

Textiles

A COMPREHENSIVE GUIDE TO FABRICS AND THEIR COMPOSITIONS

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Natural Fibers
Natural Fibers
Natural Fibers



Cotton

ORIGINS

The earliest use of cotton in fashion is seen in 5000 BC India. Mesoamerica pioneered cotton as a textile, with the Americas not far behind, first using cotton in 5500 BC. As cotton became increasingly common on a global scale, Europe was eventually introduced to cotton. Through the conquest of the Iberian Peninsula, Europe quickly began to produce the fabric and became one of the major producers of the material.



BENEFITS

Cotton is one of the most common natural fabrics used in the world. Made of fibers from cotton plants, its coloring is generally white or has a natural, slightly yellowish hue. Cotton is highly durable, and can withstand a lot of wear and tear.

Cotton has plenty of benefits, some being that it is highly light/breathable, soft, and retains heat. The fabric has excellent moisture-wicking properties; you can wash it in high heat. It is, however, prone to pilling, tearing, wrinkling, and shrinking when washed.

VARIATIONS

Cotton fibers, known as staples, have developed into distinct varieties that shape today's market. Short-staple cotton, with fibers up to 1.125 inches long, serves everyday needs with its coarser texture and affordability. Long-staple cotton, measuring between 1.125 to 1.25 inches, offers enhanced softness at a moderate price point. Extra-long staple (ELS) cotton, with fibers exceeding 1.25 inches, provides exceptional luxury and commands premium prices. Egyptian cotton, grown in the fertile Nile Delta, represents some of the longest and most luxurious varieties, available in both long-staple and extra-long staple forms. Pima cotton, developed through collaboration with Pima Indians, brings enhanced durability at a mid-range price point. Its premium variant, Supima cotton, guarantees US-grown ELS cotton produced under organic practices, representing the pinnacle of cotton quality. Throughout these variations, the length of cotton staples has consistently determined their quality and price, creating a hierarchy from everyday basics to supreme luxury.

PRODUCTION

To produce cotton fabric, you must first remove the leaves from the cotton plant. This process is called defoliation. Next, you will harvest the cotton in a machine that will remove contaminants from the fibers and form it into bales. After, a cotton gin will separate the seeds from the cotton bolls. The fourth step is to transfer the cotton to a facility that produces textiles in which the cotton will be carded. Carding is the process of creating fibers into long strands. The strands are then spun, which creates yarn. Lastly, the yarn is treated, possibly dyed, and then woven into a textile. The fourth step is to transfer the cotton to a facility that produces textiles in which the cotton will be carded. Carding is the process of creating fibers into long strands. The strands are then spun, which creates yarn. Lastly, the yarn is treated, possibly dyed, and then woven into a textile. Cotton is produced in India, China, America, Brazil, and Pakistan. Raw cotton costs approximately 75 cents per pound and costs much more when produced into yarn. The price is marked up once more when it is produced into a good. This being said, cotton is one of the most affordable and available fibers.

Cotton

IMPACT

Cotton itself is a natural fiber and, therefore, doesn't harm the environment. It is biodegradable and doesn't contribute to pollution. Manufacturing practices that are used to produce cotton create sustainability issues. The creation of cotton requires a ton of water. In addition, cotton producers look to create the most cotton they can at the lowest price possible. Over time, this depleats the farmland. In addition, cotton producers use pesticides and fertilizers to grow cotton crops faster, causing chemical run off into surrounding water. A lot of cotton facilities around the world uphold exploitative practices that take advantage of people to produce fibers at a lower cost.

Organic processed cotton does not involve any kind of pesticide or fertilizer. For cotton to be certified as organic, the producer has to compensate employees fairly and keep the environmental impact small. Organic cotton accounts for just 1% of cotton produced globally.





ORIGINS

The origins of Linen can be traced back as far as 36,000 years, and it is considered one of the longest-produced textiles. Archaeologists state that Linen originated in Mesopotamia and was reserved for nobility. In Ancient Egypt, the use of Linen was more mainstream. The Ancient Greek people used Linen for many different purposes and later introduced Western Europe to the fabric. After a while, Ireland became the most popular producer of Linen in Europe, and its popularity remained steady throughout the colonial era. As cotton became more popular and widely produced, linens' popularity started to fade. In today's society, Linen has become more of a novelty due to the price and difficulty of production.

VARIATIONS

Linen comes in a few varieties. Damask Linen is a more delicate type created on a jacquard loom that produces an ornate pattern similar to embroidery. Plain-woven Linen is Linen for everyday use, commonly for different towels. Loosely woven Linen is a lesser-durable variety and tends to be liquid-absorbant. Lastly, Sheeting Linen is made for apparel and is known for its soft, untextured surface.

BENEFITS

Similar to cotton, linen is made from flax plant fibers. Linen is a fantastic fabric for warmer climates, as it is lightweight and dries very fast. The naturally white, porous fiber has antibacterial properties, as bacteria cannot survive in the weave of the fiber. Linen can be washed cold, warm, or hot with little to no chance of pilling and bubbling.

Linen

PRODUCTION

The first step to producing a linen fabric is to plant flax seeds. Flax seeds are very peculiar in their environments and must be planted in colder seasons. Herbicides are commonly used to manage weeds. After 100 days, the seeds are ready to be arated from their outer shell in a process called 'retting.' After retting, the fibers are combined, spun, and reeled into yarn. Reeling must occur in a humid or wet environment so the flax fuses for maximum stability. After being rinsed in hot water, the flax yarn is dried and ready for treatment and fabric creation. Fabric is produced mainly in China; however, more high-quality linens are made in Europe. The fabric costs five to twelve dollars per yard and is one of the most expensive natural fibers worldwide.

Linen

IMPACT

Like cotton, Linen is a natural resource that doesn't harm the environment—the processes of producing linen harm the surrounding ecosystem. The retting process uses alkali or oxalic acid when separating the flax fibers. Chemical retting is much faster and more efficient, and both chemicals involved in the process are low in emission. However, for maximum eco-consciousness, water retting is more favorable. This does increase the cost of the garment and makes organic flax less accessible to many consumers. Linen is considered one of the fabrics with the least environmental impact.





Silk

ORIGINS

Silk is first found in China, dating back to 6500 BC. Empress Leizu is largely accredited for developing the craft of making silk, named 'Sericulture.' Initially, the fabric was reserved for the Chinese nobles, but eventually, as the civilization advanced, it became a common good. Eventually, silk would lead to the introduction of The Silk Road- a trade route stretching from China to Western Europe. In Western Europe, silk was highly valued and popular in Medieval times. Later, in 11th century AD, silk was produced all around Europe, which later introduced the fabric to America in the 17th century. Synthetic variations were developed amidst World War II, which cut off American access to Asian silk.

BENEFITS

Silk fabric is the strongest natural textile in the world and is wanted for its softness. Throughout history, silk has been an extremely popular fabric.

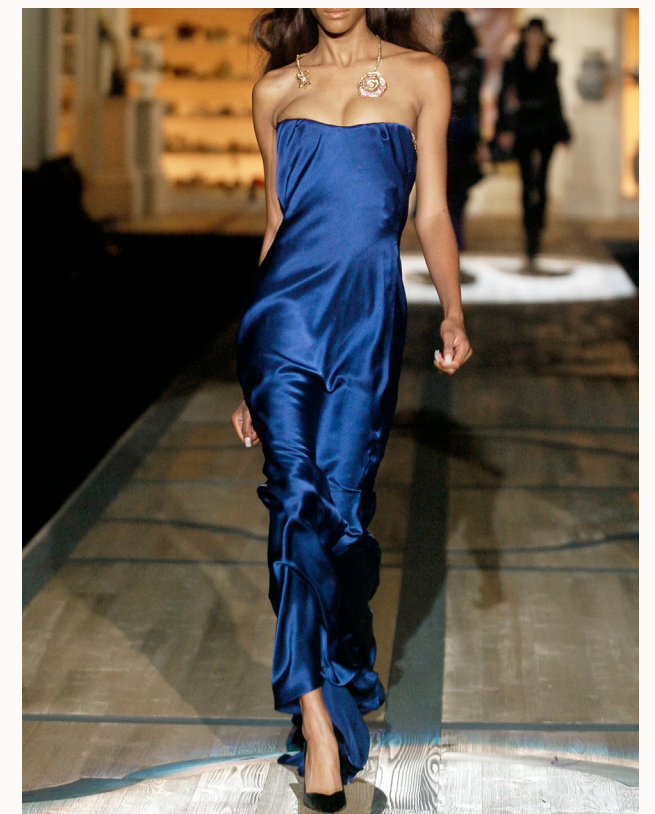
Silk comprises insect larvae secretion- specifically, the material used to create cocoons from worms on mulberry trees. Silk has a shiny effect due to the structure of the fibers, which reflect the light and make this effect.

VARIATIONS

There are tons of varieties of silk available; Mulberry Silk is the most widely produced. Other types include Eri Silk, Tasar Silk, Spider Silk, Muga Silk, Sea Silk, and Coan Silk. Eri Silk, or 'peace silk,' is a type that doesn't require the killing of silkworms and is considered more durable than Mulberry. Tasar Silk is a naturally green silk produced by Indian and Japanese silkworms. Spider silk is a stretchy silk that is extremely hard and expensive to produce. Muga silk is made only in Assam, India, and is reserved for the nobility in the region. Sea silk is derived from a species of mussel in the Mediterranean Sea. Lastly, Coan silk is a silk from silkworms native to Greece, Turkey, and Italy.

PRODUCTION

To produce silk, the harvester must expose silkworm cocoons to high heat so the worms don't come out of the cocoons. A machine (or worker) will brush the cocoon to expose the loose end and load it onto a reel that unravels the silk. While the cocoons are loaded to the reel, they are automatically connected to another strand through the bonding of proteins, so the string is continuous. After loading, the silk is twisted to make yarn and rolled for more continuity of the strands. The silk yarn is then ready to be dyed and woven. The largest Silk producer is China, which generally costs \$50-\$55 per kilogram.



Silk



IMPACT

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Wool



ORIGINS

Wool, in addition to cotton, is one of the most used textiles throughout history. Wool can be traced back to 4000 BC and was a greatly valued textile in the Roman Empire. It later became popular in Europe through the Middle Ages and then made its way to Italy, where entire fortunes were built off of wool production. The colonial era was when Europe started exporting textiles globally. Europe's introduction of wool on a global scale made Australia and New Zealand the wool capital of the world. As time passed, synthetic fibers were introduced, and the demand for wool significantly decreased.

PRODUCTION

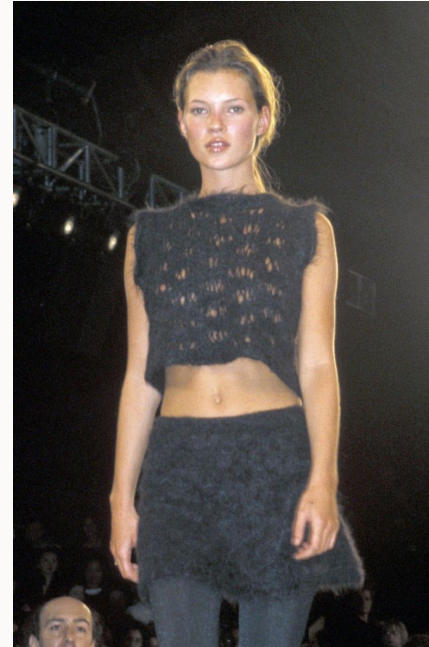
The first step in creating wool is shearing the wool off of an animal. Wool is most commonly associated with sheep, but there are plenty of other wool-bearing animals in the world. The second step is cleaning the wool and sorting it into bales. The wool is then carded, making the wool fibers into strands. Lastly, the wool is then woven and ready for the production process. Australia remains the wool capital and largest exporter/producer globally, providing 25% of the wool worldwide. Wool costs about \$20 per kilogram.

VARIATIONS

Many varieties of wool are available; Merino Wool is the most common type. Other types include Cashmere, Mohair, Alpaca, Camel, Virgin, Angora, Vicuna, Llama, and Qiviut Wool. Cashmere is a more expensive and luxurious variety of wool. Mohair comes from Angora goats with thick and wavy coats. Alpaca wool is wool from South America that has been created from generations of alpacas. Camel is a more insulative wool but can be less durable. Virgin wool is wool from the lamb, specifically its first shearing. Angora wool comes from rabbits with delicate and soft coats. Vicuna wool is the most expensive wool from vicuña animals in Peru. Llama wool is not often worn directly as it is a bit rough, but it is commonly used for outerwear. Lastly, Qiviut wool is wool from Alaskan Ox.

BENEFITS

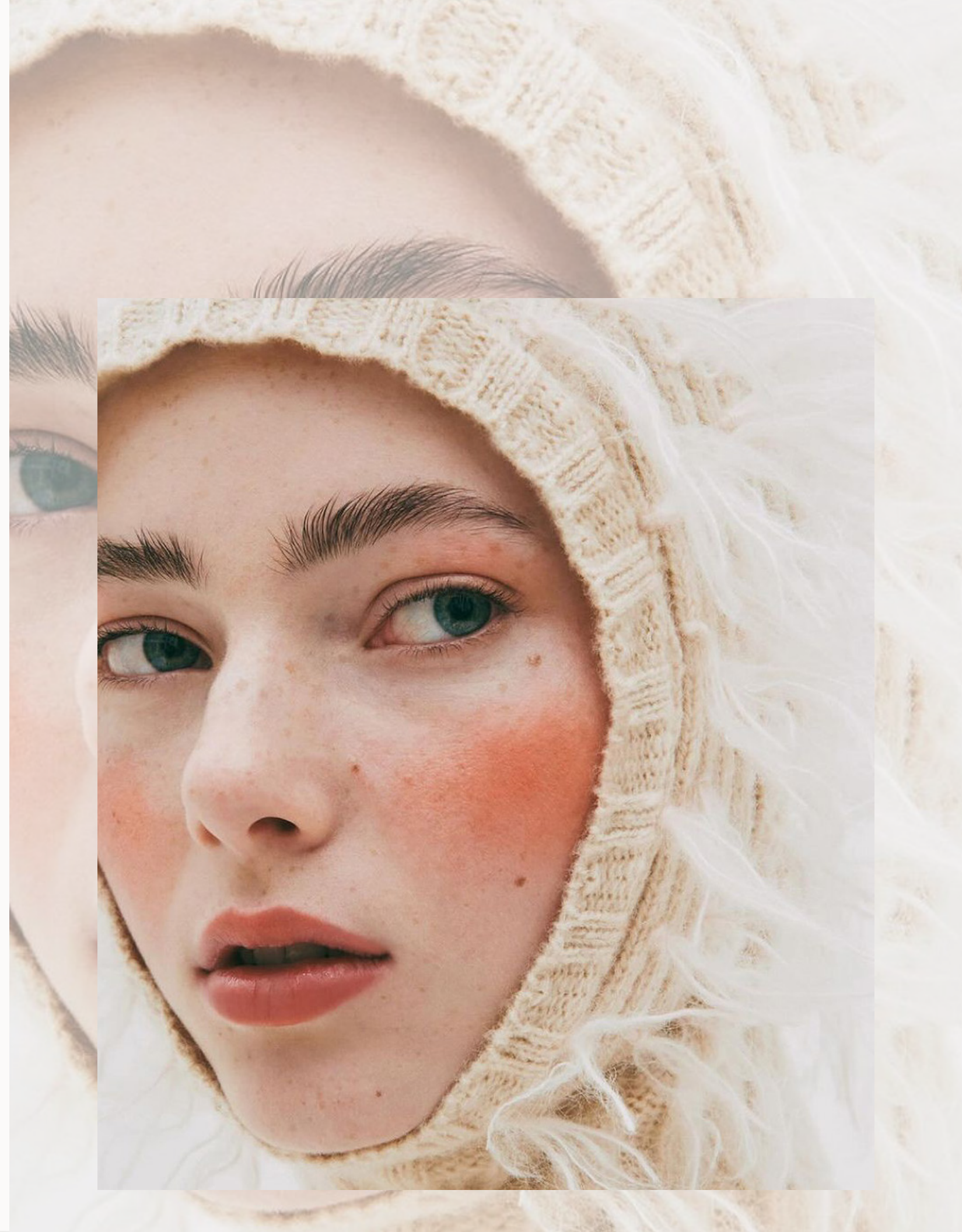
Wool is a fabric made from animal hair known for its durability, warmth, and softness. The fabric is made of 97% protein and 3% fat, making it incredible for insulation in colder environments. Wool has a natural crimp that aids in insulation by trapping air. Pre-domestication, sheep were not as wooly, and now that they have been domesticated, their traits are more desirable for textile production.



IMPACT

As long as the animals used for production are allowed to live in a free, non-harmful environment, wool is not harmful. However, more often than not, wool production is inhumane and detrimental to both the animals and their environments. PETA, an animal rights organization, actively speaks against the inhumane production of wool. In addition, the breeding of sheep can cause damage to the land as the fecal matter of sheep can pollute waterways.

Wool



Synthetic Fibers
Synthetic Fibers
Synthetic Fibers



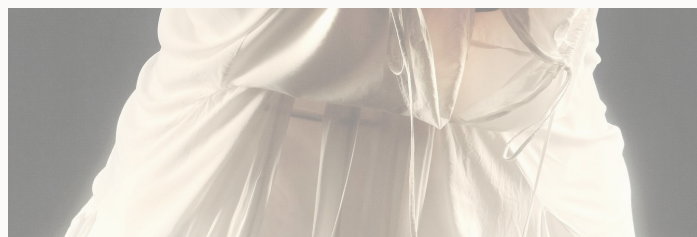
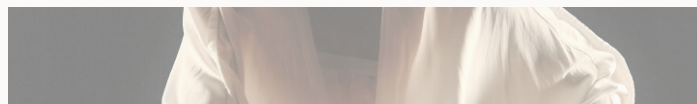
Polyester

ORIGINS

Introduced initially in 1962 America as 'Terylene,' polyester fiber first originated out of WWII from the DuPont company. The birth of synthetic material created an economic boom post-war. Polyester is one of the most produced fibers globally. Ethylene Polyester, or PET, is the most common form of polyester fabric derived from petroleum.

BENEFITS

Polyester is a fabric made of petroleum and, in some cases, ethylene. Most forms of polyester are not biodegradable and contribute to colossal amounts of pollution worldwide. It is quite common for polyester to be blended with another natural fiber—most commonly, cotton. A cotton and polyester blend makes for a long-lasting fabric while reducing the overall cost of production. The fiber will melt in high-heat environments, potentially causing irreversible body damage.

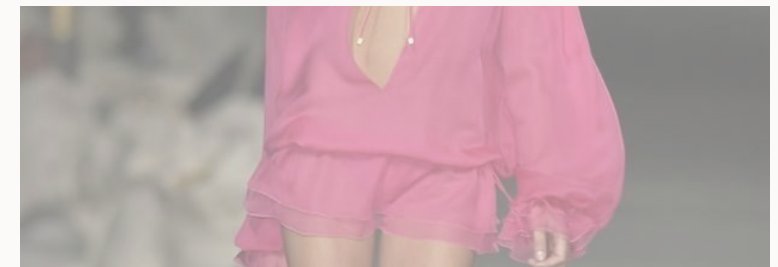
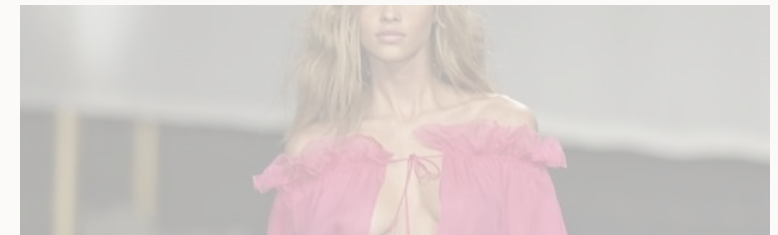


VARIATIONS

There are three types of polyester fabric. Ethylene Polyester (PET), plant-based polyester, and PCDT polyester. There are four ways to make PET fiber differing based on the application. PCDT polyester is similar to the production process of PET, but this variation has a different chemical makeup. Plant-based polyester uses ethylene sources like cane sugar instead of petroleum. China is the biggest exporter of polyester, which costs about \$1 per pound raw, and as a fabric, it costs \$10/yard.

PRODUCTION

The first step in creating Polyester fabric is to make a monomer. A monomer is a reaction between ethylene glycol and dimethyl terephthalate. Next, a polymer must be created by reacting the monomer with dimethyl terephthalate another time. The polyester polymer is then extruded into long strips that are cooled, air-dried, and broken into small pieces. After, the broken pieces are melted again to produce a substance similar to honey. The result is polyester filaments that can be experimented with to obtain the correct result.



Polyester



IMPACT

Polyester's entire life cycle hurts the environment. Fossil fuels are involved, and the process of refining oils releases tons of toxins into the atmosphere. The extraction process of the fiber is highly wasteful and creates harmful byproducts that eventually make their way into the ecosystems. Additionally, a majority of polyester production involves slave labor and workers are ultimately exposed to dangerous chemicals. Washing polyester releases microplastics into water systems, harming marine and human life. Since polyester garments are generally lousy quality, they fall apart easily, are ultimately disposed of, and do not naturally degrade.

Nylon



ORIGINS

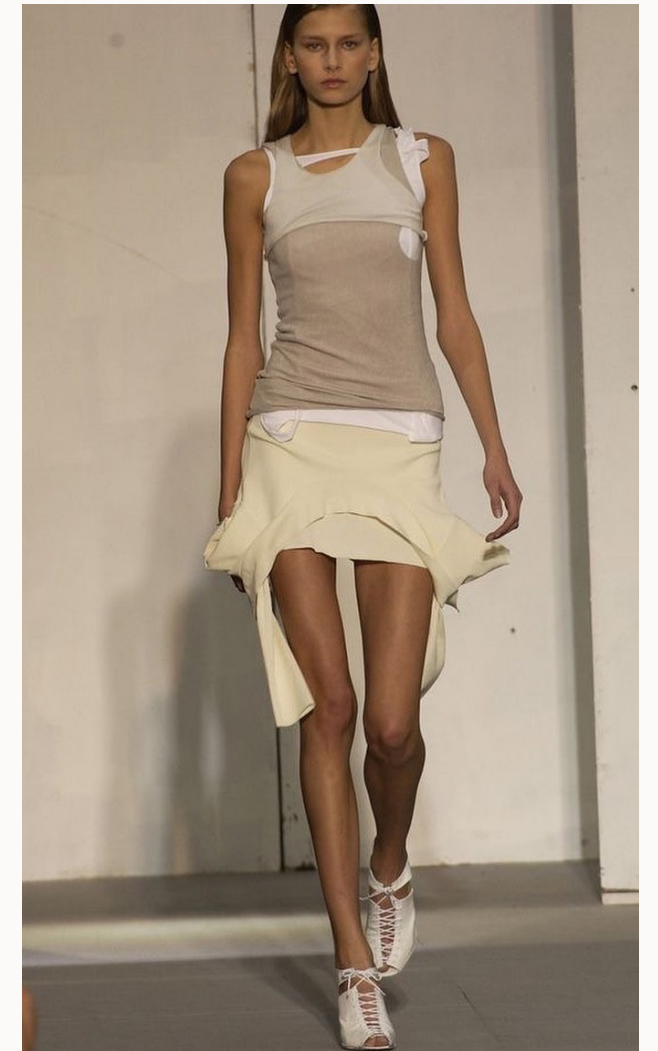
DuPont introduced Nylon in the early 1920s to replace silk and hemp for war materials. The postwar shortage of dress fabrics made way for manufacturers to create garments. It is not very durable in its raw form, but when spun with other fabrics, its good qualities are brought out. Since the 70s, nylon has significantly decreased in popularity as consumers are beginning to learn about its environmental impact.

BENEFITS

Nylon is a completely synthetic fiber made to find an alternative to silk and hemp fabric. Nylon has little moisture-wicking properties and is susceptible to runs and rips. When mixed with different fibers, the more desirable features of the fiber are maintained, while more undesirable features are lost. Most nylon garments are blends.

PRODUCTION

The fabric is produced by first extracting diamine acid from oil. It is then combined with adipic acid to create nylon salt. The new polymer is then heated and extruded through a metal plate named a spinneret. It is then loaded into a bobbin and stretched for elasticity and strength. The fibers are then drawn to another spool and ready to be spun into garments and dyed. China is the biggest exporter of Nylon, which generally is an expensive form of textile and is even more inexpensive when it is spun with other fabrics.



VARIATIONS

There are five types of Nylon fabrics. Nylon 6,6 is one of the first fully synthetic fabrics. Nylon 6 is less popular for the creation of fabrics. Nylon 46, or Stanyl, is produced by a corporation called DSM and is uncommonly found in fabrics. DuPont created nylon 510 as another variation of Nylon 6,6, and is now the most common variation of Nylon used in industrial spaces. Nylon 1,6 is another form that isn't commonly used in fabrics and has a different chemical makeup.



IMPACT

Much like polyester, nylon has a highly damaging effect on the environment. The use of crude oil and fossil fuels both release harmful chemicals into the atmosphere. The harvesting of petroleum is also highly detrimental to the environment. Producing nylon is incredibly wasteful, and the fabric is not biodegradable.

Acrylic Spandex



ORIGINS

The DuPont Corporation created acrylic fabric in the 1940s, but the textile wasn't commonly used until the 50's. Acrylic was designed to replace wool, but there was a growing concern about the flammability of the textile. An environmental movement in the 1970s started showing the vast ecological effects of synthetic fibers, and consumers began to be more mindful about purchasing synthetic textiles.

Spandex fiber, known as Lycra or Dorlastan fibers, was invented in Germany in 1937. Elastane is used in garments where permanent stretch is required. This feature is not one that is found in nature, making the fiber incredibly unique.

VARIATIONS

There are four variations of Acrylic fabric. Normal acrylic fabric is a fabric that has to contain at least 85% pure acrylonitrile. Modacrylic is a variant that uses more than one type of polymer in its production process. Nitrile is a kind of acrylic primarily composed of a vinylidene dinitrile polymer. Lastrile fabric is a form of acrylic that has elastic components.

PRODUCTION

To create Acrylic fabric, the fabric needs to be polymerized into acrylonitrile polymer polyacrylonitrile. It is then dissolved using a chemical solvent. After, it is extruded to form the acrylic fiber. The fiber is then spun in a dry or wet spinning process. Next, the fibers are washed, stretched, and loaded onto bobbins and shipped to textile producers to be weaved into apparel. China is the leading producer of acrylic fabric and produces more than 30% of it globally.

BENEFITS

Acrylic fabric is water-repellent, soft, lightweight, and warm. However, the fabric is prone to producing odor, static cling, and high flammability. The fabric is generally inexpensive and not very durable. Blending acrylic with wool tends to diminish the less favorable qualities.

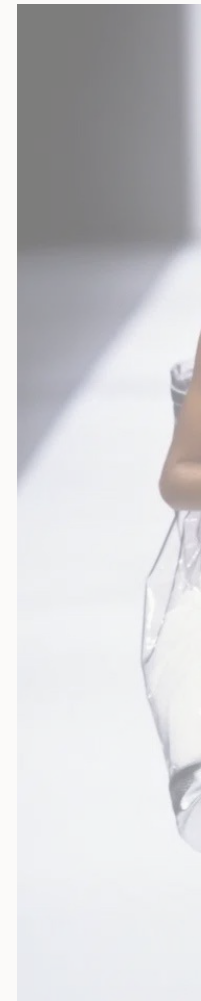
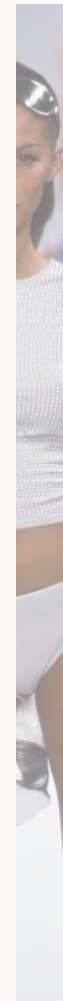
Elastane is a fabric that is permanently stretchy. It has better durability and tension than rubber and is extremely lightweight in comparison. Elastane combines natural and synthetic fibers that give it its elastic properties. The fiber can be stretched anywhere from 4-7x its original length and always revert back to its original form.



Acrylic Spandex

IMPACT

Acrylic fabric generally has a negative environmental impact. The production process of the fibers is so destructive that legislation is in place to regulate damage levels. The release of harmful chemicals during production ruins the surrounding ecosystems and wildlife. Acrylic is not biodegradable and not recyclable. When consumers wash their clothes, fibers are released into the water supply and pollute shorelines. In addition to environmental risks, acrylic is harmful to human health, and studies have shown that every time you come in contact with acrylic fabric, your chances of developing cancer increase.



Synthetic Rubber



ORIGINS

Synthetic rubber was created in the early 1900s and was first produced commercially in Germany in 1915. Natural rubber was a depleted resource due to WWII, which forced companies to develop synthetic alternatives. Not long after, the need for natural rubbers was significantly reduced.

BENEFITS

Synthetic rubber is an artificial elastic produced by using petroleum. It has a high elasticity and strong resistance against weather, heat, chemicals, and oil. Compared to natural rubber, its resistant properties are not as excellent, and the material will degrade faster.

PRODUCTION

Synthetic rubber production begins with the polymerization of petroleum monomers. The monomers are then emulsified, resulting in polymer latex. The latex is then washed and dried into rubber crumbs, which are then combined with accelerators, which enhance its properties. Finally, the rubber is vulcanized to improve its strength.

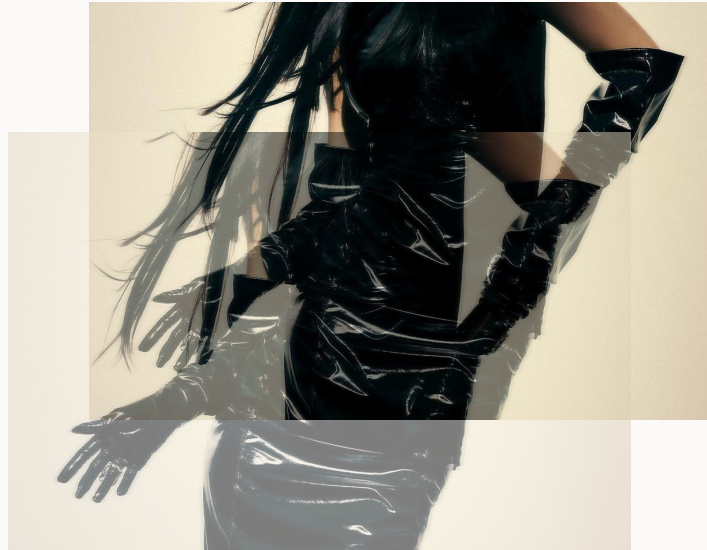


VARIATIONS

There are several major types of synthetic rubber. Styrene-butadiene rubber, or SBR, is the most common type used in industrial settings. Butadiene Rubber, or BR, has good wear and tear and low-temperature flexibility. Nitrile Rubber, or NBR, has excellent fuel and oil resistance. Ethylene Propylene Rubber, or EPR, has fantastic weather and heat resistance. Finally, Chloroprene Rubber, or CR, has outstanding chemical and weather resistance.

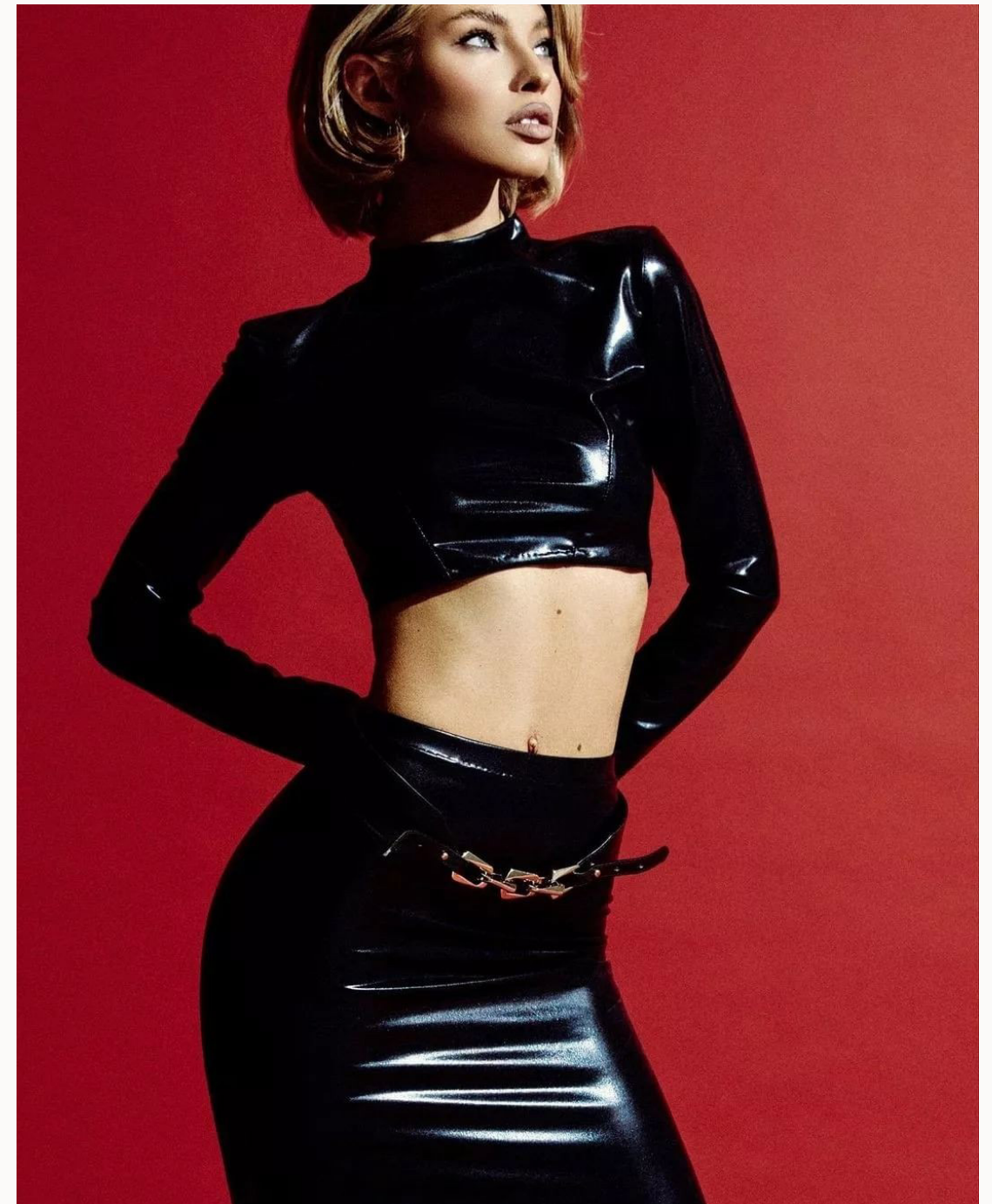


Synthetic Rubber



IMPACT

Synthetic rubber production has significant environmental impacts. The manufacturing process releases hazardous chemicals into the air. The material is not biodegradable and contributes to microplastic pollution when it does break down. The end-of-life disposal of the fiber is challenging and needs a ton of energy. Recently, new recycling technologies have been helping to lessen the impact of fibers.



Rayon



PRODUCTION

Rayon production starts with dissolving the cellulose from either wood pulp or cotton linters. The solution is spun through spinnerets into an acid bath and solidified into fibers. The fibers are cleaned, bleached, and then spun into yarn. The yarn is ready to be created into different kinds of rayons. Each type of rayon uses unique processes to achieve the properties necessary.

ORIGINS

Rayon was developed in the 1800s by Georges Audemars as a means to replace silk. The first commercial production of Rayon began in 1905. The textile was named rayon in 1924 and became essential for militia textiles during WWII. Significant advancements in textile and fabric production and quality occurred during this period.



VARIATIONS

The main types of rayon include viscose rayon, the most common type known for its silk-like qualities, and Modal rayon, which is strong when wet and not as likely to shrink. Lyocell is environmentally friendly, the strongest rayon when wet, and lastly, cuprammonium rayon is used in high-end products and has limited production due to environmental concerns.



BENEFITS

Rayon is a semi-synthetic fiber made from regenerated cellulose fiber. Rayon has qualities like high absorbency, breathability, and beautiful draping. The textile tends to be soft and comfortable and loses strength when wet. It can be blended with other fibers to enhance its properties and is often used as an alternative to silk.

Rayon



IMPACT

Rayon has many harmful environmental impacts. Viscose production releases dangerous chemicals into the air, but newer lyocell production methods are more sustainable and minimize waste. Deforestation is also an element in the production of rayon, as wood pulp is the primary material in production processes.

Lyocell

ORIGINS

Lyocell was developed in 1972 by American Enka researchers. Courtaulds Fiber commercialized the fiber in 1988 under the name Tencel. Lyocell was created after environmental concerns about traditional rayons, and by 1992, the first lyocell production facility opened in Alabama, which later became the primary global producer of lyocell fibers.



PRODUCTION

Lyocell production begins by dissolving wood pulp in a solution. The solution is then filtered and spun through spinnerets into a hardening bath to solidify the fibers. The solvent is then reused to make new lyocell fibers. The fibers are then washed, dried, and made into yarn and ready to be created into fabric.

VARIATIONS

There are four variants of lyocell. The first is the standard lyocell, which is used in clothing. The second is MicroModal, which is used in luxury garments. The next is A100, which is used in activewear for additional moisture-wicking properties, and STF, a unique fiber for technical applications.



BENEFITS

Lyocell is a sustainable type of cellulose fiber known for its strength, softness, and moisture-wicking properties. The fabric is highly breathable, has temperature regulation, and is pretty when draping. Unlike other cellulose fibers, Lyocell maintains its strength when wet and doesn't wrinkle as easily. Lyocell is biodegradable.

Lyocell

IMPACT

Lyocell is one of the most environmentally friendly textiles to produce. The production process minimizes waste and water consumption. The raw material comes from eucalyptus trees, and the finished garment is fully biodegradable. This being said, the energy consumption in the production process is a concern.





*Sustainable
Fibers*

Pinatex

ORIGINS

Piñatex was developed by Dr. Carmen Hijosa in 2008. Commercial production of the textile began in 2016.



PRODUCTION

The production process of Piñatex starts with harvesting pineapple leaves, which go through an extraction process. After extraction, the fibers are processed into a mesh and treated with pigments and resins. The resulting material goes through another round of treatments for durability and water resistance. One square meter of Piñatex uses 480 pineapple leaves.

RECENTLY

Hugo Boss recently launched sneakers made of Piñatex in their 2024 sustainable collection. In H&M's conscious collection, Piñatex jackets and accessories were released. Lastly, Nike incorporated Piñatex into a limited-edition sustainable sneaker collection.

BENEFITS

Pinatex is a natural leather alternative made from the leaves of pineapples. The material is durable, breathable, and flexible- similar to leather. It is water resistant, lightweight, and can be dyed and printed on. The texture is grainy, with aesthetic appeal and practicality.





ORIGINS

S.Café was created by a Taiwanese industrial company called Singtex. Singtex spent four years researching and developing the textile, which began commercial production in 2010. By 2015, the technology had expanded from mainly outdoor brands to mainstream fashion markets.

S.Café

PRODUCTION

To create S.Café fabric, used coffee grounds are collected from major coffee chains and cleaned; the pores in the coffee grounds are combined with recycled polyester yarn. Combining the coffee and yarn in high-temperature processing creates a permanent bond after being washed a few times. The yarn is then ready to be made into fabric.

BENEFITS

S.Café fabric is a textile that turns recycled ground coffee into yarn. The fabric has odor control UV protection and is quick-drying. It has excellent moisture-wicking and doesn't lose these properties over time. It is a lightweight fabric with temperature regulation.

RECENTLY

In their 2024 Olympic uniforms, Ralph Lauren used S.Café. In addition, Lululemon launched a capsule collection using S.Café for a high-performance line.





Fabric

FACT FILE

SCAN FOR ALL REFERENCES USED

