Passive Positives:

- **Cotton, Organic:** As the name suggests, organic cotton is cotton that has been made organically, that is, without synthetic fertilizers and pesticides, and without other post-growth chemical treatment. It is natural, ecologically sound, and non-toxic. The only downside is that, at least for now, it may cost as much as three times more than conventional cotton.³⁰ Where price is not an issue, it is appropriate for almost anything, including clothing, sheets, towels, and many more products.
- **Hemp:** Hemp is four times stronger than cotton, twice as resistant to abrasion, more resistant to mildew, soiling, shrinkage, and fading, and has an ecological footprint half that of cotton, requiring less pesticides, less water, and less chemicals to grow and produce, and can be used for pretty much anything. It also is said to cost a third less than cotton. The fact that it cannot be spun on traditional machines, and is associated with marijuana (and prohibited in the U.S.) prohibits its widespread adoption.³¹
- **Jute (a.k.a. Burlap):** Jute is one of the strongest, cheapest, and most widely available natural fibers available, made out cellulose and lignin, and is readily biodegradable and/or recyclable. It is appropriate where heavy fiber is desired: for packaging, curtains, floor covering, rope, etc.³²
- **Linen:** Linen is a natural fiber that comes from the flax plant. It is free from the extensive pesticide requirements for conventional cotton, and is a higher quality, stronger (albeit more expensive) fiber.³³ It is appropriate for clothing, bedding, housewares. Organic linen is also available, for a completely chemical-free fiber.
- **Nylon 6:** While nylon is general is undesirable for throwaway products because of it's non-biodegradable, petrochemical nature, certain applications of nylon 6 may be desirable. According to MDBC, nylon 6 has the potential to be a technical nutrient, meaning that specially designed nylon 6 products could be returned to the manufacturer to be "upcycled" into new products for eternity, without requiring large amounts of virgin materials. For more information, see MDBC's [The Promise of Nylon 6](#).
- **Ramie:** Ramie is a type of nettle plant from which textile fibers can be extracted. It is strong but brittle, and is usually blended with other fibers to enhance its resiliency. It's acceptance into the textile industry is extremely low.³⁴

³⁰ [The Future and Sustainability of Clothing and Textiles in the U.K.](#)

³¹ [The Future and Sustainability of Clothing and Textiles in the U.K.](#)

³² [International Jute Study Group](#)

³³ [Lazy Environmentalist Textile Glossary](#)

³⁴ [Ramie: Old Fiber, New Image](#)

For a list of recommended clothing retailers where you can buy clothing and linens made from the “better but not best” and “passive positive” fibers, see our [Clothing](#) page.

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If you have any ideas, suggestions, or corrections you would like to contribute to this guide on Eco-Fabrics, please send us an email at [additions@lotuslive.org](mailto:additions@lotuslive.org).

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