



NONWOVEN & TEXTILE

RECYCLE TEXTILES INTO SUCCESS

FOR YEARS TO COME

ANDRITZ

ENGINEERED SUCCESS



“All textile products placed on the EU market are ...

... durable, repairable and recyclable

... to a great extent made of recycled fibers

... free of hazardous substances

... produced respecting social rights.”

EU Commission’s 2030 vision for textiles

**ENGINEERED
SUCCESS**

The textile industry should be aware of its responsibility	4
Sustainability is a serious responsibility for all of us	6
Committed to sustainability	8
Benefit from a full suite for textile recycling	10
Start by sorting textile waste	12
Take the proven route with mechanical recycling	14
Prepare the fibers properly for the next process steps	16
Be innovative with chemical recycling	18
Transform textiles into new nonwovens	20
Taking a step forward together	22
Creating tomorrow’s success	24
Vast experience in a changing textile market	26

The textile industry should be aware of its responsibility

> 92 million tons

of textile waste are produced annually



"Fast fashion" is responsible for 20 % of global wastewater

< 1 %

is recycled into new clothing



1 truckload of textiles goes to landfill or incineration every second



Clothing accounts for approx. 10 % of greenhouse gas emissions

Up to 35 %

of all microplastics released into the environment can be traced back to textile products



Sustainability is a serious responsibility for all of us



The circular textiles ecosystem is thriving

Driven by sufficient capacities for innovative fiber-to-fiber-recycling, while reducing the incineration and landfilling of textiles to a minimum

WE HAVE A SERIOUS RESPONSIBILITY

The world of textiles and the textile industry should be under no illusions about their responsibilities. The price of fast fashion is that making clothes accounts for around 10 percent of CO₂ emissions from human activity. But despite the need for circularity in our use of resources, the clothing industry has been fed by a distinctly linear value chain. Clothing is notoriously over-supplied, and while it might be resold, recycled into cloths or insulation, much of it ends up incinerated or in landfill. Textile-to-textile circularity has been conspicuously absent.

THINGS ARE CHANGING

Thanks to media pressure, consumer demand, regulations and technology, things are starting to change. Consumer and industry ignorance about the price the planet pays for our full wardrobes is at last being replaced by deep concern about the impact of textiles on the environment. There is also increasing awareness of the need to make greater use of sustainable raw materials in fiber and textile production. Meanwhile, existing technology is proving highly adaptable to textile recycling, and projects that take recycling a step further into true circularity are flourishing.



Committed to sustainability

Sustainability has always been an integrated part of ANDRITZ's corporate policy, which is reflected in the daily work of each employee as well as in the management principles and business relationships implemented within the Group. At ANDRITZ, sustainability is a decisive factor in order to be successful in the long term. It is an important element of the company's corporate policy and strategy.

ESG (ENVIRONMENT, SOCIAL, GOVERNANCE)

ANDRITZ follows a multi-dimensional, comprehensive and practice-oriented sustainability approach. Our ESG strategy is based on three main fundamental topics, which are the basis for achieving our ESG goals. We continuously strive for sustaining high performance in these topics and for keeping up with developments and requirements to ensure best practice and highest standards.

TEXTILE RECYCLING AS FOCUS AREA FOR ANDRITZ

Our focus areas build on the defined fundamental topics. They have been chosen with regard to the expected maximum positive impact on society and with regard to the areas where we are able to provide the highest contribution to a sustainable future, among this is also textile recycling. For all our focus areas we set ambitious goals.

ANDRITZ FOR THE CHANGE

Under this initiative, ANDRITZ summarizes the environmental technologies and innovative decarbonization solutions that enable the green transition. Textile recycling is one of the main topics of this initiative, as these processes help to reduce the large volumes of textile waste and convert them into value and new fibers.

Sustainability is an essential part of ANDRITZ's business strategy and our corporate culture. The focus topics and targets were selected in consideration of the areas where ANDRITZ can make the greatest contribution to a sustainable future. In the area of textile recycling, we are at the heart of the movement for state-of-the-art recycling solutions and collaborate with internationally renowned partners.

DR. JOACHIM SCHÖNBECK
Chief Executive Officer, ANDRITZ AG

Benefit from a full suite for textile recycling

One partner for all your textile recycling purposes: Consumer demand and textile industry targets are driving the circularity agenda, but it is technology that will actually make it happen.



YOUR PARTNER FOR TEXTILE RECYCLING

ANDRITZ has always been a pioneer in providing industrially and economically viable solutions that bring the circular economy to the world of textile fibers.

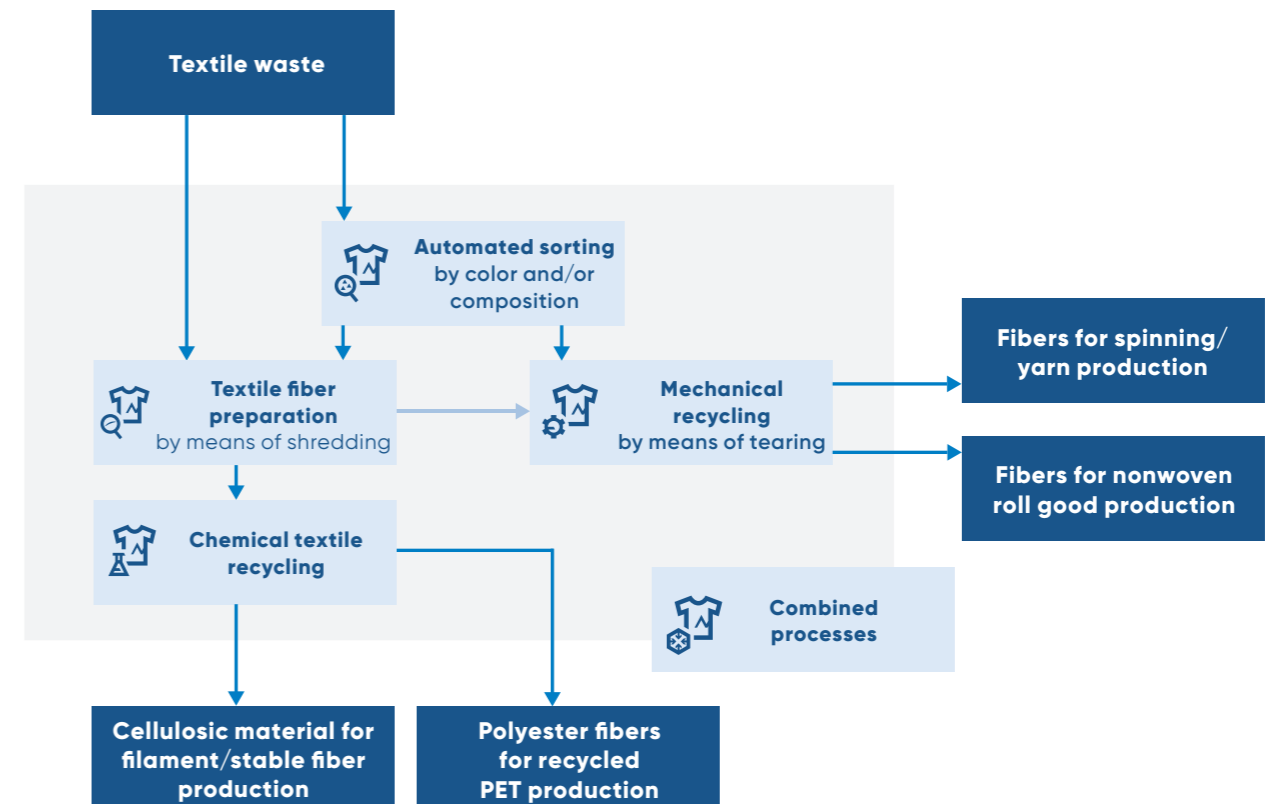
ANDRITZ is not only a reliable supplier but also a knowledge provider. From textile sorting, textile fiber preparation to mechanical and chemical recycling and combined processes, we offer the full suite.

As a whole, ANDRITZ offers single and multiple complementary technologies to address the needs of different textile recycling challenges. We are your partner with the vision, expertise and capabilities when it comes to textile recycling processes.



ANDRITZ TEXTILE RECYCLING PROCESSES

Processing of textile waste for production of new yarn/textiles and nonwoven products



TEXTILE SORTING

The sorting of textile waste is one of the most important pillars in optimizing the quality of recycled fibers. Innovative and automated sorting allows to separate clothes, depending on the nature of fibers and/or colors.



TEXTILE FIBER PREPARATION

The preparation of textile waste by means of shredding lays the foundation for the subsequent textile recycling processes, whether they are based on mechanical, chemical, combined, or another customer-specific treatment.



MECHANICAL RECYCLING

Mechanical recycling by means of tearing can be used for almost all types of pre-/post-consumer waste textiles with the aim of maintaining the nature of the original fibers.



CHEMICAL RECYCLING

Chemical recycling of textile waste is a vital, emerging business area. It is the piece of the puzzle that completes the picture of textile-to-textile circularity.



COMBINED PROCESSES

Combinations of mechanical, thermal and chemical process steps are also possible depending on customer and market needs.



NONWOVEN PROCESSES FOR RECYCLED FIBERS

The transformation of recycled textile fibers into technical nonwoven felts is one of the key methods for recycling textiles into new products and for creating value.



TEXTILE SORTING

Start by sorting textile waste

Optimize the fiber quality: The sorting of textile waste is one of the most important pillars to optimize the quality of recycled fibers. It is a bottleneck and an essential element within the recycling value chain. The automation of this process adds clear value to the entire process.

THE AUTOMATED SORTING PROCESS

Innovative and automated sorting allows to separate clothes, depending on the nature of fibers and/or colors. During this process, hard elements will be removed in order to obtain a material ready for mechanical recycling by tearing or chemical processing.

ANDRITZ offers a wide range of tearing machines, which are suitable for many applications, for both the spinning and nonwoven markets.

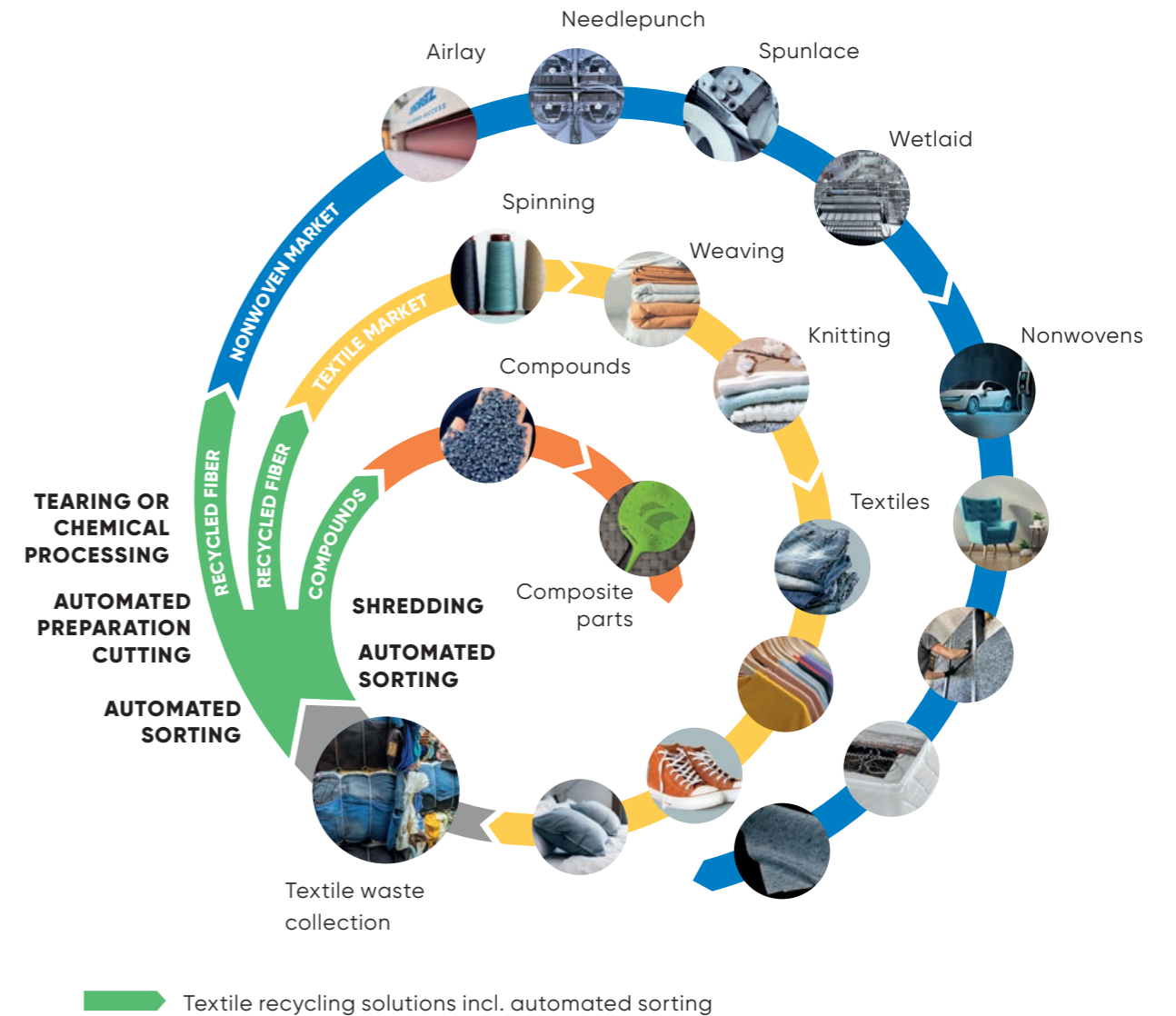
COLLABORATION LEADS TO SUCCESS

The unique process for automated sorting is the result of a long-term collaboration between ANDRITZ, Nouvelles Fibres Textiles and Pellenc ST, France.

These three companies have enormous combined expertise in sorting technologies, post-consumer textile value chains from sorting to manufacturing and textile machinery as well as automation processes. We leverage their decades of expertise and experience to create the best solution for this huge challenge of textile sorting.

ANDRITZ and Nouvelles Fibres Textiles opened the very first industrial line in France dedicated to textile sorting using a closed-loop process. These new opportunities provided by Nouvelles Fibres Textiles allows on-the-ground circularity to be promoted for textiles, to guarantee traceability of recycled materials while reducing the environmental impact and carbon footprint of the textile industry.

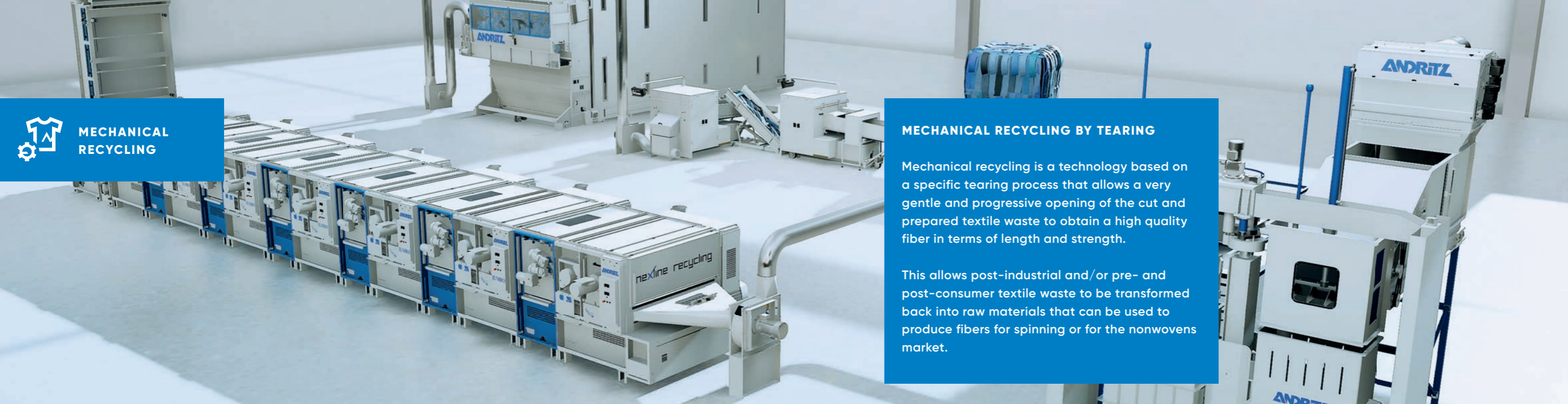
NOUVELLES FIBRES TEXTILES' CIRCULAR AND SUSTAINABLE ECOSYSTEM WITH ANDRITZ TECHNOLOGY



Automated sorting line at Nouvelles Fibres Textiles, France



Sorted textiles by color



MECHANICAL RECYCLING

MECHANICAL RECYCLING BY TEARING

Mechanical recycling is a technology based on a specific tearing process that allows a very gentle and progressive opening of the cut and prepared textile waste to obtain a high quality fiber in terms of length and strength.

This allows post-industrial and/or pre- and post-consumer textile waste to be transformed back into raw materials that can be used to produce fibers for spinning or for the nonwovens market.

Take the proven route with mechanical recycling

Mechanical recycling by means of tearing: In order to permit participation in the circular economy driven by institutions, markets and customers, we offer a wide range of tearing machines to recycle textile waste into fibers from small to high volumes for respinning to new yarn, or to produce nonwoven roll goods and panels.

MORE THAN A CENTURY OF EXPERTISE

The mechanical tearing process has been developed by ANDRITZ Laroche for over a century. Thanks to this expertise and more than 2,000 reference projects world-wide, you can process almost all types of pre-/post-consumer textile waste.

Today, ANDRITZ offers a complete range of tearing equipment, from 50 to 3,000 kg/h, suitable for a large variety of textile materials, natural, animal, synthetic, artificial and mineral fibers. This technology aims to preserve the original

character of the fibers, e.g. cotton, by maximizing fiber length and strength. Depending on the raw material, Ne24 and Ne30 yarn counts use 70% recycled cotton fibers in some blends.

PERFECT FOR RESPINNING AND NONWOVENS

Mechanical recycling developed by ANDRITZ offers a wide range of opportunities with many possible end uses. In fact, this mechanical technology allows a high-quality fiber to be obtained for both the spinning and nonwoven industries (depending on the textile waste quality). The recycled fiber is

suitable for many technologies developed by ANDRITZ such as airlay, needlepunch, spunlace or Wetlace CP.

These lines are designed in particular for the production of nonwovens for the automotive, insulation, construction, bedding industries, wipes and more. Take advantage of a mechanical recycling process that allows a reduction of CO₂ emissions by using less water and very limited chemicals, and by reducing the machinery installation footprint.

INPUT

- Industrial and post-industrial textile waste
- Post-consumer textile waste (clothing)
- Special material like carpets
- Nonwoven waste made of natural and synthetic fabrics



Textile waste



Carpet waste

OUTPUT

- Regenerated, clean textile fibers
- Dust waste
- Heavy and metal parts, such as bale wire, buttons, zippers, rivets, ornaments and more



Output material

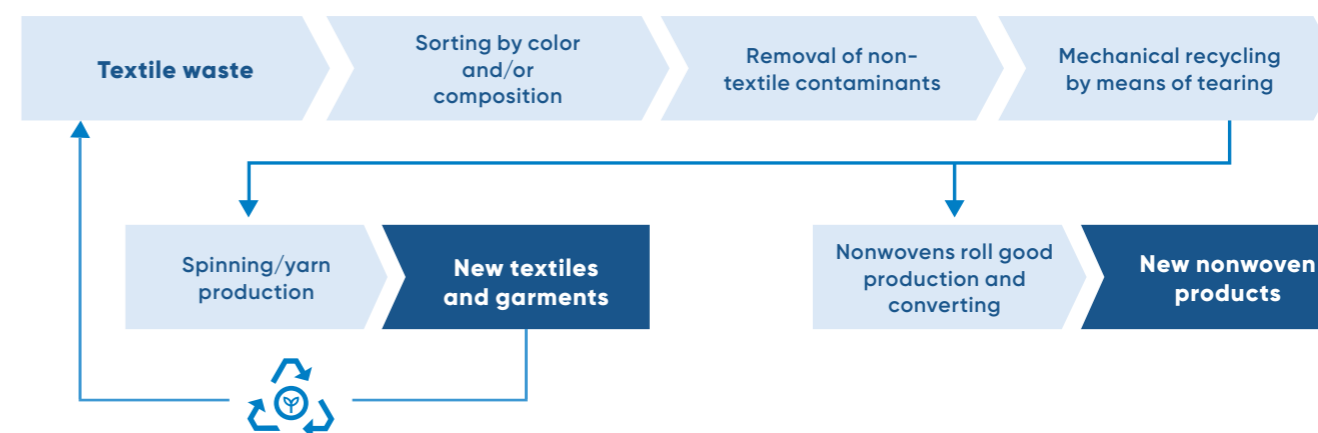


Output material



RECYCLING PROCESS ON THE BASIS OF MECHANICAL RECYCLING

Processing of textile waste for production of nonwoven products and yarn.





TEXTILE FIBER PREPARATION

SHREDDING PROCESS

Shredding refers to the mechanical process of material size reduction by cutting. The input material such as pre- and post-consumer textile waste, is put into the material feed and then cut into small pieces. The outcome is a cleaned textile in the required size. During the process, heavy parts like metal, buttons and zippers are removed.

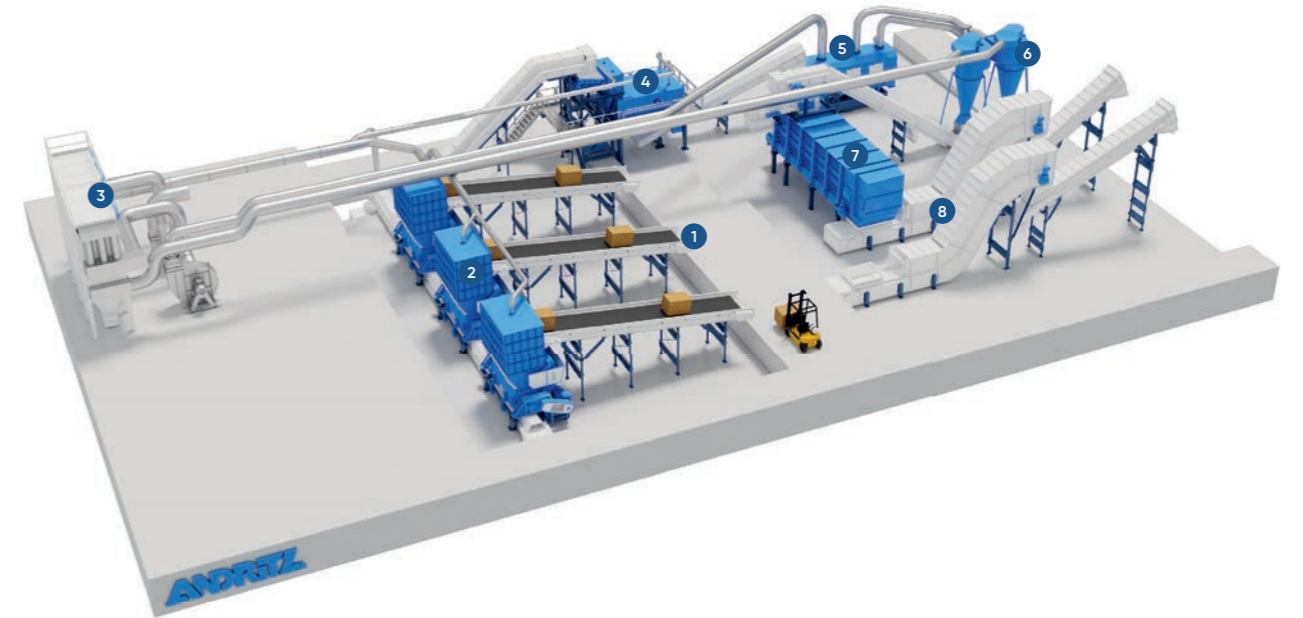
Prepare the fibers properly for the next process steps

Textile fiber preparation by means of shredding: We focus on the fiber preparation of textile waste by means of shredding and separation, which lays the foundation for the subsequent textile recycling process steps, no matter if they are based on mechanical, chemical, combined or another customer-specific form of treatment.



Top view of an ADuro U shredder – for innovative one-step shredding to a defined particle size

Numerous parameters influence the choice of technology, including the type and origin (input material) of the waste, feeding technique, particle size required, cleanliness, impurities such as zippers and ornaments, capacity and all the needs of downstream processing. ANDRITZ Recycling offers single units and complete fiber preparation systems that include the following process steps: material feeding, shredding, conveying, separation, fine grinding and storage of the fully conditioned material.



Example of a textile fiber preparation line

- 1 Material feed 2 ADuro U shredder 3 Aspiration system 4 Metal separation 5 Heavy particle separation
- 6 Pneumatic transport system 7 Bunker system 8 Dosing system

INPUT

- Pre- and post-consumer textile waste from industry, commerce and households.
- Natural and synthetic fabrics used in clothing and linens, and special streams such as carpets and technical textiles.



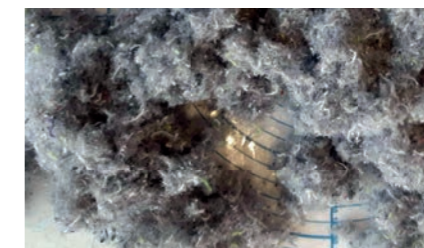
Textile waste



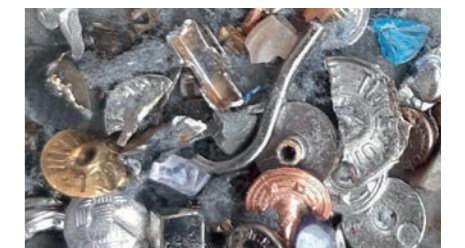
Carpets

OUTPUT

- Cleaned textile, size on demand
- Heavy and metal parts, such as bale wire, buttons, zippers, rivets, ornaments and more



Fine-ground output material



Impurities from denim

YOUR BENEFITS

- Perfectly suited to various downstream processes such as mechanical or chemical recycling, combined or customer-specific
- Capable of handling large volumes of up to 200 t per day
- Trouble-free processing of challenging feed material, like denim
- Optimized shredding of feed material to the defined particle size applying different shredder types and cutting systems
- Tailor-made separation of shredded textiles and heavy items (e.g. zippers and buttons)
- Utmost purity of output material



CHEMICAL/CIRCULAR RECYCLING PROCESS

Chemical recycling is the process of recycling textile waste (e.g. cotton and polycotton) back into its raw fiber material form. The results can be used to produce new textiles using the same techniques as for virgin material. Because chemically recycled fibers are like virgin fibers, a recycled pair of worn-out jeans, for example, can be upcycled into another piece of clothing just as sturdy and comfortable.

The specifics vary depending on the technology used, but the basic process remains the same: Textile waste (without contaminants like zippers and buttons) is treated in a chemical process which removes dyes and materials that cannot be recycled. The material is modified so that it can be turned into strong fibers ready for textile production.

Be innovative with chemical recycling

The chemical recycling of textile waste is a vital, emerging business area.

It is the piece of the puzzle that completes the picture of textile-to-textile circularity. This is why it is also called circular recycling: the recycled waste completes a full circle from raw materials to textile, to textile waste and back to raw materials.

TURNING IDEAS INTO REALITY

When a customer approaches us with an idea about chemical recycling, our process experts and test laboratories start working together with the customer. They test and develop the idea to see if and how it can be scaled up to capacities required for a commercially viable process. We do not compete with customers – we help them achieve their goals for our mutual benefit.

ANDRITZ has a long history of mutually productive partnerships with our customers. When you choose us as your partner for developing your chemical recycling process, you get a reliable companion with extensive and solid expertise in industrial-scale process technologies and a desire to help customers to succeed.

At ANDRITZ, we do not sell a chemically recycled product or ready-to-install process technology to produce it. What we do is to provide our customers – our cooperation partners – with our extensive expertise in industrial-scale process technology.



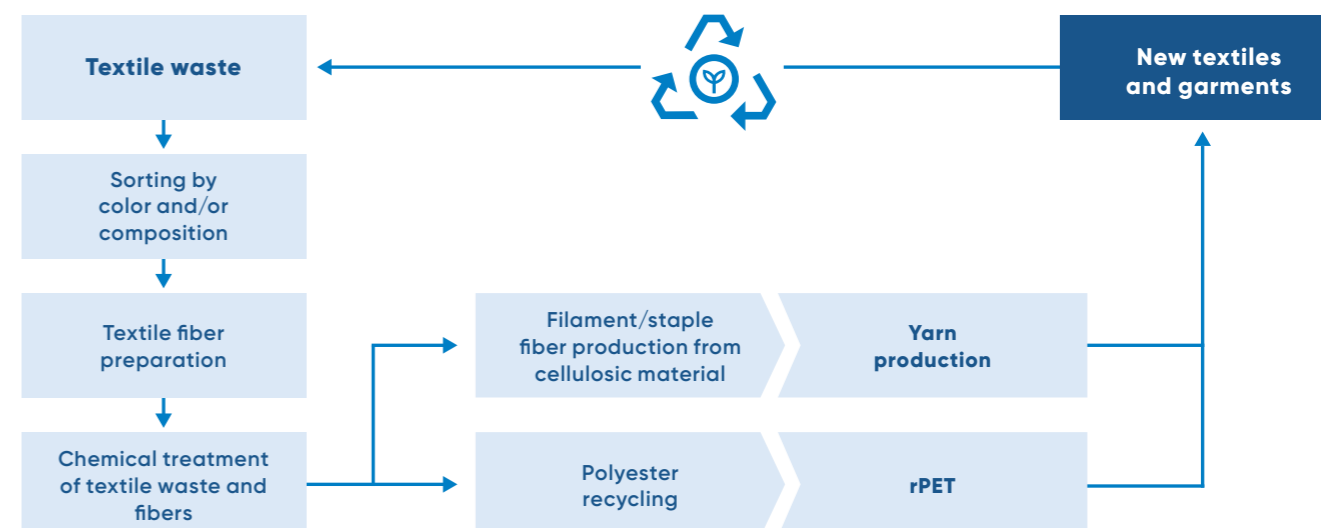
ANDRITZ is a key player in this industry not only because of our expertise in chemical process technology, but also because the recycling processes can utilize the same equipment that we use in pulp and paper production.

Chemical and mechanical processes are fully complementary in the drive to achieve the desired end result, but the addition of chemical treatment is a game changer for textile-to-textile recycling.



RECYCLING PROCESS ON THE BASIS OF CHEMICAL RECYCLING

Processing of textile waste for the production of textiles of the same or even higher quality.





NONWOVEN PROCESSES FOR RECYCLED FIBERS



Transform textiles into new nonwovens

The transformation of recycled textile fibers into technical nonwoven felts is one of the key methods for recycling textiles into new products. It represents approx. 20% of all textile applications in annual tonnage. ANDRITZ offers complete nonwoven roll-good production lines to process recycled fibers from textile waste.

ANDRITZ offers state-of-the-art nonwoven production lines, which process recycled fibers perfectly. This includes lines such as airlay thermobonding and/or needling, needlepunch, spunlace and Wetlace CP. In general, these lines include fiber opening and blending, fine openers and web forming

(in which fibers are treated and laid to form a sheet), web bonding (in which the sheet is entangled/bonded) as well as slitting and winding equipment. A great variety of new nonwoven products can be created with these nonwoven roll goods.

NONWOVEN END USES INCLUDING RECYCLED FIBERS

- Bedding, mattresses
- Furniture fillings
- Carpet and carpet underlays
- Horticultural materials
- Insulation
- Automotive applications
- Building and construction
- Filtration
- Wipes
- and many more



AIRLAY

Complete production lines with needlepunching, thermobonding and/or other bonding processes for applications like building, construction, automotive, mattresses and more.



NEEDLEPUNCH

Complete production lines with needlepunch bonding for applications like building, construction, automotive, carpets and more.



SPUNLACE

Complete production lines with hydroentanglement bonding for applications like household wipes.



WETLACE CP (CARDED-PULP)

Complete production lines with drylaid and wetlaid forming and hydroentanglement bonding for applications like technical wipes. Recycled fibers can be used within the carded/drylaid layer.



Creating tomorrow's success

ANDRITZ focuses on research and development, with a worldwide network of pilot plants and technology centers, offering customers an excellent platform for trials and R&D work.

ANDRITZ RECYCLING TECHNOLOGY CENTER

The ANDRITZ Recycling Technology (ART) Center in St. Michael, Austria, is open to customers from recycling sectors as well as to R&D facilities.

With a total space of 3,600 sqm, the new ART Center can conduct tests with a wide variety of raw materials on state-of-the-art recycling equipment of industrial size. The center contains the

innovative ADuro product line, which can be used for primary and secondary shredding as well as for fine granulation and dismantling of composite materials. This allows trials with a broad range of waste streams and complete recycling process simulations.

Customers can run tests with their own material or with material provided by ANDRITZ. They can make use of the expertise and

know-how of our recycling experts. Thus, new recycling projects and investments can be planned easily, reducing investment risks to a minimum.

Our experienced team is ready to support waste recyclers, research and development facilities and all other companies serving the recycling industry, with top-quality conditions for testing and R&D.



ART Center, Austria: ADuro shredders for primary and secondary shredding as well as for fine granulation and dismantling

CHEMICAL RECYCLING R&D

In addition to the research carried out at ANDRITZ's internal research laboratories, ANDRITZ collaborates with two Finnish university research laboratories: XAMK Fiber Laboratory in Savonlinna, and LUT University's research laboratory in Lahti. This collaboration allows ANDRITZ to test and develop pulping equipment and processes for chemical pretreatment of textile waste on a pilot scale, to test different process steps, and to analyze various properties of recycled textile pulp.

MECHANICAL RECYCLING TECHNICAL CENTER

Our technical center located in Cours, France, has all the equipment necessary to process all types of textile or nonwoven waste by tearing. From industrial (textiles, automotive, furniture,

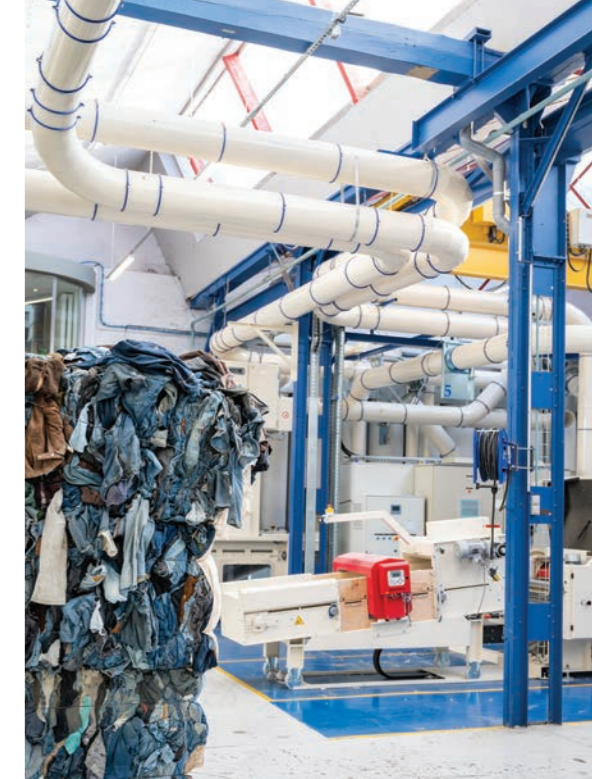
building insulation, nonwovens, waste, etc.) to pre- and post-consumer waste, we aim to bring our expertise in technical and eco-friendly solutions to our customers.

TECHNICAL CENTER IN USA

ANDRITZ has a Fiber R&D Center in Springfield, Ohio, USA. Here, we can run tests of a concept's feasibility in repeated small-scale productions.

TECHNICAL CENTER CETI

At CETI, its facility in France, ANDRITZ offers a way of testing the mechanical and/or thermo-mechanical recycling of textile waste of all origins to develop a new generation of recycled textiles.



Technical center at ANDRITZ Laroche, France: Tearing lines to process any kind of textile and nonwoven waste

CUSTOMER TRIALS

- Individual machine demonstrations with different materials and operating parameters
- Demonstration of recycling processes
- Proof of capacity and output quality of processed materials
- Basic sample analysis
- Preparation of raw materials for further testing

RESEARCH & DEVELOPMENT

- Processing of new materials and development of new recycling solutions
- Testing of new machine settings and configurations for different applications
- Optimization of recycling machines
- Testing of new prototypes
- Networking with other test centers and laboratories



Analysis of textile cleaning rejects at the ART Center in Austria



JOIN US ON A
TOUR THROUGH
THE ART CENTER



Vast experience in a changing textile market

Take advantage of a broad service portfolio to keep your machines at peak performance. Running complete textile recycling production lines and individual machines calls for in-depth process expertise and excellent service. We offer a full service portfolio and thus can ensure improved uptime, productivity, product quality and lowest cost of ownership.



ONE ANDRITZ FOR YOUR ENGINEERED SUCCESS

Benefit from our vast know-how and global experience as well as our worldwide service network. As part of the international ANDRITZ GROUP, ANDRITZ Textile Recycling has the support and power of an extensive global network of service specialists, machining centers, rebuild shops and service locations.

These centers are strategically located close to customers – around the globe.

Innovative technology goes hand in hand with in-depth process knowledge. With ANDRITZ, you have ONE partner to meet your challenges in textile recycling.

GLOBAL NETWORK, LOCAL PRESENCE

We want to provide you with the most efficient and reactive support possible. Therefore, we assign dedicated teams of skilled experts who are located close to you. Customers appreciate having an ANDRITZ Textile Recycling expert on site to help them diagnose process or equipment issues and offer solutions to improve reliability and performance. That is why we maintain local service experts in key locations, backed by the global network of a leading technology supplier.

Our skilled technicians and engineers have access to certified workshops to provide a quick response for repairs, rebuilds and

upgrades. While there are other local companies in the service business, none understand the machinery and processes as well as ANDRITZ. Each local organization is backed by ANDRITZ's worldwide service organization, giving them access to experts in the recycling industry for those special problems or situations that cannot be handled locally.

From routine work during a scheduled shutdown to a quick response during a disruption, ANDRITZ service specialists work side-by-side with the customer's team to diagnose, offer recommendations or training, provide replacement parts or perform repair services as needed to keep operations running smoothly.

YOUR BENEFITS OF OUR SERVICE APPROACH

- Decades of experience with textile recycling machines and plants
- Global expertise, local contacts
- Replacement parts
- Wear components
- Rebuilds and retrofits
- Field services, audits, inspections
- Shutdown and start-up assistance
- Service agreements/contracts
- Operator/maintenance training



RECYCLE TEXTILES INTO SUCCESS

ANDRITZ is the right partner when it comes to textile sorting, textile fiber preparation, mechanical and chemical recycling or combined recycling solutions for pre- and post-consumer or industrial textile waste. We accompany you throughout the product life cycle and beyond. Take advantage of our in-depth experience and skills to leverage your production, create new products, and make the right investment decisions. To complete our portfolio, we also provide engineering, project and site management, manufacturing and assembly, logistics, service and improvement processes, automation and digital solutions so that you can recycle your textiles into success.

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