FOCUS PAPER

Pulp and Fiber Production

Reducing environmental impacts through emission management and certified production standards in Lenzing's pulp and fiber manufacturing

Lenzing
Innovative by nature

Issue August 2026

Executive Summary – Pulp and Fiber Production

This focus paper explains how the Lenzing Group produces dissolving wood pulp and regenerated cellulose fibers using resource-efficient technologies on an industrial-scale, with a strong emphasis on environmental performance and circular economy principles.
Overall, it outlines Lenzing's approach to maintain technological leadership, including vertically integrated production and circularity solutions, that enables pulp and fiber manufacturing in line or even exceeding state-of-the-art practices. For customers, this means access to cellulose fibers produced with high resource efficiency, advanced environmental controls, and transparent sustainability practices — providing best-in-class cellulose fibers from natural resources[1] and supporting informed material choices across textile and nonwoven applications.

From Wood to Fiber: A Two-Stage Production Process

Regenerated cellulose fibers are made from cellulose, a natural polymer derived mainly from wood. The wood is sourced from sustainably managed forests. Lenzing's production follows a two-stage process: first, cellulose is extracted from wood to produce high-purity dissolving wood pulp; second, this pulp is transformed into fibers for textile, nonwoven, and industrial applications. Lenzing operates across all three major cellulose fiber technologies — viscose, modal, and lyocell — enabling a broad and flexible product portfolio tailored to customer needs.

Biorefineries, Best Available Technologies and Closed-Loop Production

A key differentiator of Lenzing's production model is its integrated biorefinery concept. At its pulp production sites in Austria, the Czech Republic, and Brazil, 100 percent of the wood input is utilized by producing biobased co-products and renewable energy, in addition to dissolving wood pulp (see Table 1). These sites are energy self-sufficient and even produce surplus energy, which is used on-site or fed into local power grids. This approach maximizes resource efficiency and reduces waste at industrial scale.
Lenzing applies best available technologies across all production stages. Its own biorefineries operate with totally chlorine-free (TCF) pulp bleaching, exceeding common industry practice of elemental-chlorine-free (ECF) bleaching and meeting EU Best Available Techniques (EU BAT). In fiber production, closed-loop systems recover and reuse chemicals and solvents. The lyocell process stands out in particular for its simplified chemistry and a solvent recovery rate of 99.8 %, supporting lower chemical consumption compared to conventional processes.

Clear Principles for Resource-Efficient Production

Pulp and fiber production at Lenzing is guided by clearly defined principles. The Group has established Responsible Viscose Criteria covering raw material sourcing, chemical management, worker health and safety, product quality, transparency, and substantiated sustainability communication. These criteria are supported by independent standards and certifications, including forest certification schemes, ISO management systems, EU Ecolabel requirements, and traceability tools along the value chain.

Circular Economy Embedded in Industrial Operations

Circular economy thinking is embedded throughout Lenzing's operations. The company focuses on natural circularity, resource-efficient technologies, and commercial-scale recycling solutions. Through technologies such as REFIBRA™, Lenzing uses chemically recycled pre- and post-consumer textile waste and reintegrates it into new fibers, increasing recycled content while maintaining performance and quality. Continuous innovation and partnerships aim to further expand alternative feedstocks by 2030.

Managing Environmental Impacts Through Continuous Investment

Environmental impacts from production are actively managed through group-wide implemented ISO 14011 environmental management systems as well as ongoing investments in emission control and wastewater treatment. Recent upgrades across multiple sites have led to substantial reductions in air and water emissions and support compliance with regulatory and voluntary frameworks such as the ZDHC MMCF Guidelines.

[1] For more information on Lenzing's sourcing principles, please see the Focus paper Wood and pulp.

Table of contents

Introduction

This focus paper describes the production processes of dissolving wood pulp and regenerated cellulose fibers. It provides an overview of the Lenzing Group's manufacturing operations with particular regard to environmental aspects and state-of-the-art production.

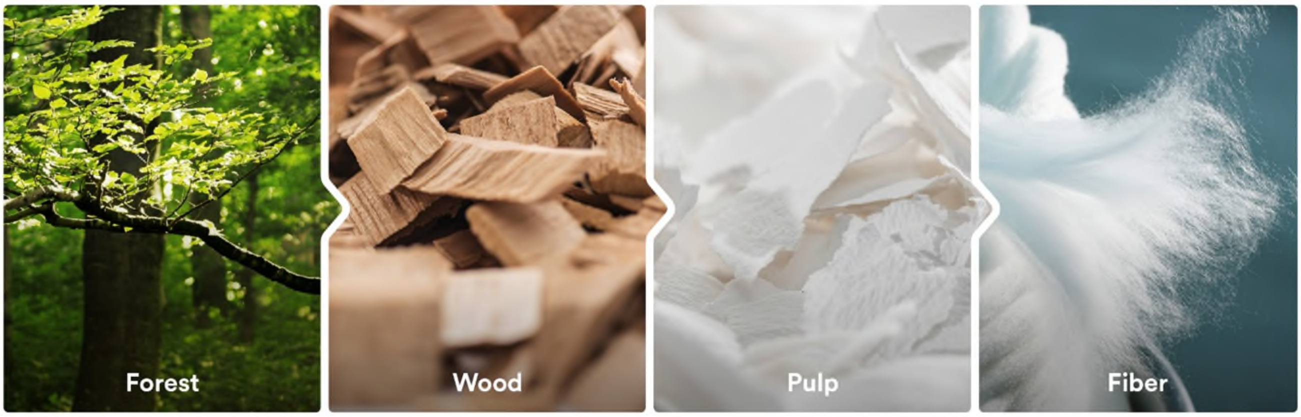

Figure 1: Schematic process stages of transforming wood into fibers.

In recent years, regenerated cellulose fibers gained interest as these come with high sustainability potential and offering nature-based solutions. By sourcing raw materials from sustainable forestry, as proven by forest certificates, and best available production technologies are applied, regenerated cellulose fibers can reduce potential environmental impacts to a minimum.

What is cellulose?

Cellulose is the main structural component of plant cell walls. It can be used to make a variety of commodities such as paper or textile fibers.

What are regenerated cellulose fibers?

Regenerated cellulose fiber is a manufactured fiber that uses cellulose, typically obtained from wood. During production, cellulose is dissolved and then shaped into fibers, therefore the name "regenerated".

Two-stage production process

Regenerated cellulose fibers are produced from the natural polymer cellulose. The two-stage production process starts with extracting cellulose from wood or other plant-based materials to make pulp, which is similar to the production process of paper. In a second stage, pulp is dissolved and cellulose fibers are regenerated from the solution into a shape suitable in diameter and length for use in textile and nonwoven applications. Shaping of cellulose pulp into fibers requires a special quality of pulp, referred to as dissolving wood pulp, which must meet different requirements than those for paper pulp. Among other things, dissolving wood pulp must have a higher pure cellulose content of over 90 percent, lower impurity levels, must be bleached to a higher level of brightness and have a more uniform molecular weight distribution. Dissolving wood pulp is the most important raw material used in producing regenerated cellulose fibers, including Lenzing's fibers.

The three major fiber process technologies are:

- Viscose (rayon)
- Modal
- Lyocell

The final fiber product consists of natural cellulose, with a chemical structure identical to natural fibers (e.g. cotton, linen), and finishing agents. A broad range is biodegradable in soil, fresh water and marine conditions as well as compostable in home applications and industrial facilities.[2]

In line with its strategic focus on specialties, the Lenzing Group offers a portfolio of different fiber types on the basis of the three mentioned technologies. In order to meet the broad range of requirements for textile, nonwoven or other industrial applications, regenerated fibers from Lenzing can be offered:

- With different fiber fineness, from the finest microfibers to coarse fibers for carpets;
- in various cut lengths. From shortcut fibers for special applications in wipes or as reinforcing material in fiber composites to long staple fibers for wool blends up to filament yarns;
- with modified cross-sections;
- or as tow.

Furthermore, regenerated cellulose fibers can be functionalized by incorporating certain compounds into the spinning mass. Examples include flame retardant agents, spin dyes, dulling agents etc.

Lenzing contributes to Sustainable Development Goal (SDG) 12, **"Responsible consumption and production"**, with sustainable sourcing, efficient use of raw materials, longstanding experience with biorefineries, life cycle thinking along the value chain and a long pipeline of innovative and sustainable products.

[2] For more information on the End-of-Life of Lenzing fibers, please see the Focus Paper End of product use.

Lenzing´s global presence

The Lenzing Group operates globally, with production sites as well as marketing and sales offices in the regions most relevant to our business.
The Lenzing Group's current dissolving wood pulp production capacities are located in Austria, the Czech Republic and Brazil. In addition to its own dissolving wood pulp production, Lenzing procures dissolving wood pulp in the global market (see website section "Wood pulp from certified or controlled sources"), mostly under long-term supply contracts. Fiber production capacities are located in Austria, United Kingdom, USA, Indonesia, Thailand and China.

Locations

Numbers = Nominal capacities as at December 31, 2025

1 Airdry

Figure 2: Locations of the Lenzing Group

Pulp production in the Lenzing Group

What is a pulp biorefinery?
A biorefinery is a facility for processing of biomass into dissolving wood pulp and a spectrum of marketable biobased products as well as bioenergy.

Figure 3: LENZING™ Acetic Acid Biobased used for food applications.

Biorefinery

Lenzing's biorefinery process ensures that 100 percent of wood constituents are used to produce dissolving wood pulp for fiber production, biobased products, and bioenergy, thereby maximizing value creation from an economic and environmental perspective.

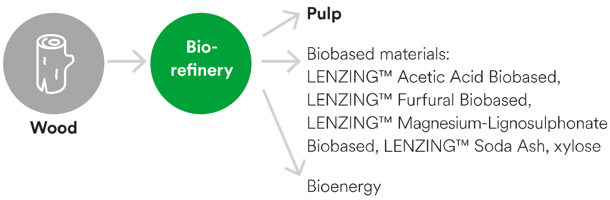

Figure 4: Highly efficient use of the raw material wood at the Lenzing site (Austria).

Dissolving wood pulp production at each Lenzing pulp site is not only self-sufficient in terms of meeting its own energy demand but the process actually generates more energy than needed. This surplus green energy is used on-site (e.g. for integrated fiber production) or fed to the local power grid. Lenzing pulp sites also produce biorefinery products such as acetic acid, furfural and magnesium lignosulfonate, increasing the total yield from wood as well as creating additional economic value and reducing impacts to the environment.

Pulping technologies

In the pulping process, logs are debarked, chipped and treated in a cooking liquor. Cellulose is a major component of wood – around 40 percent of the wood substance, depending on the species – and is separated as raw pulp in this process. This pulp is then washed and screened to remove the residual cooking liquor, knots, and impurities. The raw pulp is bleached in a totally chlorine-free (TCF) process and turned into pulp sheets or flakes. The other wood constituents remain within the thin liquor together with other cooking chemicals. The cooking chemicals are recovered and recycled from the liquor and the organic components are converted into bioenergy (steam and electricity). For cooking chemicals used, please see table 1 "Description of biorefinery facilities in the Lenzing Group" below.

Pulp bleaching in the Lenzing Group

Bleaching is necessary to yield a dissolving pulp quality suitable for regenerated cellulose fibers, such as viscose, modal, and lyocell. Most dissolving wood pulp producers use elemental chlorine-free (ECF) pulp bleaching processes. Lenzing's three biorefineries produce pulp using a TCF (totally chlorine-free) bleaching process without using any chemicals containing chlorine, but with oxygen-based substances.

Due to the omission of chlorine-based bleaching methods, dissolving wood pulp produced in the Lenzing Group not only has less impact on the environment and human health but also ensures the high quality required for fiber production. This technology applied at all three plants complies with the EU Best Available Techniques (EU BAT).

Table 1: Description of biorefinery facilities in the Lenzing Group

Site	Lenzing (Austria)	Paskov (Czech Republic)	Indianópolis (Brazil)
Nominal capacity (tons per year of air-dry pulp)	320,000	300,000	600,000
Biorefinery products	Acetic acid, furfural, xylose, magnesium-lignosulfonate, soda (sodium carbonate), hemilye, magnesium-lignosulfonate X	Magnesium-lignosulfonate, soda (sodium carbonate)	Fertilizer (by-product from on-site composting plant)
Use of energy surplus	Used for fiber production at the site	Electricity exported to public grid	Electricity exported to public grid
Main wood source	Beech	Spruce	Eucalyptus
Production technology	Magnesium bisulfite process		Prehydrolysis Kraft process
Pulp cooking chemicals	Magnesium oxide, sulfur dioxide		Sodium hydroxide, sodium sulfide
Bleaching chemicals	Oxygen, ozone, hydrogen peroxide, sodium hydroxide		
Sustainability features	TCF bleaching		

Biorefinery and pulp production sites

Process chemicals from pulp production waste streams are extracted early in the biorefinery process at all three production sites, which significantly reduces the emission load of effluent water. This is one example of best practices where potential waste streams are converted into useful products, thereby avoiding potential pollution and reducing the amount of emissions and wastewater to be treated at wastewater treatment plants.

Lenzing Aktiengesellschaft (AG), Lenzing (Austria)

Vertically integrated dissolving wood pulp & fiber production

Lenzing AG is the headquarter and one of the largest vertically integrated pulp and cellulose fiber production plant in the world. The integrated dissolving wood pulp and fiber production provides economic benefits as well as environmental advantages and savings compared to non-integrated mills.

Wood for pulp production at the Lenzing site consists mainly of beech (*Fagus sylvatica*). Marketable biorefinery products such as acetic acid, furfural, and xylose are obtained in further processing steps. More than half of the wood is transformed into pulp and other biobased products.

Lenzing's expertise in integrated dissolving wood pulp and fiber production is the basis for future opportunities towards carbon net-zero and to contribute to the greenhouse gas reduction target.

Lenzing Biocel Paskov a.s, Paskov (Czech Republic)

Dissolving wood pulp production

Lenzing Biocel Paskov specializes in producing high-quality dissolving wood pulp from the natural raw material base spruce wood (*Picea abies*). The dissolving pulp production process based on magnesium bisulfite is similar to that employed at the Lenzing site (Austria). The other two major components of wood – lignin and hemicellulose – are dissolved in the liquor. The insoluble remainder is crude unbleached pulp. This pulp is then washed and screened. Further, deeper removal of lignin and hemicellulose is performed by means of alkali extraction and a TCF bleaching process. After final fine screening, the pulp is dried in sheets, baled, and dispatched.

The Paskov site operates with fuel sources from biomass, biogas and natural gas. In terms of heat and electricity generation the Paskov site is completely self-sufficient and supplies its surplus electricity to the public grid.

LD Celulose S.A,

Indianópolis (Brazil)

Dissolving wood pulp production

LD Celulose S.A., a joint venture between the Austrian Lenzing AG and the Brazilian company Dexco, is one of the world's largest dissolving wood pulp plants. It has a capacity of 600,000 tons of dissolving wood pulp and generates about 1,200 direct jobs.

To mitigate wood scarcity risks, Lenzing operates its own eucalyptus plantation in Brazil to ensure reliable and sustainable wood supply. The plantation is managed by LD Celulose, which implements targeted measures to protect biodiversity and safeguard soil and water quality. LD Celulose does not use genetically modified organisms (GMOs). The plantation is located approximately 800 km away from the Amazon region. The dissolving wood pulp produced at LD Celulose is used in the textile and nonwoven industries, generating innovative, sustainable and high-tech fabrics and nonwovens.

The mill adopts EU Best Available Techniques (EU BAT) and Best Environmental Management Practices (BEMPs), aiming at reducing air emissions, liquid effluents, noise and solid waste generated by the industrial processes. LD Celulose operates on fuel sources such as biomass and oil. The eucalyptus wood extracted from LD Celulose's plantations is also used as fuel to generate electricity for the LD plant, thus ensuring a renewable energy source for industrial operation. Excess electricity not directly used for pulp production is sold and distributed in the national power grid.

Fiber technologies

Lenzing's product portfolio extends from dissolving wood pulp to innovative specialty fibers as well as energy, biorefinery products and co-products from fiber production.

The Lenzing Group combines comprehensive expertise in operating pulp and biorefinery processes with decades of experience in three major fiber process technologies:

- Viscose (rayon)
- Modal
- Lyocell

Based on the lyocell process, three new process technologies have been developed in recent years: REFIBRA™ technology for textiles, Eco Filament technology and LENZING™ Nonwoven technology. For more information, see chapter "Technology innovations in fiber production" of this focus paper. Lenzing's high-quality fibers are supplied to the textile and nonwoven industry as well as for industrial applications. Each of the fiber types has its special properties valued in textile, nonwoven and industrial applications and is therefore an integral part of the product portfolio.

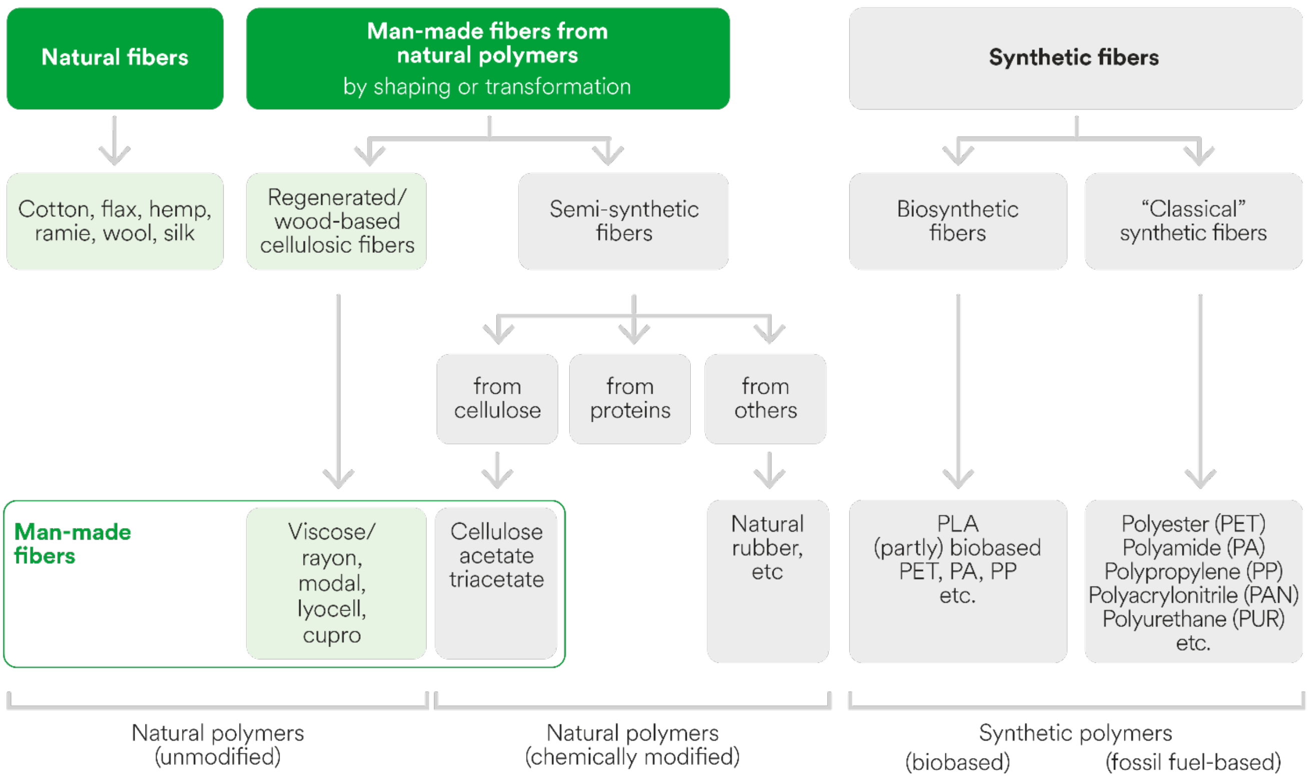

Figure 5: Fiber types on the world market

Lenzing's viscose and modal production process

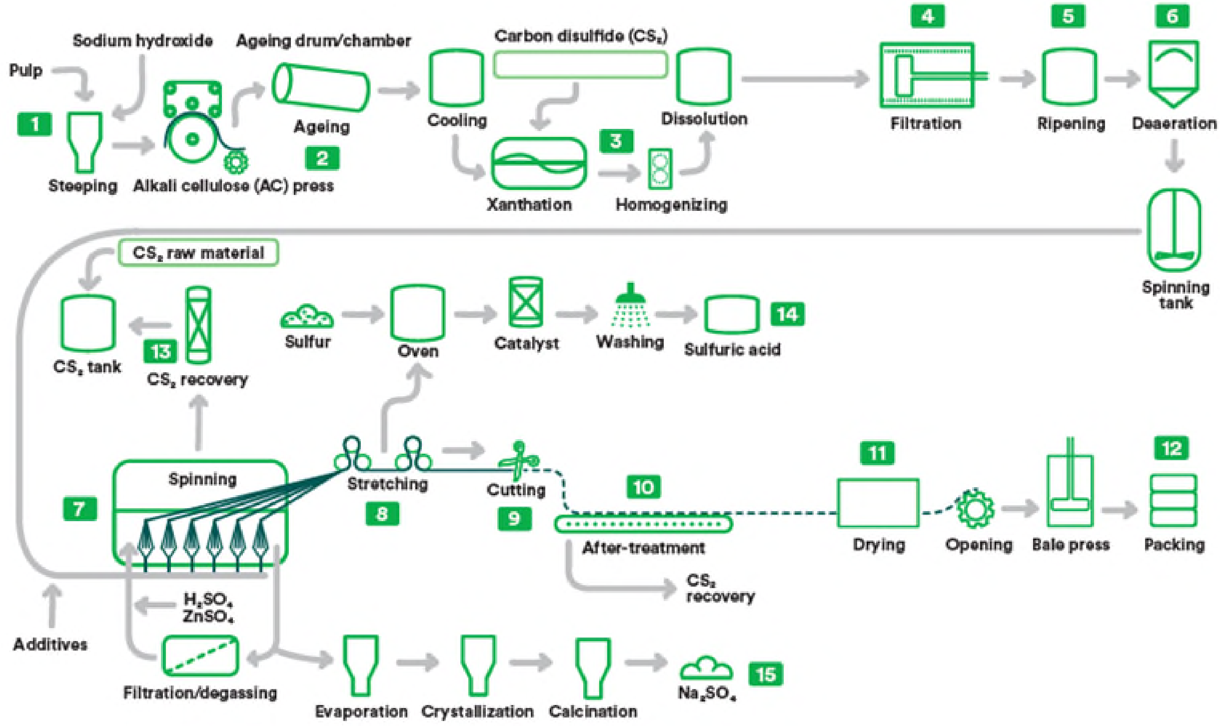

Figure 6: Lenzing's viscose and modal production process

Viscose fibers were the first regenerated cellulose fibers produced on an industrial scale since the late 19th century and are produced in a multi-step process. The cellulose in the viscose process is derivatized by a chemical reaction (xanthation with carbon disulfide) prior to being dissolved in sodium hydroxide solution.

In the first step, pulp is steeped in a sodium hydroxide solution and is converted to alkali cellulose (AC) after pressing out excess lye (see figure 6, step 1). The AC is then aged in a drum or chamber (2) prior to reacting with carbon disulfide (CS_2) in a reaction chamber (3). The resulting xanthate is then dissolved in a sodium hydroxide soultion prior to being filtered (4). The resulting deep orange and highly viscous cellulose solution (hence the name) is then ripened (5) and deaerated (6) before the viscose enters the spinning process. The cellulose solution is pressed through a number of orifices into an acidic spin bath where a plurality of single filament tows is formed (7). After stretching of the tow (8) it is cut into the desired staple fiber length (9). In the after-treatment (10) the staple fibers are desulfurized, repeatedly washed and bleached and finally a finish agent is applied. After drying (11) of the viscose fibers they are pressed into bales and finally packed (12).

CS_2 is recovered from different waste gas streams (13) and is fed back into the system. Sulfur compounds containing waste gas streams are also converted into sulfuric acid (H_2SO_4) in several process steps and are reused in the process (14). Zinc is precipitated and recovered from the wastewater. Sodium sulfate, generated as a reaction product of sulfuric acid and sodium hydroxide in the spin bath, is isolated as a co-product in a multi-step process (15) and is sold to other industries. Lenzing's modal fibers are exclusively produced in Lenzing (Austria) and Nanjing (China) in a modified viscose process. At the Lenzing (Austria) site an integrated production process is employed in which the raw material pulp is produced at the same site as the viscose and modal fibers.

Lenzing's responsible viscose criteria

Lenzing has defined six criteria that are essential to produce viscose (and modal) fibers in a matter of environmental and social responsibility within own operations and the supply chain.

1

Certified wood and pulp sourcing

Wood and pulp used in the viscose production process come from sustainably managed forests and plantations.

Evidence 1

- FSC® (FSC-C041246) or PEFC (PEFC/06-33-92) certified and controlled sources
- CanopyStyle verification of the entire wood and pulp supply

LENZING™ ECOVERO™ and VEOCEL™ branded fibers fulfill Lenzing's criteria for responsible viscose and provide a solution to improve the sustainability of the industry. These fibers are available from the Lenzing (Austria), Purwarkata (Indonesia) and Nanjing (China) sites.

2

Efficient production and closing the loops

Viscose production requires chemicals that need to be handled safely and effectively to reduce impacts on human health and ecological systems. Proper recovery and emission treatment equipment is required to reduce air and water emissions to a minimum and close the loops in the viscose process. For further details, see section "Closing the loops".

Evidence 2

- LENZING™ ECOVERO™ and VEOCEL™ branded fibers are certified with the EU Ecolabel (see section EU Ecolabel)
- LENZING™ ECOVERO™ and LENZING™ Viscose fibers show substantially better performance than generic viscose as substantiated by Higg Material Sustainability Index (MSI). (Based on Higg MSI database v3.11 Oct. 2025.)
- OEKO-TEX® STANDARD 100, Annex 6, product class I - aligned with Detox Campaign

Safety and health for workers and community

Management practices such as safety trainings, safety walks & talks, safety and environmental management systems are required to run the process effectively and to make continuous improvements. This avoids health risks for employees and the community.

Evidence 3

- ISO 14001:2015
- ISO 45001:2018

Quality and product safety

Quality is a key pillar of sustainability and product responsibility. Without quality, no product is sustainable, since it will not satisfy the intended function. Products must be safe to use and meet the purity requirements for the respective application.

Evidence 4

- ISO 9001:2015
- OEKO-TEX® STANDARD 100, Annex 6, product class I

Transparency along the value chain

Customers and consumers can support sustainable products if they have information about how and where the products are made. Track- and traceability of raw materials in the final product ensure that they originate from sustainably managed sources, thereby preventing counterfeiting by unscrupulous producers. In the long run, this will help improve the overall sustainability of the industry thanks to informed decision-making by all parties.

Evidence 5

- Fiber identification technology for e.g. LENZING™ ECOVERO™ Viscose, ECOVERO™ x REFIBRA™, TENCEL™ Modal, LENZING™ FR
- Downstream value chain track and traceability via digital tokens
- Lenzing fiber certification scheme

Substantiated claims for sustainability communication

Communication is essential for improving transparency. Responsible producers take communication seriously and help their customers and final consumers to use sustainable products with substantiated claims.

Evidence 6

- Marketing/Branding support - Lenzing E-Branding Service
- Disclosure of potential environmental impacts via Higg MSI

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Lenzing's lyocell production process

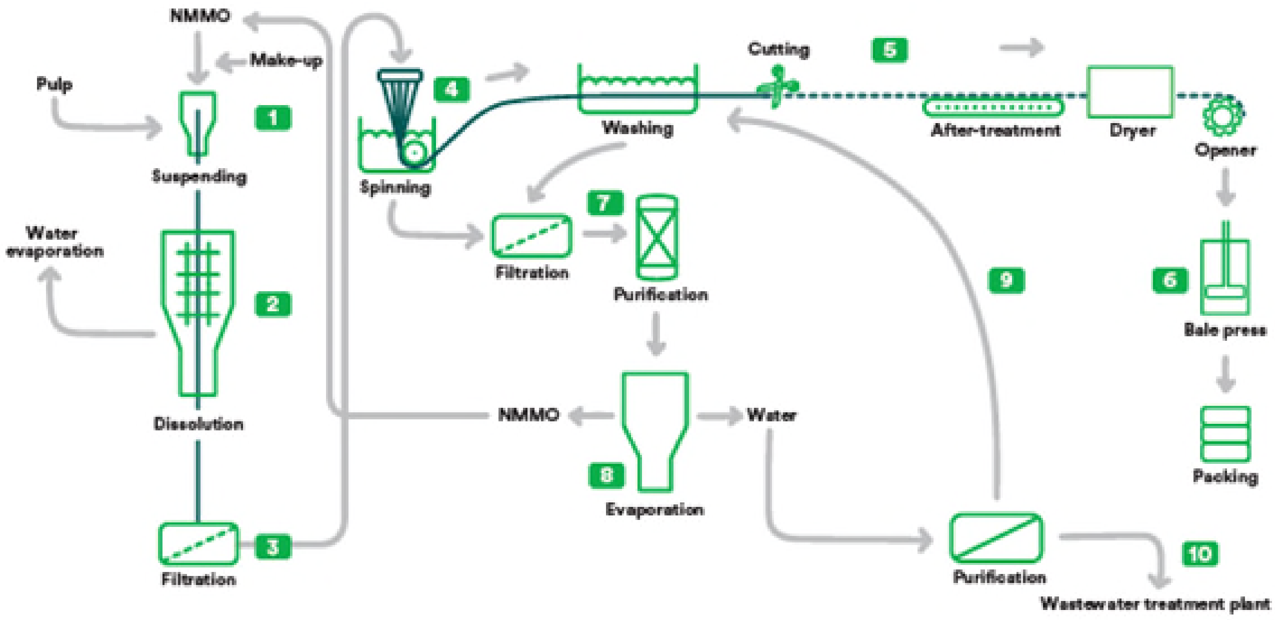

Figure 7: Lenzing's lyocell production process

Lyocell fibers are the latest generation of regenerated cellulose fibers. They have been produced at a commercial scale for about 30 years. The generic fiber name is lyocell and branded products from Lenzing are marketed as TENCEL™ Lyocell (for textiles) and VEOCEL™ Lyocell (for nonwovens).

The initial idea in developing the lyocell process was to derive cellulose fibers from pulp without relying on the chemically complex viscose process.

Similar to viscose fiber production, the raw material pulp is derived from renewable wood. In contrast to the traditional chemical viscose process, the lyocell process directly dissolves cellulose in the organic solvent N-Methylmorpholine-N-oxide (NMMO[3]) without the need to derivatize the cellulose[4]. This means that, in contrast to the viscose process, no sulfuric chemicals are used at all and the overall production process for lyocell fibers is therefore simplified.

Waste generation in the production process is minimized thanks to closed loops and lower consumption as well as higher utilization of both chemicals and raw materials.
The lyocell production process starts by suspending pulp in water and NMMO in order to get a homogenous slurry (see figure 7, step 1). In the next process step, water is removed, and cellulose is thereby dissolved to form a solution called dope (2). Prior to spinning, the cellulosic solution is filtered in order to remove undesired particles and undissolved material (3). The heart of the production is the spinning process (4) where the cellulosic solution is pressed through a number of very small orifices thereby forming cellulosic filament tows. These filament tows are cut into staple fibers of desired length and then enter the after-treatment zone where the fibers are washed, and a finishing agent is applied (5). The wet staple fibers are then dried, opened, pressed into bales and finally packed to obtain the final product (6). The recovery rate of NMMO in the lyocell process is 99.8 percent. The recovery starts with filtration and pre-purification steps (7) of the spin bath before water is removed by evaporation (8) to obtain

[3] N-Methylmorpholine N-oxide is an aqueous, biodegradable, organic solvent.

[4] For literature on the lyocell production process, see White 2001 and Ganster & Fink 2009.

NMMO and the whole cycle can start again after minor solvent losses are compensated with make-up NMMO. Water that is obtained from the evaporation step is also fed back into the process (9) and only a small amount of water is sent to the wastewater treatment plant (10).

Lenzing has also developed technological measures to minimize the process energy required in lyocell production. The second-generation plant installed at the Lenzing site (Austria) includes innovative heat recovery systems to reduce energy consumption compared to the former plant design. In principle, closing the loops requires less effort due to the generally simple process.

Use of lyocell fiber offers great advantages from an environmental perspective compared to other cellulose fibers due to simplified chemistry and high solvent recovery rates. Compared to the viscose process, the lyocell process is by design less resource-intensive and therefore reduces chemical use due to conversion of pulp into fiber in a closed-loop process.

Lyocell fiber is the latest generation of regenerated cellulose fibers commercially available. It has been produced at a commercial scale for more than 30 years. The generic fiber name is lyocell. The **branded products from Lenzing are marketed as TENCEL™ and VEOCEL™ fibers**.

Technology innovations in fiber production

Lenzing continuously works on advancing fiber production with technology innovations enhancing performance and sustainability.

The LENZING™ Nonwoven Technology produces a direct formed nonwoven fabric made of 100 percent continuous lyocell filament. The technology offers a unique self-bonding mechanism where endless fibers ("filaments") bond into a fabric during the laydown process. This self-bonding mechanism allows for a much wider variety of basis weight, surface textures, drapeability and dimensional stability than other nonwoven technologies based on cellulose.

LENZING™ Viscose Color technology (LENZING™ ECOVERO™ Black) and LENZING™ Modal Color technology fibers are produced by incorporation of color pigments into the viscose or modal spinning mass for nonwoven and textile applications. This technology avoids resource-intensive conventional dyeing of fabrics.

LENZING™ FR incorporates a flame-retardant additive into the spinning mass based on the modal process. These fibers are used in protective wear such as for firefighting, protection from metal splashes, protection from electric arc and motor sports.

Other technologies

Moreover, technology innovations for nonwoven fibers include tailoring fiber properties to meet specific performance requirements for different uses:

- Translucency technology
- Disperse technology
- Micro technology
- Dry technology
- Absorbency technology

For a detailed overview of the mentioned fiber technologies for textile and nonwoven fibers, please visit Fiber Technologies: Explore Lenzing's Production Processes.

Fiber production sites

Lenzing Aktiengesellschaft (AG), Lenzing (Austria)

Dissolving wood pulp & lyocell, viscose and modal fiber production

Lenzing AG is the world's only production site for all three generations of cellulose fibers.

The Lenzing headquarters runs on around 70 percent renewable energy, showcasing its commitment to innovative and forward-thinking energy solutions. Surplus energy (steam and electricity) is used on site, mainly for fiber production. Fuel sources used in Lenzing (Austria) are biomass, waste, natural gas and coal.

As the core R&D center for the entire Lenzing Group, it plays a pivotal role in shaping the future of sustainable fiber technology and driving innovation in the industry.

Lenzing Fibers GmbH, Heiligenkreuz (Austria)

Lyocell fiber production

The fiber plant in Heiligenkreuz is designed for specialty lyocell fiber production. As the first facility worldwide to produce over one million tons of lyocell fibers, it combines advanced manufacturing with environmental stewardship. The 2023 acquisition of a biomass plant supports the transition towards net-zero GHG emissions according to Lenzing's long-term science-based target. Heiligenkreuz facility runs on biomass, biogas and natural gas sources.

Lenzing Fibers Grimsby Ltd., Grimsby (UK)

Lyocell fiber production

The production site Lenzing Fibers Grimsby Ltd. in Grimsby (UK) operates using natural gas as its fuel source. The site has strengthened its environmental performance through the construction of a new wastewater treatment plant, which reduces wastewater-related emissions.

Lenzing (Thailand) Co. Ltd.

Prachinburi (Thailand)

Lyocell fiber production

The facility in Prachinburi is Thailand's only lyocell plant and plays a key role in meeting the growing demand for TENCEL™ branded lyocell fibers, producing 100,000 tons of high-quality fiber annually, delivering cellulosic solutions for a large variety of textile applications. The Prachinburi site operates on biomass and coal and aims to achieve scope 1 and 2 carbon neutrality by 2030 by using 100 percent bioenergy and in the medium-term 95 percent biomass energy by 2027.

Lenzing Fibers Inc.,

Mobile (USA)

Lyocell fiber production

Lenzing Fibers Inc. in Mobile (USA) is a production site for lyocell fibers used in textile and nonwoven applications. The facility relies on natural gas as its primary fuel source and uses certified grid electricity entirely from renewable sources. It has improved its environmental performance by replacing older gas boilers with more efficient models, thereby reducing scope 1 GHG emissions.

PT. South Pacific Viscose,

Purwakarta (Indonesia)

Viscose fiber production

PT. South Pacific Viscose in Purwakarta is a production site for high quality viscose fibers. The facility's product portfolio includes specialty fibers of the LENZING™ ECOVERO™ and VEOCEL™ brands. Electricity is sourced from 100% renewable grid power, which contributes to reducing location-based emissions. For thermal energy, the plant additionally relies on coal and natural gas.

Lenzing (Nanjing) Fibers Co., Ltd,

Nanjing (China)

Viscose and modal fiber production

The site Lenzing (Nanjing) Fibers Co., Ltd., located in Nanjing, China, produces viscose and modal fibers that is powered with grid electricity entirely from renewable energy. It currently uses external coal-based steam and natural gas for on-site energy generation, and in 2025 commissioned a natural gas equipment to replace coal-based steam and further enhance energy efficiency.

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Textile recycling– contribution to circular economy

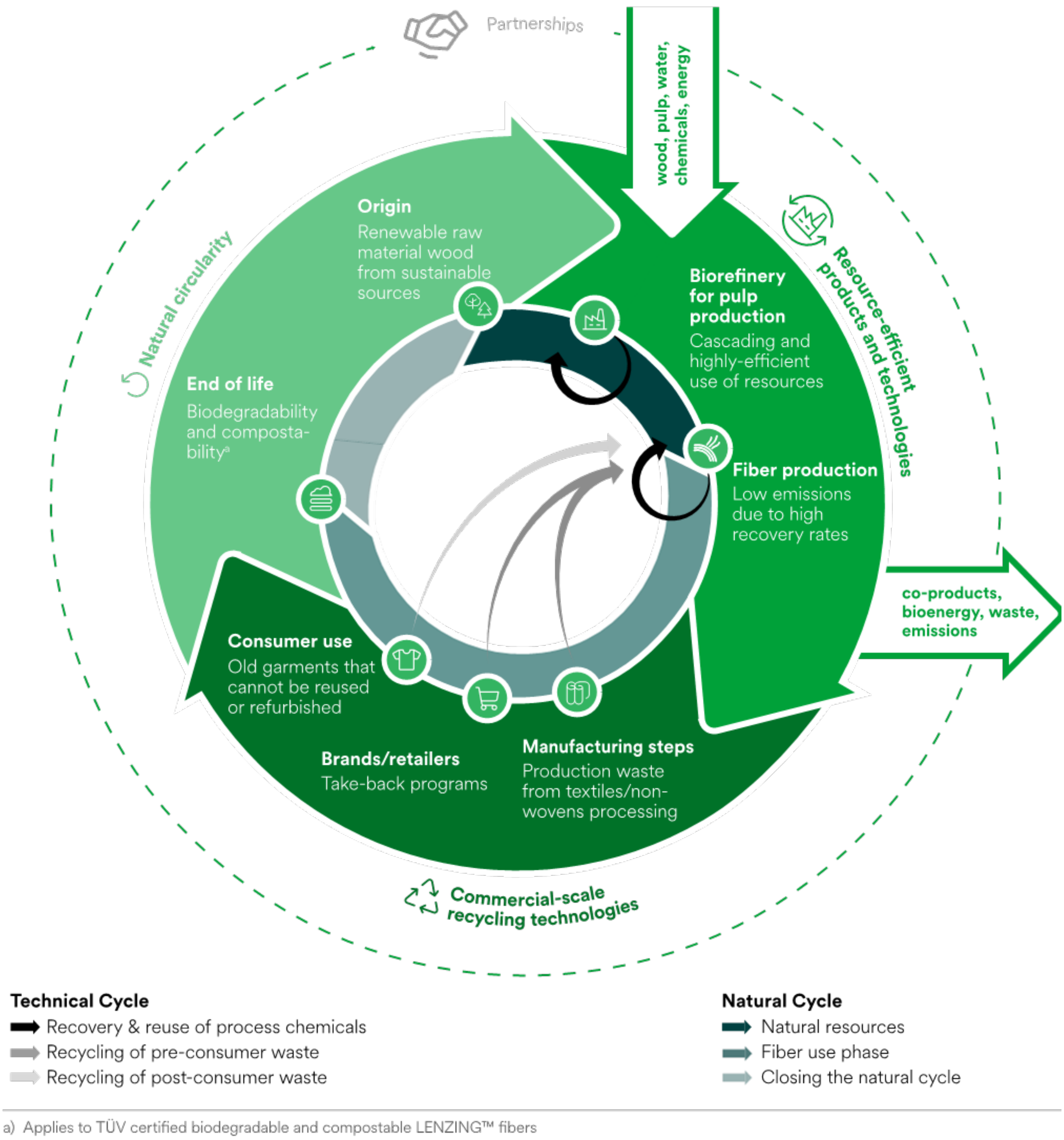

Figure 8: Lenzing's circular economy practices

Lenzing pursues its circular economy vision through three core practices that integrate key elements of circular economy into its business model namely: natural circularity, resource-efficient products and technologies and commercial-scale recycling technologies (see figure "Circular economy model"). Together, these practices help close material loops by establishing biological and technical cycles. This reduces dependence on virgin resources and supports long-term sustainability.

Natural circularity

Renewable raw materials sourced from sustainable forestry form the basis of Lenzing's value chain. At the end of their life, most products are designed for biodegradability and are compostable, thereby ensuring the closure of the biological cycle and reducing environmental impact.

Resource-efficient production and technologies

Biorefinery processes optimize resource utilization and minimize waste throughout the production process. The three biorefineries of the Lenzing Group produce a specific portfolio of biorefinery products. Surplus energy from pulp production is supplied as renewable energy in the form of steam and electricity. This illustrates the cascading use of biomass and the 100 percent utilization of the raw material wood.

Commercial-scale recycling technologies

Lenzing deploys two types of recycling within its product portfolio: chemical and mechanical. At Lenzing's pulp and fiber sites, advanced technologies recover and reuse process chemicals and fibers, thereby maintaining material circulation within the technical cycle. Production waste from textiles and nonwovens is recycled into dissolving pulp and subsequently reintegrated into fiber manufacturing. Partnerships with brands and retailers support take-back programs for post-consumer textiles that feed into chemical recycling.

In line with Lenzing's circular economy vision, "We give waste a new life", the current generation of innovative fibers, manufactured in a commercial large-scale, use pre-consumer cotton scraps, post-consumer garments, and wood from sustainably managed forests as a raw material.

Mechanical recycling

During mechanical recycling, textiles are shredded down to individual fiber level as far as possible. Due to shortening of fiber length and loss of performance such as tenacity, these mechanically recycled fiber materials require carrier fibers in order to be "respun" into new high quality yarns.

This technology diverts tons of cotton scraps and post-consumer garments from entering landfills or incineration.

Chemical recycling

Moreover, Lenzing has developed the innovative REFIBRA™ technology, which uses chemically recycled pre- and post-consumer cellulosic textile waste from cotton or regenerated cellulose, together with virgin pulp, for production of new cellulosic fibers.

LENZING™ ECOVERO™ branded viscose fibers produced with REFIBRA™ technology contain a minimum of 20 percent recycled content from pre- and post-consumer textile waste. These fibers deliver high quality and performance equivalent to fibers made from virgin dissolving wood pulp.

Lenzing itself is further improving REFIBRA™ technology and showcasing its ecological benefits. On the technological side, this not only involves optimizing the processes, but also expanding the raw material base. Furthermore, recycling options for nonwovens cut-waste and discarded textiles (post-consumer waste) are being assessed. This involves textiles and roll goods made from different fiber types, making it a very complex and challenging process. For further information and current status updates please see the "Textile recycling target" below.

Fibers made with REFIBRA™ technology for textile applications are available with the Recycled Claim Standard (RCS).

Recycled Claim Standard[5]

LENZING™ ECOVERO™ x REFIBRA™ fibers contain a minimum of 20% RCS certified recycled content, certified by Control Union Shanghai (CU1260548).

Products certified with the RCS contain recycled content that has been independently verified at each stage of the supply chain, from the source to the finished product.

CU1260548

Particularly in the development of circular flow models that enable economic growth without increasing the consumption of natural resources, close collaboration all along the value chain is essential for Lenzing. Accordingly, cooperation was sought and continues to take place with various partners – from raw material producers to fashion companies – in further development of the REFIBRA™ technology. Lenzing's R&D department is also actively engaging with the market, cooperating with interesting start-ups as well as guiding others in their approach. Lenzing also actively participates in multi-stakeholder initiatives (e.g. Textile Exchange Materials Matter Standard working group) to further increase awareness and importance of the topic in the public and political sector.

Textile recycling target	**Increasing the share and types of alternative feedstocks, e.g. by using recycled textile waste or agricultural waste by 2030**	**2030 On track**
Sub-targets	Increasing recycled content in viscose and lyocell fiber types from 20 percent to minimum 30 percent from post-consumer waste on a commercial scale by 2030	**2030 On track**
	Innovating the use of at least 5 alternative feedstocks providers (e.g. from recycled textiles and agricultural waste) by 2030	**2030 On track**
Status 2025	Lenzing has continued to work on enhancing technology that enables the chemical recycling of cotton-rich textile waste in cellulose fiber production. The company has also made progress in preparing for the processing of post-consumer household textile waste, which Lenzing anticipates will become the most significant category to address locally. There is optimism that new EU regulations will mandate the collection and treatment of textile waste and support scale-up efforts. Collaboration with Södra on textile recycling has continued and remained successful throughout the year. A highlight in 2025 was production of lyocell staple fiber with 30 percent recycled content from Circ Inc., an innovation company. Notably, Circ effectively processes challenging polycotton waste, recovering both polyester and cotton fractions. In exploring other alternative raw materials, lab tests were conducted on agricultural waste such as hemp, banana fibers and aquatic plants. However, none of these innovations reached pilot-plant scale in 2025. Lenzing remains committed to further investigating these alternatives.	

[5] Textile Exchange, holder of the RCS, has recently been introducing a new, harmonized standard called Materials Matter Standard (MMS). The MMS will become effective in 2027 and gradually incorporate, hence phase-out, existing standards such as the RCS until 2029.

Lenzing
Innovative by nature

Managing emissions from production

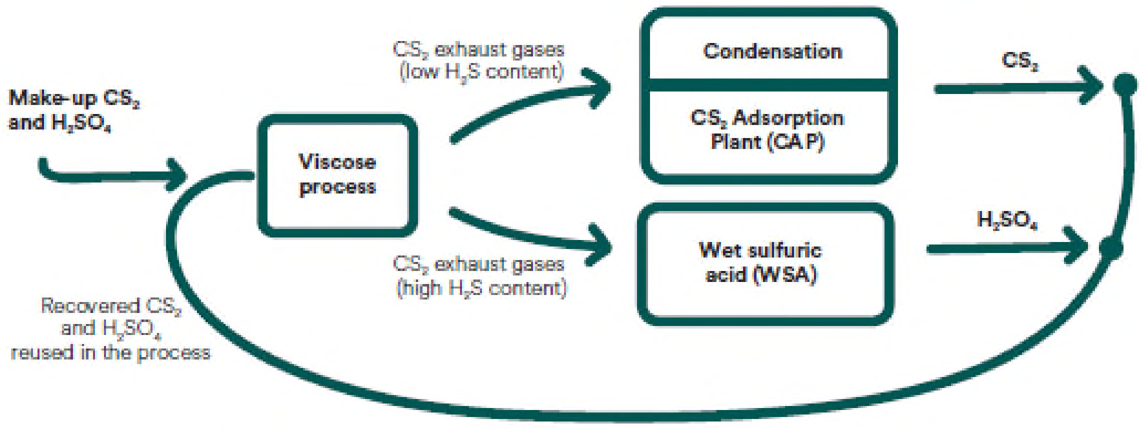

Figure 9: Closing the loops in viscose and modal production process in the Lenzing Group

Air emissions - closing the loops in viscose process: best practice

In the viscose process, CS_2 and sodium hydroxide (NaOH) are used to dissolve cellulose pulp to form the spinning mass. During this process, some carbon disulfide is transformed into hydrogen sulfide (H_2S). When regenerating the dissolved pulp as fiber in an acid spin bath, carbon disulfide and hydrogen sulfide are released as exhaust gases at different locations along the production process. As shown in the figure 6 below, the three recovery systems required to close loops and to safely handle these gas streams are:

1. Condensation unit
2. Wet Sulfuric Acid (WSA) plant and
3. Carbon disulfide Adsorption Plant (CAP)

CS_2 exhaust streams with low hydrogen sulfide content are treated in the condensation unit as well as in the carbon disulfide adsorption plant (CAP) to recover it. CS_2 exhaust gas streams with higher hydrogen sulfide content are preferably recycled as sulfuric acid (H_2SO_4) via catalytic oxidation in wet sulfuric acid (WSA) plants. Without a WSA plant, H_2S rich gas cannot be handled safely, and would be a potential hazard to human health. The recovered CS_2 in the condensation process and CAP plant as well as the sulfuric acid produced in the WSA plant are directly reused for fiber spinning. This closes the loop of sulfuric compounds used in the viscose process. Both technologies, state-of-the-art CAP and WSA and proper maintenance of these systems is key to avoiding any release of CS_2, H_2S, SO_2, or other sulfuric substances. By doing so, more than 90 percent of the CS_2 can be recovered safely and reused in the process.

Viscose production facilities without a WSA plant face the challenge of handling H_2S emissions from the viscose process. In this case, H_2S may be processed through energy generation boilers or by absorbing it in NaOH to form sodium hydrosulfide hydrate. Both of these alternative H_2S control measures have the disadvantage of lower recycling rates of sulfuric chemicals compared to the WSA option. In addition, burning H_2S in energy generation boilers also result in higher SO_2 emissions, unless the SO_2 is recovered as gypsum.

Another prerequisite of a safe viscose process is a plant design with sufficient capacity in equipment such as blowers to ensure safe extraction and transfer of CS_2 and H_2S to the recovery equipment described above.

Best practice reporting

As there are many emission points along the viscose fiber production process, the Lenzing Group reports CS_2 and H_2S emissions, expressed as sulfur emissions, based on mass balance calculations, which reflect the reality much better than the single point measurements.

Water emissions – Wastewater treatment plants

Effluents are discharged in a controlled manner, therefore avoiding groundwater contamination. Process water is treated by biological wastewater treatment plants (WWTPs).

Lenzing invested in a new WWTP on its Grimsby (UK) site, in order to meet the ambitious Lenzing Environmental Group Standards. In 2025, it became fully operational and is set to reduce water emissions by 60 to 80 percent. The Grimsby site complies with all local laws and regulations on wastewater as well as the EU Water Framework Directive. After initial start-up in 2024, biomass build-up and operational balancing were completed, enabling a stable and efficient performance. COD and amine removal exceeded minimum requirements. Amine emissions are specific to lyocell production and therefore monitored by Lenzing at all lyocell production sites. Both absolute and specific amine emissions decreased substantially. The project has now moved into its second phase with further optimization underway to reach EU BAT limits in 2026. This strategic investment of EUR 24mn represents a significant step in the site's sustainability roadmap and supports the achievement of the ZDHC lyocell and wastewater targets.

Lenzing's plant in Purwakarta (Indonesia) has made great progress in improving its environmental performance. The completed EUR 100 million plant upgrade includes an upgraded WWTP. Its construction concluded in 2023 and it has been fully operational in 2024, significantly reducing wastewater emissions (COD and sulfate). In 2025, the site continued to optimize the WWTP to further reduce COD levels. Sulfate emissions may occur during fiber and pulp production. Through improved monitoring of sulfate in wastewater and enhanced recovery of sodium sulfate, specific sulfate emissions were also reduced.

In 2021, another WWTP upgrade project was approved for the site at Mobile (USA) and has been fully operational since May 2024. This investment will not only help to fulfil future ZDHC requirements for lyocell production but will also allow potential enlargement of fiber production capacity.

A further improvement project was completed at the fiber production site in Nanjing (China) in 2025. Enhanced wastewater degassing led to a substantial reduction of sulfur emissions to water, thereby lowering carbon disulfide loads in the effluent.

For further details and current status updates please see the connected target "Wastewater target" below.

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Wastewater target	To improve Lenzing Group's specific wastewater emissions (chemical oxygen demand (COD)) by 20 percent by 2024 (baseline 2014) [a, b]	2024 Achieved
Measure(s)	Lenzing implements a wastewater treatment plant upgrade at Purwakarta site (Indonesia)	2023 Achieved
	Lenzing implements a new wastewater treatment plant at Grimsby (UK) site	2024 Achieved
Status 2025	The construction of the wastewater treatment plant in Purwakarta (Indonesia) took place in 2023 and the start-up was completed at the beginning of 2024. The first phase of the modern WWTP at Grimsby (UK) was completed in January 2025 and brought into operations in May 2025. It has achieved good performance levels, therefore the wastewater target was successfully achieved, reducing COD emissions by 24 percent from the baseline.	

a) Relevant for the Managing Board long-term incentive (LTI) bonus targets

b) The target has the same production volumes and scope of facilities as the 2014 baseline (i.e. production sites excluding the new sites in Prachinburi (Thailand) and Indianópolis (Brazil)).

Labels, Certificates and Standards

EU Ecolabel

The Lenzing Group Environmental Standard is based on the associated emission limits as provided in the EU Best Available Techniques (EU BAT) reference document (EU BREF), as well as recognized ecolabel requirements, such as the EU Ecolabel.

The European Commission established the EU Ecolabel in 1992. It is an environmental label awarded to products and services that have less impact on the environment and human health throughout their entire life in a certain product category. Products bearing the EU Ecolabel are therefore among the most environmentally friendly on the market.

Independent experts, scientists and NGOs devised the guidelines and criteria for awarding the EU Ecolabel in collaboration with the EU member states. The criteria are determined on a scientific basis and take into account the entire product life cycle. Regular revisions ensure that the criteria are adapted to new developments and that assessments remain current.

EU Ecolabel

Strict criteria must be met in pulp and fiber production, both regarding air and water emissions including the management of chemicals used.

For the Lenzing Group this means that strict criteria must be met in pulp and fiber production, both with regard to emissions released to air or water and with regard to the management of chemicals used. The Lenzing Group can provide viscose, modal and lyocell fibers certified with the EU Ecolabel.[6]

[6] Note that LENZING™ fibers are certified with the EU Ecolabel Standard for textile products. Single-use end products are NOT included in this Standard. A labelling or marketing of single-use end products made of LENZING™ fibers as EU Ecolabel certified must be checked independently and depends on the compliance with applicable EU Ecolabel Standards (such as e.g. EU Ecolabel Standard for PCPs and AHPs).

Table 2: EU Ecolabel criteria

Man-made cellulose fibers criteria	Limit
Pulp: wood sourcing	Sustainable forestry: >25% e.g. FSC®, PEFC or equivalent schemes. Legal forestry: the rest
Pulp: bleaching agent	Elemental chlorine free
Pulp: OX on finished fiber	≤ 150 ppm
Pulp: sourcing	50% input from mills with energy or chemicals recovery
Staple fiber: sulfur emission to air	30 g/kg
Chemicals and processes criteria	
Restricted substance	Spin finishes: 90% of the component substances readily biodegradable
Substitution of hazardous substances	Should satisfy restrictions concerning certain hazard classifications

ZDHC

The Roadmap to Zero Programme of Zero Discharge of Hazardous Chemicals (ZDHC) is a collaboration of brands, value chain affiliates and associates committed to eliminating hazardous substances from the textile, apparel and footwear value chain.

The ZDHC Man-Made Cellulosic Fibres (MMCF) Guidelines define requirements for wastewater discharge quality, air emissions and chemical recovery at manufacturing facilities producing man-made cellulosic fibres. The scope of the guideline covers the full production process, with a focus on reducing environmental impacts throughout the value chain.

In 2023, the revised and extended MMCF Guideline Version 2.2 was published, extending its scope to include additional fibres such as lyocell. Lenzing implemented this guideline accordingly, and first reporting for lyocell production sites commenced in October 2023. For detailed information and current status updates, please see the “ZDHC viscose” and “ZDHC lyocell” targets below. The ZDHC MMCF guideline version 3.0 was published in 2025 with implementation at Lenzing starting in 2026. The revision includes, among others, updated sulphur air emissions requirements aligned with EU BAT, revised wastewater requirements and additional obligations related to sludge testing and documentation of disposal pathways.

The new guideline requirements are structured as the following:

- **Input Management**
  - Input feedstock management
  - Input chemical management
- **Process Management**
  - Chemical recovery
- **Output Management**
  - Wastewater discharge
  - Sludge testing and disposal
  - Air emissions

The MMCF Guidelines specify detailed requirements for wastewater testing using ZDHC Approved Laboratories, defined reporting frequencies and data formats, as well as parameter-specific limit values. Further requirements address chemical consumption (e.g. raw material consumption of pulp and sodium hydroxide), chemical recovery (e.g. recovery rates for Na_2SO_4 and CS_2) and sulphur air emissions. The MMCF facilities are assessed based on the guideline by a third party though the ZDHC Supplier to Zero Plattform. The assessment result is further interpreted as “Foundational”, “Progressive” or “Aspirational”. Continuous improvement towards higher performance levels within the ZDHC framework forms an integral part of environmental management at Lenzing.

ZDHC viscose	**To achieve 'aspirational' MMCF level for ZDHC wastewater and air emission guidelines at Lenzing viscose facilities by 2026**	**2026 On track**
Status 2025	Lenzing viscose sites have continuously implemented the ZDHC MMCF guideline in its revised version 2.2 and Lenzing has actively engaged in the MMCF version 3 revision, which is published in 2025. The implementation of the wastewater guideline continued in 2025. In addition to the Wastewater target all Lenzing viscose sites completed their 2024/5 Supplier to Zero Platform assessment and successfully achieved the overall performance at 'aspirational' level.	

ZDHC lyocell	**To achieve 'aspirational' MMCF level for ZDHC wastewater and responsible production guidelines at Lenzing lyocell facilities by 2028**	**2028 On track**
Measure(s)	First ZDHC Gateway reporting of MMCF wastewater guideline v2 at all lyocell sites in 2023	2023 Achieved
	First supplier platform implementation and reporting of MMCF Guideline v2 – Responsible fiber production at all lyocell sites in 2023	2023 Achieved
	Lenzing lyocell sites achieves 'aspirational' level for wastewater and responsible production	2025 Delayed
	Lenzing site in Grimsby (UK) achieves 'foundational' level for wastewater and responsible production	2026 On track
	Lenzing site in Grimsby (UK) achieves 'aspirational' level for wastewater and responsible production	2028 On track
Status 2025	Lenzing facilities Heiligenkreuz (Austria) and Prachinburi (Thailand) have successfully achieved aspirational levels in 2025, however the facility in Lenzing (Austria) has achieved aspirational level for all parameters except one. In 2025, ZDHC granted the use of ISO certified laboratories in the USA in the absence if ZDHC authorized laboratories. Hence, the Lenzing site in the USA has completed wastewater testing in 2025 and will be able to perform the MMCF assessment for 2025/26. Due to the above reasons, the sub-target has been slightly delayed. The modern WWTP at Grimsby (UK) was completed in January 2025 and brought into beneficial operation in May 2025. Currently there are no ZDHC authorized testing laboratories are available in the UK.	

Annex

Definitions / glossary

Best Available Techniques (EU BAT)

Best available techniques mean the most effective and advanced stage in the development of activities and their methods of operations. The techniques should indicate the practical suitability of particular techniques for providing, in principle, the basis for emission limit values designed to prevent, and, where this is not practicable, generally to reduce emissions and the impact on the environment as a whole.

Biobased

Biobased products are those that originate partially or completely from renewable resources. These products can be either biodegradable or non-biodegradable.

Biodegradable

Breakdown of polymers by **microorganisms** (bacteria & fungi) into H_2O, CO_2/CH_4, energy and new biomass.

Biodegradability

The ability of a material to be broken down by microorganisms (bacteria, fungi) into carbon dioxide, water, and new biomass, or compost, so that it can be consumed by the environment. Conditions must be defined to make the term relevant. Standardized test methods exist for most environments, describing the specific environment and the time permitted.

Bioenergy

Bioenergy is energy derived from biomass. The term refers to various forms of energy, including heat and electricity. The main sources of bioenergy are renewable resources.

Biorefinery

A biorefinery is a facility for processing of biomass into a spectrum of marketable biobased products and bioenergy.

Cellulose

Cellulose is a component of all plants and the most abundant natural polymer in the world. The cellulose content of wood is about 40 percent.

Co-products

Co-products are marketable substances obtained during fiber spinning as an inherent characteristic of the fiber production process.

Dissolving wood pulp

A type of pulp with technical specifications required to manufacture viscose, modal and lyocell fibers and other cellulose-based products. This grade of pulp is characterized by higher alpha cellulose content and by a high degree of purity.

ECF

Elemental chlorine-free – a bleaching process that does not use elemental chlorine.

Filament

In the process of manufacturing cellulose fibers, the spinning mass is pressed through tiny holes (“spinnerets”) that results in theoretically endless fibers – so called filaments. Only after cutting filaments into desired lengths, staple fibers are produced for subsequent textile and nonwoven production.

Finishing agent

Soap-like materials, are applied in the final wash cycle. The adhesive properties of the fibers are adjusted in such a way that facilitates common types of processing for textile or nonwoven production. The effect is similar to using a fabric softener when washing household laundry. A mixture of gliding agents, adhesive agents, and antistatic agents is used.

Higg Index

The Higg Index is the core driver of Cascale, an association of leading companies in the textile and chemical industry, non-profit organizations as well as research and educational experts aiming to create a more sustainable international textile industry. This suite of self-assessment tools empowers brands, retailers and facilities of all sizes to measure and verify their environmental, social and labor impacts at every stage in their sustainability journey and identify areas for improvement. The Higg Index provides a holistic overview of the sustainability performance of a product or company – a big-picture perspective that is essential for progress to be made.

Material Sustainability Index

The Materials Sustainability Index (MSI) is the quantitative part of the Higg Index, scoring materials according to their environmental impacts in on global warming, eutrophication, water scarcity, and abiotic resource depletion (fossil fuels), and according to chemistry applied.

Regenerated cellulose fiber

A fiber industrially produced from raw materials derived from cellulose sources (wood, cotton, hemp, agricultural residues etc.), known in the industry as man-made cellulose fiber or regenerated cellulose fiber.

TCF

Totally chlorine-free (bleaching process).

Tow

Tow is a bundle of (several million) individual filaments

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List of Figures

List of Tables

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