

SPEC TRUM № 44

A Pulp and Papermaker's Dream

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A Pulp and Papermaker's Dream

Klabin's Puma Mill



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A NEW LEADER FOR THE PULP & PAPER BUSINESS AREA

Dear SPECTRUM readers,

I am delighted and honored to take over the role as head of the Pulp & Paper Business Area and member of the ANDRITZ Executive Board, starting on October 1, 2023. I would like to extend warm gratitude to the two former leaders of the business area, Joachim Schönbeck, who will focus on his role as President and CEO of ANDRITZ, and Humbert Köfler who has retired after 36 years with the company. My two colleagues have left the Pulp & Paper Business Area in exceedingly good shape, and I am looking forward to supporting our customers in the pulp, paper, and bioproducts industries even further on their journeys with cutting-edge ANDRITZ technology paired with outstanding local service support.

I am taking this leadership role at a very important time as our planet experiences major challenges through the increased effects of climate change. At ANDRITZ, we see all our business areas as playing a major role in dealing with these challenges through technologies to decarbonize, use less fossil fuels, and reuse and recycle valuable natural resources wherever possible.

I will do my best to ensure that the work never stops on the environmental and sustainability front. Our experts are on a continuous mission to examine every process area, seeking ways to decarbonize mill processes and close the loops when it comes to emissions and waste, for the benefit of all stakeholders involved.

Of course, the added advantage of ANDRITZ's mission on circularity and sustainability comes with other enormous benefits, including the ones of lower costs, higher efficiency, and less waste. This is a win for the planet, as well as for pulp, paper, and bioproducts producers.

Revolutionary and evolving technologies

This issue of SPECTRUM sees a full array of references and examples of the latest technology from ANDRITZ being applied at greenfield mills, as well as evolving, existing technologies that can be applied to mills already in operation.

Sincerely,

Jarno Nymark
Member of the Executive Board
Pulp & Paper Business Area



We have two special mill reports from Brazil, one on Klabin's Puma mill and one on Suzano's giant Cerrado pulp mill project. Both of these mills have installed the latest sulfuric acid plants from ANDRITZ, SulfoLoop, which will enable them to be totally self-sufficient in sulfuric acid. The two mills have also installed ANDRITZ gasification plants that enable them to reduce or eliminate fossil fuels used in the lime kilns. Both technologies result in a large reduction of CO₂ emissions, helping to make the Puma and Cerrado mills showcases of sustainability for the industry.

You can also read about how ANDRITZ has developed and successfully installed technology for secondary heat recovery in pulp mills. Here we have a case study on Austrian pulp and paper producer Heinzl Pöls and its DEvap digester evaporator from ANDRITZ. The tailor-made installation has made an enormous difference at the mill when it comes to capacity increase and energy and water savings.

As well as our mill reports and case studies, this issue also contains articles and interviews about the latest pioneering developments from ANDRITZ, including technology for carbon capture and the production of e-fuels at pulp mills.

I look forward to working with you in the future in the development and success of our mutual sustainability goals!

SPOTLIGHT ON

Textile recycling: CIRC x ZARA fashion collection

Big congratulations to our textile recycling partner Circ Inc. (Virginia, USA) on their collaboration with Zara. The groundbreaking CIRC x ZARA collection is made using recycled polycotton waste where both elements of polycotton are recovered.



For the first time in the industry, recycled polyester and lyocell clothing manufactured from polycotton textile waste are put into the hands of consumers. This unique collection was launched at Milan Design Week this year and sets a new standard for circularity in fashion. And we are proud to be part of this success.

In 2021, we signed a cooperation agreement with Circ to use our expertise in the field of recycling to help scale up Circ's proprietary textile recycling technology for commercial use. A series of successful trials was conducted at our Fiber R&D Center in Springfield, USA and other R&D facilities to jointly realize the vision of a circular economy for textiles and other materials.

Peter Majeranowski, CEO of Circ explains, "The trials conducted at the ANDRITZ center in Springfield marked a significant step forward in our development efforts. The launch of the CIRC x ZARA collection is the best proof possible of our success."

Michael Waupotitsch, Vice President, Reject and Recycling, ANDRITZ, adds, "To us, textile recycling is the future. It is a very vital, dynamic, and growing business. We strongly focus on innovative technologies in all textile recycling process areas – no matter if sorting, fiber preparation, mechanical or chemical recycling – with the main target of real circularity."

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Welcome ANDRITZ TEP d.o.o.

ANDRITZ has acquired boiler plant specialist ĐURO ĐAKOVIĆ TERMOENERGETSKA POSTROJENJA d.o.o (A-TEP). The well-established Croatian company has over 100 years' experience in the production of boiler plants for various kinds of fuels. The company focuses on manufacturing boiler facilities, energy islands, and power stations that process biomass and waste on grate technology.

A-TEP also manufactures and delivers complete power stations on a turnkey basis with a power output larger than 2MWe producing heat and electricity from biomass and waste, as well as customized pressure parts and boiler accessories.

The acquisition further strengthens ANDRITZ's market position for renewable energy equipment especially with grate technology and enhances its capacity and quality of manufacturing pressure parts and auxiliary equipment.



One of many biomass to energy power plants designed, built, and commissioned in Croatia by ANDRITZ TEP as EPC or EPCC contractor.

Zero Waste goal for Metsä Fibre's Kemi Bioproduct mill



Watch
our
video



Metsä Fibre's new Kemi bioproduct mill is set to become a showcase in sustainability for the global industry. ANDRITZ was chosen to supply environmentally efficient technology to achieve the mill's Zero Waste goal.

Metsä Fibre's Kemi bioproduct mill will produce 1.5 million tons of softwood and hardwood pulp a year as well as many other valuable bioproducts generated from side streams. Environmental efficiency is at the forefront of its operation, with no fossil fuels being used at all at the mill, at the same time as generating an electricity self-sufficiency rate of 250%.

Another crucial goal at the mill is to have Zero Waste which is where Metsä Fibre has trusted in ANDRITZ to supply its proven waste stream solution for transforming sludge into fuel pellets, a valuable side stream. The company has also supplied and installed two of the world's first autonomous logyard cranes featuring AI (artificial intelligence) to optimize wood handling at the mill.

ZERO WASTE STREAM SOLUTION

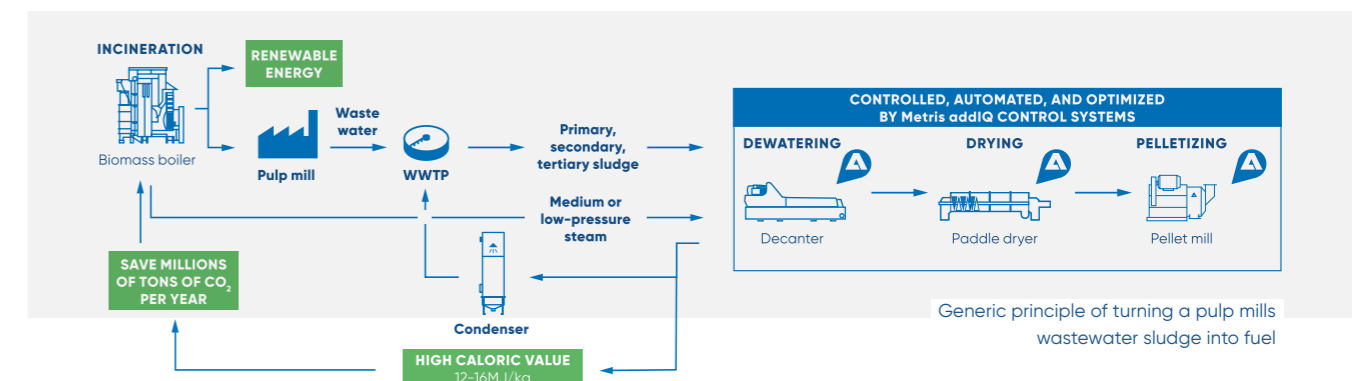
The turnkey waste stream solution from ANDRITZ enables the sludge from the mill's wastewater treatment plant to be dewatered, dried and then transformed into dry pellets that can be used for fuel. Thanks to the high calorific value of the dried final product, the pellets can also be sold outside of the mill creating a valuable side stream.

The sludge is dewatered in D6LX decanters, minimizing the consumption of wash water. The small footprint paddle dryers dry the sludge, ensuring minimal off-gas emissions. Specialist pelleting equipment, also supplied by ANDRITZ, provides a low dust end product suitable for the commercial market.

WORLD'S FIRST AUTONOMOUS LOGYARD CRANES

ANDRITZ has also supplied two 2 x 25 ton autonomous cranes to the Kemi bioproduct mill project. The cranes operate on a 540 m long logyard with a storage capacity of around 120,000 m³. Featuring the latest in AI technology, the cranes will handle approximately 7.6 million m³ wood/year shipped in on trucks and electric trains as well as handling wood storage and wood feeding to the pulping process.

The cranes will be the first autonomously operated cranes worldwide with the AI feature enabling the optimization of log handling, the minimizing of wood losses, and securing an environmentally friendly and cost-effective operation.



ANDRITZ goes Zoo! A Special Menu for Giant Pandas

Following an unusual request in 2019 from the famous Vienna zoo in Austria for the refining and preparation of bamboo feed for its giant pandas, the cooperation between the zoo and ANDRITZ successfully continues.



Special animals, special care: with the refined bamboo bread is prepared.

The Vienna zoo in Austria is not only famous for being the world's oldest zoo, it is also one of the few zoos worldwide with giant pandas. This year, the zoo is celebrating its 20-year jubilee of cooperation

with the Chinese Wildlife Conservation Association. A cooperation of great success: Yang Yang (a female) lives at Vienna zoo since 2003 and during that time gave birth to five baby giant pandas, including the birth of twins. All of the babies have been sent back to China.

RARE ANIMALS – SPECIAL NUTRITION

Not only are giant pandas very rare, but their nutrition is special as well. They more or less solely eat bamboo. An essential part of their nutrition is steamed bamboo bread. Rice flour, corn flour and above all bamboo form the basis. It is an important addition to the natural bamboo sticks as it delivers important nutrients and energy. In 2019 a new male (Yuan Yuan) arrived at Vienna zoo. As Yuan Yuan's teeth are a bit worn, he can't chew the entire bamboo sticks – only the leaves – and therefore has a higher demand on bread. And this is how ANDRITZ came into play.

SPECIALIST FOR ALTERNATIVE RAW MATERIALS

So far, the Vienna zoo refined the bamboo manually so that bamboo bread could be prepared. But the increasing demand exceeded the capacity and a solution needed to be found.

Denis Jozic, Fiber and Product Manager at ANDRITZ says, "Technology managers at the Fiber R&D Center have to deal with a lot of different requests, for example, developing new pulping processes for new raw materials. However, this most unusual and interesting request came in 2019 from the Vienna Zoo. We were asked to grind up bamboo in a special way into flour so it could be used for preparing the bamboo bread and the task immediately got the full attention of the team in Graz. We

investigated different solutions and in close cooperation with the zoo we developed a process that was the easiest and most optimal for both parties: the zoo pre-shreds the bamboo and ANDRITZ grinds the material in the disperser at the pilot plant in Graz. Since the first contact with the zoo, ANDRITZ has ground the bamboo to full customer satisfaction four times and it's now a well-established process. We hope that this cooperation will continue for many years to come."

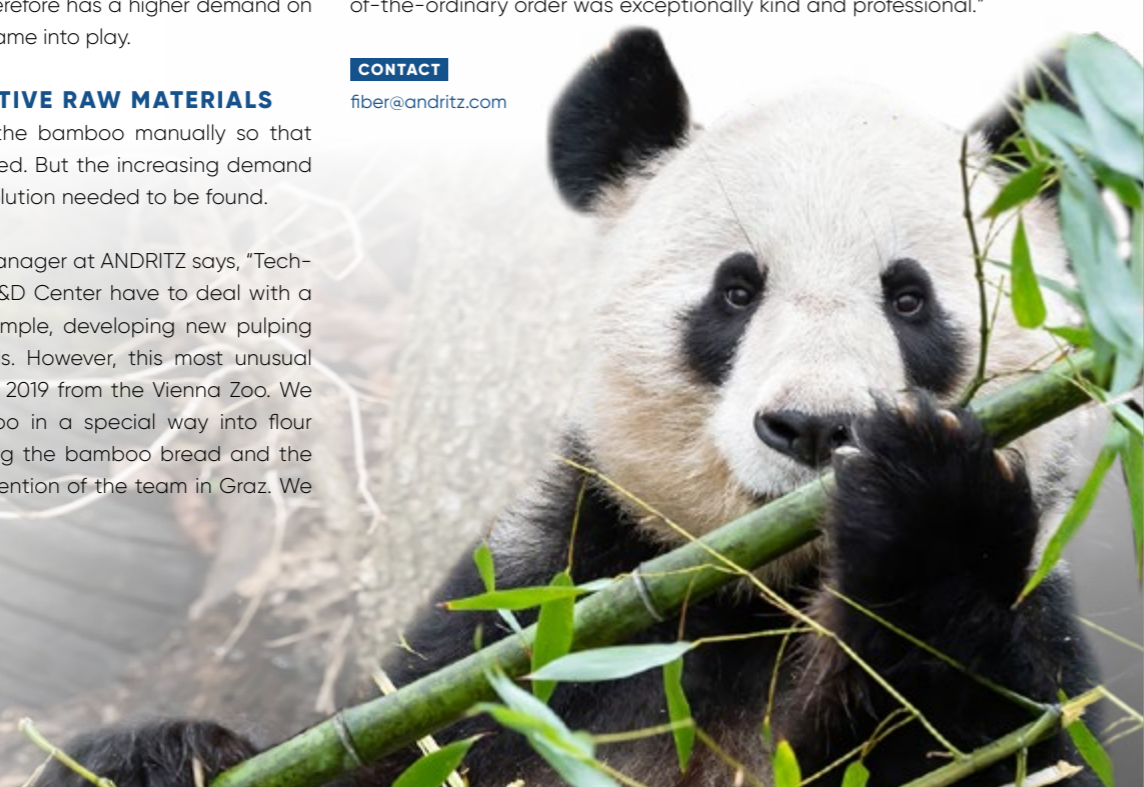
In fact, the giant pandas liked the ANDRITZ solution so much that cooperation with the zoo continues and there are orders for the specially prepared bamboo going well into the future.

Laura Liukkonen, Global Director of Fiber R&D centers at ANDRITZ says, "It always puts smiles on our faces at the R&D center when we see the van from the zoo delivering the unprocessed bamboo. "We generally receive a delivery of 500 kg of raw bamboo in bags, which we then hand feed onto our conveyor. Everybody at the center generally gets involved as this is a manual process; we feed the bamboo through the disperser twice. This regular project really shows that ANDRITZ can take on any task when it comes to raw material refining, especially since the pandas are such important customers."

Dr. Eveline Dungal, Zoo Curator and Animal Trainer, Vienna Zoo, concludes, "The way ANDRITZ dealt with this unusual and out of-the-ordinary order was exceptionally kind and professional."

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Health & Safety: Benefits of HSE Harmonized Standards for Contractors working on Pulp Projects

Occupational safety while working on pulp mill projects is a major topic at European Pulp Industry Sector (EPIS), an international non-profit association of market pulp producers.

At the end of 2021, Giuseppe d'Amelj, ANDRITZ HSE Manager, Pulp & Paper Capital Systems, was invited by EPIS to present at one of its safety webinars. In March 2022, a webinar, entitled "HSE Harmonized Standards", was presented to health and safety experts from EPIS member companies. The presentation was well received, with 100% of attendees recognizing the advantages of a harmonized approach towards contractor Health & Safety at pulp mills. Due to this important subject, the EPIS members decided to accept ANDRITZ's proposal to define common HSE standards and requirements to be adopted in the different mills, independently from ownership and their geographical distribution.

"It was recognized by the EPIS members that a harmonized approach to HSE on projects can bring many benefits to both contractors and customers," says d'Amelj. "Working and operating under common HSE standards, from mill to mill, will facilitate the learning process of the work forces and faster consolidate the defined and created safe behaviors, resulting in a safer working environment and more efficient performance." The improvement project was launched at the end of May 2022, putting together the different EPIS members, ANDRITZ, and other relevant main contractors; all were fully motivated to

define the most suitable HSE standards for future projects. The team decided to start from the preparation of a common HSE induction training to be used in all mills, during new projects or shutdowns. The target was achieved in December 2022 and the training material is currently available in English, Finnish, French, Spanish, Portuguese, and Swedish.

Anna Maija Wessman, Secretary General of EPIS, says, "The improvement of Health & Safety on pulp mill projects is a regular topic of discussion at EPIS. We see many benefits with the harmonized, common standards approach, which provides less confusion, more awareness, and more understanding when working on pulp mill projects. It's a very helpful tool in aiming for the ultimate, overall goal of improved safety for all."

One of the members of EPIS is Ahlstrom, which has around 40 manufacturing sites operating in 13 countries. The company's Global Vice President, Health & Safety Manager, Rune Årnes, confirms, "I think the HSE Harmonized Standards for Contractors approach is a great way of bringing the contractors in and making sure they understand completely what is expected from them on site. Workplace safety has no boundaries; there is no competition in this area. Everyone should be safe not only in our company, but in all companies. Harmonization of standards and transparency across Health, Safety & Environment issues will help to achieve the main pay off, which is fewer incidents and accidents."

Due to the positive response from pulp producers regarding the harmonization of standards, the ANDRITZ improvement project team decided to continue with the preparation of a common HSE manual, covering all contractual HSE requirements for all future pulp projects. The manual, including all relevant appendices, has been prepared and distributed to all EPIS members.



Members of the association include all the major European market pulp producers, as well as Latin American producers. The combined membership represents around 60% of the total capacity of market pulp produced around the world.



GIUSEPPE D'AMELJ
HSE Manager
Pulp & Paper Capital Systems

Meeting Smurfit Kappa's Environmental and Sustainability Goals

Packaging giant Smurfit Kappa is extremely cautious and demanding when it comes to making sure sustainability goals are met in its operations, often going above and beyond when it comes to meeting environmental regulations. The company recently embarked on its biggest investment program ever – the Future Energy Project – at its Nettingsdorf mill in Austria. ANDRITZ was chosen to supply key technology in order to achieve its sustainability ambitions.

Smurfit Kappa's Nettingsdorf mill produces around 450,000 tpy of kraftliner for the central European market and is firmly focused on "high quality, efficient and low-cost production," according to Günter Leitgeb, Mill Manager, Smurfit Kappa Nettingsdorf.

The mill is also firmly focused on sustainability and environmental regulations as the site is situated

close to the city of Linz in Austria, the country's third largest city, as well as operating in an urban area in the town of Nettingsdorf. "Environmental regulations are very tight here," continues Leitgeb. "Even more so than normally found in the pulp and paper industry. Austria prides itself on being first-in-class when it comes to protection of the environment. Emissions and odorous gases in particular are closely regulated, especially at Nettingsdorf, as we operate right in the town."

As the environmental limitations in Austria have grown tighter, as well as operating with some aging equipment, Smurfit Kappa decided to implement the Future Energy Project at the mill to address not only the environmental concerns, but also to improve energy and production efficiencies. "The last major investment at the mill in the recovery boiler area was some time ago," says Leitgeb. "With the Future Energy Project, we wanted to install the very latest in technology to maximize efficiencies as well as reach our environmental goals."

As part of its investment at the mill, Smurfit Kappa chose ANDRITZ to supply a new HERB recovery boiler and Mechanical Vapor Recompression (MVR) plant to enhance its implementation of sustainability initiatives as well as increase efficiency and profitability.

"We chose ANDRITZ as we have a long history of working together at this mill and we were confident in the technology and expert know-how it could provide



ANDRITZ
HERB

“When it comes to emissions, we are outperforming, the energy efficiency is brilliant, and the chemical recovery is much better than before. All in all our expectations have been met, despite the challenges.”

Günter Leitgeb
Mill Manager
Smurfit Kappa Nettingsdorf



→ for a project of this scale. When it came to the sales phase of this project, ANDRITZ experts were extremely flexible and easy to work with. They understood exactly what we needed from the start”, says Leitgeb.

Henrik Wikstedt, Vice president, Recovery Boilers, ANDRITZ, says, “When the project was first being talked about, the important factors were that Smurfit Kappa needed high energy efficiency and low emissions for the recovery boiler and significantly lower steam use for evaporation. The MVR process is extremely energy effective vs. multiple effect evaporation plants.

“ANDRITZ had already been involved quite heavily at the mill in the recovery boiler and evaporation areas, so we already had a lot of knowledge about the details of the operation. We were ready to help the customer as and when they needed it. Also, we were very familiar with regulations and standards, meaning the customer could be confident that the project could go ahead with ANDRITZ strictly adhering to any specific requirements. And in this case, the standards were set very high by Smurfit Kappa.”

OUT WITH THE OLD, IN WITH THE NEW – IN JUST ONE DAY

Contracts were signed in the spring of 2018 and the project commenced with the delivery of the pre-evaporation units. The installation of the units was completed by November 2018 and commissioning and take-over was achieved in April 2019. The recovery boiler project proceeded immediately after the installation of the pre-evaporation plant, the hydrotest was completed by late December 2019, with take-over taking place at the end of July 2020.

“This was an extremely challenging project for a number of reasons,” says Wikstedt. “The mill layout was really tight, with the recovery boiler being constructed on the site of the former lime kiln. There were also challenges with the pre-evaporation unit that involved a complex layout in an extremely narrow place.

“Added to this were Austrian rules relating to the use of labor and the, of course, there was COVID-19, which came along right in the middle of the main part of the project.”



“We were very pleased; the commissioning went well and the start-up and ramp-up to full production went exceedingly well.”

Henrik Wikstedt
Vice President, Recovery Boilers
ANDRITZ

Despite all the challenges, the project started on time. The new recovery boiler took over from the old one and was running at nominal capacity after just one day. “This project was carried out on another level, especially when it came to safety,” says Leitgeb. “And the start-up was brilliant. The project manager and team from ANDRITZ were completely focused and always pushing to make sure all requirements were met and the timeline was followed.

“We stopped the mill for one day and the next day we had full production. There was such a fast ramp-up after the start-up; I could even say the recovery boiler was outperforming. We did all this during normal operation; it really was a case of out with the old and in with the new and up and running again – in just one day.”

“We were very pleased; the commissioning went well and the start-up and ramp-up to full production went exceedingly well”, adds Wikstedt.

Leitgeb comments that now all capacity numbers agreed on with ANDRITZ have been fulfilled, he says, “The expectations were really high with this project and the senior management at Smurfit Kappa have followed progress very closely. The recovery boiler is now running smoothly 99% of the time with the major difference being that it’s not a bottleneck anymore.

“When emissions, we are outperforming, the energy efficiency is brilliant, and the chemical recovery is much better than before. All in all our expectations have been met, despite the challenges.”

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THE LATEST TECHNOLOGY FOR RECOVERY BOILERS

Nettingsdorf is no stranger to the implementation of the latest technology. The mill has already some of the newest technology from ANDRITZ on its fiberline in operation, including a number of the world’s first installations.

The new recovery boiler delivered to Nettingsdorf comes complete with some of the latest advanced autonomous technology developed by ANDRITZ, including a Smelt Spout Robot, sootblowing control with a Metris HEWI Weight Indication, a Metris Water Leakage Advisor (WLA) system, and a process simulator.

Michael Strach, Pulp Mill Manager, Smurfit Kappa Nettingsdorf, says of the Smelt Spout Robot installed on the smelt deck of the recovery boiler, “This is a very important step for us at the mill in terms of safety as the smelt deck is one of the most dangerous places to work in at the mill.

“We have been really surprised at how effective the robot is; we were expecting teething troubles, but apart from a maintenance learning curve it has been very effective right from the beginning. It has now made the smelt deck a lot safer for our mill personnel.”

Strach also comments on the process simulator that was supplied alongside the new recovery boiler, “The simulator is perfect for us as we can train our personnel how to run and operate the boiler. We can simulate different scenarios including dealing with tricky situations learning what to do, and importantly what not to do when these occur. We use the simulator a lot to see how the boiler reacts to various events; it’s very useful for gaining experience of boiler operation.”

The Metris WLA system is the first of its kind supplied to a pulp mill, as it comes with the new feature of machine learning. The system was developed in close cooperation between ANDRITZ and the Nettingsdorf Mill. Walter Marchgraber, Pulp Mill Manager, Smurfit Kappa Nettingsdorf says, “The Metris WLA came as a result of close collaboration between Nettingsdorf recovery boiler management and ANDRITZ. Safety is of utmost importance to us at the mill, so to have a system that warns us of possible water leakage is a great tool to have for our operators.

“The new system will alert operators to a possible leak, enabling them to take action and therefore prevent the chance of an explosion in the recovery boiler.”



Michael Strach and Walter Marchgraber
front of the Smelt Spout Robot installed
at Smurfit Kappa Nettingsdorf

Machine Learning in Water Leakage Detection

In the search for maximum safety in recovery boiler operation, ANDRITZ has developed its state-of-the-art Metris Water Leakage Advisor (WLA) to reduce the risk of explosions in the furnace of the boiler. Smurfit Kappa Nettingsdorf in Austria is the first mill to receive delivery of the WLA, and has been instrumental in the co-development of the new solution.

Safety is of major importance to ANDRITZ and its customers. A lot of work and resources have been invested in the development of autonomous solutions for improving safety in pulp mills. The recovery boiler is an area of particular concern as it bears the risk of large accidents as well as being an indispensable part of profitable production.

As part of the contract for its new recovery boiler, which started up in second part of 2020, Smurfit Kappa's Nettingsdorf mill received the first Metris WLA tool from ANDRITZ. The system has been developed to offer a simple yet effective tool to operators to support their decision making when dealing with suspected leaks in the recovery boiler and to improve

capability of detecting leaks. Leaks left unnoticed can cause serious injury, or in the worst case, boiler explosion. There are several recorded cases where such explosions have occurred, including fatalities, in the pulp industry globally.

The WLA tool is unique in the fact that it comes complete with machine learning that supports the traditional leakage detection methods. "Technically, the principle of the tool is measuring the mass balance of water and steam; this sounds basic, but it's very important," says Niki Lankila, Product Manager, Automation & Digitalization, ANDRITZ. "When monitoring incoming water and outgoing steam, the balance should add up close to zero to ensure that none of the elements are being lost.

"What sets the Metris WLA apart from other water leakage methods is the machine learning feature to detect unusual situations and cross-connections of the measurements. This is essential as it builds a model of the normal boiler operation condition. This principal model status can then be used as a reference point for the operating condition of the recovery boiler. As well as the solution searching for leaks, machine learning enhances knowledge gained in boiler operation by using accumulated data to also search for signs of leaks by monitoring other parts of the process, for instance, the flue gas balance."

MUTUAL, PROACTIVE COLLABORATION

The WLA product initially delivered to the Smurfit Kappa's Nettingsdorf mill was based only on the traditional methods of searching for leaks, without the machine learning

"What sets the Metris WLA apart from other water leakage methods is the machine learning feature to detect unusual situations and cross-connections of the measurements."

Niki Lankila
Product Manager
Automation & Digitalization, ANDRITZ



features. After the takeover of the boiler in 2020, ANDRITZ presented a proof-of-concept with machine learning technology to the Nettingsdorf recovery boiler management. It was agreed to set up a co-development and piloting program to bring the Metris WLA to life.

"When we first received the WLA, although the information we were receiving from it was useful, there wasn't really enough information provided," says Walter Marchgraber, Pulp Mill Manager, Smurfit Kappa Nettingsdorf. "The system we have subsequently co-developed with ANDRITZ is now a completely different one."

Although the solution was initially functional, ANDRITZ wanted to develop it further to improve the everyday usability, which is why the collaboration with the Nettingsdorf mill was so important.

"The co-development and piloting stage was an amazing time for us at the mill," says Marchgraber. "To bring the ANDRITZ WLA experts together with the recovery boiler team was an excellent idea. These experts listened to all our needs and put into place almost all of the suggestions we had to enable the solution to give us all the information we needed."

Lankila adds, "From the ANDRITZ point of view this was an excellent collaboration as we were approaching the development from two different angles; a company running a recovery boiler and

a technology supplier. We took all Nettingsdorf's requirements into consideration, then implemented them to the system.

"After many meetings, calls, and inputs from the mill team, accompanied by a multitude of fine tuning and trials, we ended up with a very successful result that suits both parties."

A JOURNEY NOT JUST A DESTINATION

The result of the collaboration is the Metris WLA, which uses standard instrumentation in the recovery boiler enhanced with modern machine learning tools to detect possible leaks. Operators have one all-inclusive display to check all relevant data connected with the boiler's water and steam system, which improves the capabilities to detect even the smallest leaks and will alarm operators in case a leak is suspected.

"This has been a journey and not just a destination," concludes Marchgraber "The way the WLA system reported when first delivered to Nettingsdorf was completely transformed after this close collaboration between ANDRITZ experts and the mill operators. We now have a system that fully suits our needs, and one that gives us much more confidence when it comes to possible leaks."

The new Metris WLA system from ANDRITZ is available for all new and existing recovery boilers.

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"These experts listened to all our needs and put into place almost all of the suggestions we had to enable the solution to give us all the information we needed."

Walter Marchberger
Pulp Mill Manager
Smurfit Kappa Nettingsdorf





Innovative carbon capture technology for a sustainable future

Decarbonization trailblazers

Carbon Capture, Utilization, and Storage (CCUS) can make an important contribution to the urgently needed reduction of greenhouse gas emissions. ANDRITZ has various types of solutions in its portfolio that help customers to remove CO₂ from their flue gases which can be stored, or processed for further use in making other products.

For more than 15 years, ANDRITZ has been active in the field of decarbonization of flue gases in different industries. The CCUS solutions developed have been tested in cooperation with various universities and scientific entities. The first approach was the development of solutions for the fossil fueled power sector, where ANDRITZ has installed and tested pilot plants for nearly 10 years.

Meanwhile, ANDRITZ is also active in the cement, pulp & paper, waste to energy, iron and steel industries, as well as the maritime industry. The latest reference of a CCUS solution was recently installed in the German cement industry. The Global Cement and Concrete Association (GCCA) reports that the cement industry contributes around 7 - 8% of global man-made CO₂ emissions. That means curbing the CO₂ emissions resulting from cement production will make a crucial difference in helping the world achieve its net-zero objectives to limit global temperature rise. ANDRITZ is set to play a key role in helping the cement industry achieve this target by

deploying its CCUS technology that is already proven in other industries.

In this pioneering project, ANDRITZ was the engineering, procurement, and construction (EPC) contractor for a demonstration project to develop Europe's first carbon capture plant in the cement industry. The plant has been constructed for Rohrdorfer Zement at its Rohrdorf site, near Rosenheim in Germany. This site was already a focus for major developments in decarbonization. In fact, in 2022 it was producing cement with 45% less CO₂ than in 1990 by optimizing cement types and fuel use. This approach can achieve a maximum reduction in CO₂ emissions of around 60%. The remaining 40% must be eliminated by carbon capture, utilization, and storage (CCUS).

LIQUID AMINE PROCESS

ANDRITZ has deployed a liquid amine process for the pilot plant. This technology is currently the most mature and commercially viable approach for large-scale applications. It uses amines – organic compounds derived from ammonia (NH₃) – to “scrub” the

CO₂ from the flue gas. At lower temperatures the amines bind to CO₂ and absorb it. When heated, they desorb it to yield close to pure carbon dioxide.

There are two advantages to the amine process. First, it offers a high removal rate – up to 95% is a good practical value. Second, it produces a high purity CO₂ product – up to 99.9% without purification. Once separated, the CO₂ is cooled, further purified, and compressed. It can then be permanently stored underground or processed for use.

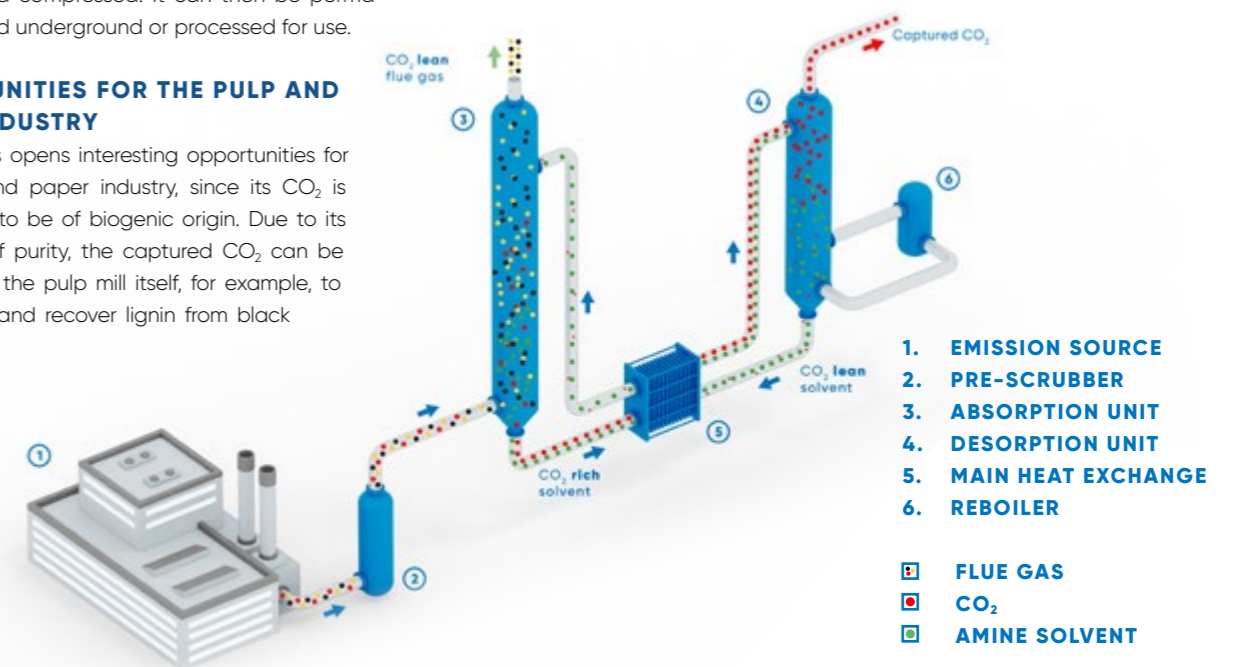
liquor, which can then be used to produce polymers or biofibers. Other opportunities for the use of the captured CO₂ include the production of e-fuels, like e-methanol or e-methane, or green ammonia.

Since the product portfolio from ANDRITZ also includes systems for green hydrogen and e-fuel synthesis, comprehensive support can be provided to pulp mills wishing to explore these opportunities.

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OPPORTUNITIES FOR THE PULP AND PAPER INDUSTRY

This process opens interesting opportunities for the pulp and paper industry, since its CO₂ is considered to be of biogenic origin. Due to its high level of purity, the captured CO₂ can be used within the pulp mill itself, for example, to precipitate and recover lignin from black



Klabin's Puma Mill

A Pulp and Papermaker's Dream



"Klabin's relationship with the local communities is transparent, very close, and goes beyond employment of the workers."

João Braga
Klabin's Director of Projects and Engineering

Over the past 10 years Klabin has been working virtually non-stop to bring its Puma projects I and II to life in Paraná state, southern Brazil. With the Puma I pulp mill starting up in 2016 and Puma II phase I and phase II starting up in 2021 and mid- 2023 respectively, the company has succeeded in creating an integrated mill that virtually knows no bounds when it comes to pulp, paper, and board qualities, types, grades, and ranges.

So, how do you like your pulp, paper or board: Hardwood or softwood? Eucalyptus or pine? Bleached or unbleached? Would you like brown or white Kraftliner? And would you like Topliner with that? Would you like carrier board, folding box board, or liquid packaging board? And would you like to add a biodegradable coating to your board? How about the 100% eucalyptus Eukaliner range that is taking the world by storm? Or would you prefer something from our fluff range?

The choices of grade and qualities of pulp, paper, and board being produced at the Puma mill appear to go on endlessly, being self-sufficient and exporting power to the grid, using biomass as solid, liquid or gas as fuels and producing sulphuric acid, tall oil, turpentine, methanol, and potassium. And as an extra bonus the Puma operation can switch easily and quickly to any grade that the current market demands. With a total capacity of 2.5 million tonnes of pulp, paper, and board, this mill in southern Brazil is now an exhibition in pulp and papermaking. In fact, Klabin's Project and Technology Manager, Rodrigo Vendramini, goes even further, "This is a Disneyland for pulp and paper makers; we basically have everything here a pulp or paper maker could ever dream of and make whatever they want."

ONE OF THE LARGEST FOREST PRODUCT OPERATIONS IN THE WORLD

In terms of raw material, Klabin has some 234,000 ha of wood planted in Paraná state alone, with 40% of the land given over to biodiversity. João Braga, Klabin's Director of Projects and Engineering, says, "Our conservation strategy is recognized the world over as an excellent sustainability model." Braga continues, "The target here is to have at least 80% of our wood coming from our own, sustainably managed plantations.

"For this project, we had to build the inward and outward logistics for the development, including roads and a rail head. It was an enormous operation, and now our development in Paraná state is considered to be one of the largest forest products operations in the world."

Klabin is a huge and important employer in the region, with some 6,000 employees in Paraná state when forestry operations and the nearby Monte Alegre and Puma mills are considered. "Klabin's relationship with the local communities is transparent, very close and goes beyond employment the of workers," continues Braga. "Bringing economical health to the area is one of the main pillars in our operational strategy, which generates important benefits, including



ANDRITZ gasification plant for the lime kiln

→ helping the local cities with administration support from specialists and helping young people when it comes to improving their education.

Klabin's operations in the area see a lot of truck movements everyday transporting around 14 million tons of wood a year. "This is why we have built an impressive logistic hub, including the containers terminal connected to the port," says Braga. "From here our final products go out to the main local port by rail, and then out to the 60 countries around the world to whom we export our products."

"The rail terminal takes trucks off the road and reduces emissions as well as costs."

ENVIRONMENTAL EXCELLENCE – A GIVEN

The focus on environmental excellence extends across the board at Klabin, from forestry operations right down to the final product, which is why this was an important issue when it came to the Puma II project at the mill.

After the successful results working with ANDRITZ on the Puma I project at the mill, which included the installation of the woodyard, four complete debarking and chipping lines, two cooking plants and fiber lines for bleached pulp grades for hardwood and softwood, two lime kilns, and a

white liquor plant, Klabin embarked on the Puma II project that has included several major deliveries and upgrades from ANDRITZ, as well as adding two of the latest paper machines to the site, thus maximizing the potential of an integrated pulp and paper mill.

"It's all about trust and cooperation," says Rafael Sirtoli, Director of Operations, ANDRITZ. "The Puma I project went even better than the original plan. We were even ready for the start-up some days before the contractual date in some areas. The Puma I project also included a hardwood and a softwood bleached kraft pulp line with the challenge of building both lines in parallel. The ANDRITZ team did a great job on the cooking and washing concept, and the project was carried out smoothly. We were all very happy with how the Puma I project went."

Puma II project phase 1, was focused on supplying brown pulp to Klabin's new paper machine 27, which is producing the company's new revolutionary Eukaliner, a Kraftliner made from 100% eucalyptus. For this part of the project, ANDRITZ supplied a wood processing line, HERB recovery boiler, EcoFluid power boiler, and a complete white liquor plant consisting of a recausticizing plant and lime kiln. ANDRITZ also supplied a gasification plant and SulfoLoop sulfuric acid plant.

The Puma II project also meant that a major expansion program was needed to increase capacity of the Puma I bleached fiberlines in two different phases; first, comprising a capacity increase of the cooking plants and second, a capacity increase of the hardwood line, from 3,742 adt/d to 4,080 adt/d. ANDRITZ once more was chosen as the main supplier to provide the very latest environmentally leading technology for the capacity increase. The scope of supply included the modernization of the cooking, washing, screening, and bleaching processes including the delivery of the 400th ANDRITZ DD-Washer to ensure the production of high-quality pulp,

maximum operating availability, and low chemical consumption.

Great portion of the capacity increase was done during the annual maintenance shutdown, of the mill "This was the most challenging modification ever," says Vendramini. "It was amazing the amount of work done by ANDRITZ and Klabin teams to increase the capacity of the line by 340 t/d. During a 10-day shutdown there were some 50 tons of piping to be replaced as well as many motors and pumps to be changed/repowered. This period was a hive of activity on the hardwood line, ending up with a great result, on schedule, with safety and quality."

"We were delighted to receive the 400th DD-Washer that ANDRITZ has produced," says Vendramini. "We also have the 300th one on our Puma I line. The washer capabilities are very familiar to us especially in its flexibility for higher production rates and low chemical consumption in bleaching."

The scope of the second phase also included a debarking and chipping line, making it the sixth wood processing line from ANDRITZ installed at the mill. The complete wood processing plant includes six ANDRITZ debarking drums and six EXL-size HHQ-Chippers, one for each line.

ANDRITZ also supplied leading environmental technology for renewable and recyclable technology with its SulfoLoop sulfuric acid plant and gasification technology for one of the Puma I lime kilns.

"Along with its proven technology in the woodyard, pulping, and recovery processes, we also chose ANDRITZ because we want to be environmentally responsible," says Braga. "This is why we decided to invest in the new technology of SulfoLoop and gasification of the new lime kiln."

"Sustainability is another one of the pillars of our strategies at Klabin; the reuse of raw materials, saving of fossil fuels, and reducing GHC emissions fits firmly into our strategy."

COVID CHALLENGES: "WE WERE REALLY STRONG TOGETHER"

"The Puma II project kicked off in May 2019 and was going really well, with all the plants we were working better than the schedule," says Vendramini. "And then came the pandemic!"

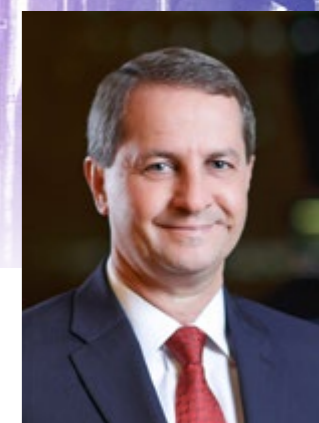
"This was obviously a major challenge. We suddenly had to shut down the site construction and installation activities of the project, and somehow demobilize the 6,000 people we had on site and move them back home under the governmental conditions of the pandemic. As everybody else, we had no experience like that before and, of course, the safety of our people and those working on the project was of paramount importance. We then had to figure out how we could continue the project under these adverse conditions. Remobilizing the workers took long, following strict protocols set by authorities, Klabin, and ANDRITZ."

This turned out to be a real test of the relationship between Klabin and ANDRITZ, as this was not just a question of health and safety. There was also a major project to continue with all the attendant challenges of equipment deliveries held up in ports and ongoing construction activities with a severely depleted work force due to the raging pandemic.

→

"The technology for SulfoLoop and gasification of the lime kiln from ANDRITZ fits in well with our own ambitions to improve our environmental performance."

Francisco Razzolini
Klabin's Director of Industrial Technology Innovations and Sustainability



"We basically have everything here a pulp or paper maker could ever dream of and make whatever they want."

Rodrigo Vendramini
Klabin's Project and Technology Manager

→ Sirtoli says, "This was a difficult time, and there were some major headaches due to equipment delays with ports being shut.

There were also challenges on the ground; for example, there were days when as many as 100 construction workers didn't turn up due to positive COVID tests.



Klabin's newest DD-Washer is ANDRITZ' 400th DD-Washer produced

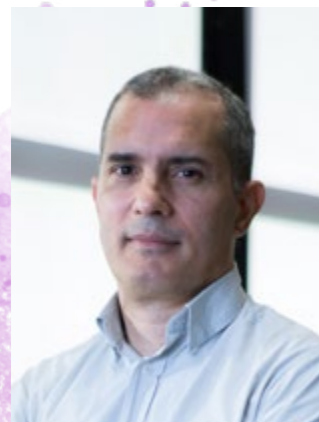
"But it has to be said, the cooperation with Klabin was brilliant, the lines of communication were fully open, and the company was very empathetic to our needs and challenges. At this stage we had weekly meetings where the project leaders from both sides covered all the event-

ualities that were affecting the project and found solutions that worked for both parties.

"This was a difficult phase we went through, but we were really strong together," adds Vendramini. "And with open and transparent communication we all understood very well the challenges both parties were facing, which enabled us to move forward in a decisive way."

As well as dealing with COVID-19 as the project got back on track, there were still major challenges, including the first capacity increase of the cooking plants during the maintenance shutdown of the mill.

"In the end, the whole project had gone under replanning and deviated for some weeks from the original schedule, which was impressive considering the impact COVID had," says Vendramini.



"It's reassuring to know that ANDRITZ is here to work with us on this journey."

Ricardo Cardoso
Industrial Director of Klabin Puma Mill

A WORLD OF OPPORTUNITIES

After the start-up of ANDRITZ pulping technology and two paper machines, PM27 (which started up in 2021) and PM28, the Puma mill is now producing some of the most varied ranges of paper and board seen at any mill around the world. PM28 started up in late June 2023 and is now adding value to the mill's output by satisfying numerous customers from specialist liquid packaging grades to 100% Eukaliner for corrugated packaging, and almost every grade in between.

But the work doesn't stop. Ricardo Cardoso, Industrial Director of Klabin Puma Mill, says, "We are very pleased with how ANDRITZ supported us in the Puma II project. Through a close collaboration between the Klabin team and our suppliers, we are now fully equipped to provide sustainable solutions, encompassing all sorts of paper and cardboard types and varieties that our clients require to enhance their business success.

"With all the efforts we have made to streamline and increase capacity, along with providing various innovative technologies following the best environmental practices, we are already witnessing improvements in the capacity and quality of our paper and board production. However, it's a complex plant, and there is still work to be done to optimize the overall factory balance. It's reassuring to know that ANDRITZ is here to work with us on this journey."

The Puma mill is the result of one of those extraordinary projects in this industry in terms of its scale and depth of innovation, ingenuity, and execution. Whether its civil or equipment engineering excellence, and sheer physical effort, or intricate new innovations and environmental additions, Klabin's Puma mill is now virtually a closed loop circular biorefinery, and a fantastic example for the pulp and paper industry and the global bioeconomy as a whole.

Braga concludes, "ANDRITZ has played an important role in the whole Puma project, both projects I and II, and we see the company as the forerunner in the development and supply of top, environmentally-leading technology for the pulp and paper industry."

CircleToZero

NEW SUSTAINABLE TECHNOLOGIES AT THE PUMA MILL

Importantly, the orders to the Puma mill from ANDRITZ also included two firsts from under the umbrella of its CircleToZero initiative; the world's first ANDRITZ SulfoLoop sulfuric acid plant, and a gasification plant for the lime kiln, the first of its kind started up in Brazil.

Francisco Razzolini, Klabin's Director of Industrial Technology, Innovations and Sustainability, says, "Klabin is on a long journey to reduce and eliminate the use of fossil fuels, so we are always looking for renewable, reusable, and recyclable solutions in our operations.

"The technology for SulfoLoop and gasification of the lime kiln from ANDRITZ fits in well with our own ambitions to improve environmental performance and reduce our carbon footprint. We have always thrown out challenges to our suppliers and we are always keen to challenge them to come up with these types of solutions."

SulfoLoop CONCENTRATED SULFURIC ACID PLANT

Klabin successfully started up the SulfoLoop plant at the Puma mill in the second half of 2022. The plant has the capacity to produce 150 tons of commercial grade sulfuric acid from concentrated odorous gases and elemental sulfur. The plant serves the whole pulp and paper mill and makes the site completely self-sufficient in sulfuric acid by recycling sulfur from the waste streams.

"Despite some expected challenges as it's a world's first, we are now producing 98% concentrated sulfuric acid in the SulfoLoop plant, which means we no longer have to buy from the market," says Razzolini. "This has also saved us fossil fuel emissions as we no longer need to use trucks to transport sulfuric acid to the mill."

GASIFICATION PLANT

The gasification plant was also started up in the first half of 2022 and enables entirely fossil-fuel free operation of the lime kiln by replacing 100% of the heavy fuel oil with a biomass-derived gas.

"We are very happy with the result of this addition to the mill," says Razzolini. "We have calculated that with this project we are reducing the use of fossil fuels by some 21,000 tonnes per year, as well as eliminating more than 60,000 tonnes of greenhouse gas emissions a year. Gasification, integrated to other renewable fuel sources, as hydrogen, tall oil, methanol, odorous gases, and turpentine, results in a very high green energy mill operation, getting closer to our ambition to zero fossil fuels."

ACHIEVING GOALS WITH THE "NEW NORMAL" TECHNOLOGY FOR PULP MILLS

Both projects, SulfoLoop and the gasification of the lime kiln, are part of the investments Klabin is making to reduce fossil-based emissions. "We have submitted and approved a goal with the Science Based Target Initiative (SBTi) to reduce emissions on all our operations by 25% by 2025, and 49% by 2035, based on 2020 figures," says Razzolini. "Implementing these technologies is part of that process."

As both areas were new to Klabin's operational team, ANDRITZ developed and delivered the first simulator, Operator Training System (OTS) for SulfoLoop and the gasification plant. The expected results with process validation, DCS logic validation, and operator training were achieved with better-than-expected results.

Leonardo Scanavini, Chemical Recovery Plant Specialist for new projects at Klabin, says, "The solutions of SulfoLoop and gasification of the lime kiln fit like a glove for us at the Puma mill. In fact, they are the 'new normal' at pulp mills now. In the future, all mills will have these types of solutions."

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TISSUE MACHINE SAFETY

TISSUE PRODUCTION – MAKE IT SAFE!

Avoiding accidents and unplanned downtime while observing the highest safety standards is one of the foundations of today's high-speed tissue production. The industry's safety mea-



Fully cantilevered shoe press for safety and efficiency

asures and concepts already went hand in hand with the constant increase of machine performance and capacities. Nevertheless, this part of the tissue production process is subject to great dynamics, as not only technologies evolve, but also awareness of the importance of safety increases and the regulatory framework changes. In addi-

tion, the understanding and interpreting of the guidelines often varies by country and by supplier.

"Safety is quite a complex area for us as machine suppliers," says Thomas Nager, Machine Safety Expert, ANDRITZ. "On the one hand we want to supply the safest tissue machines on the market; however, on the other hand we also want them to be the most productive machines when it comes to ease of operation. We try to live a culture that combines those two, often remarkably divergent, topics."

ANDRITZ has gone to great lengths not only to comply with machine safety regulations, but also to go beyond them to ensure that every customer enjoys the highest level of safety in every machine the company supplies. ANDRITZ follows three main principles when it comes to tissue machine safety:

- A safe machine ensures the safety of the operating personnel and the surrounding environment.
- A safe machine is the basis for a reliable process to create maximum output.
- A safe machine is obligatory to fulfill legal requirements.

"The first and most fundamental of our principles when supplying tissue technology is that obviously we don't want any operators to be hurt," continues Nager. "The second is reliability and machine performance, and third on the list is regulations and legal requirements."

"Currently, European safety standards are the most detailed for tissue making and finishing machines. The basis for ANDRITZ machines is the risk assessment in combination with the standards. For the European market, additionally, the Machine Directive, as well as the Electro-magnetic Compatibility Directive (EMC), Low Voltage Directive (LVD), and Pressure Equipment Directive (PED) and their harmonized standards must be fulfilled. Products in compliance with these directives are identified by the CE mark (Conformité Européenne) which signifies that the products sold have been assessed to meet the legal requirements for health and safety."

ANDRITZ communicates with the customer already in the sales phase about the implications of the risk assessment and the most advantageous route to take. "There are always discussions early on about the CE mark for the European market, and whether, for instance, the whole plant must have a CE mark, or individual machines only. As an example, a tissue machine needs a CE mark of its own, as does a pressure vessel such as a Yankee. ANDRITZ's advice is to have individual CE marks, as updating in the future tends to be easier and more flexible than with a mark covering the whole plant, even it is not necessary according to the machine directive," explains Nager.

In addition to CE markings on new supplied machines, ANDRITZ provides audits on older machines to ensure that these machines comply with the current regulations. Furthermore, safety advice will be issued if it comes to major rebuild projects.

Other countries and regions also have their own conformity markings including the USA and Canada (e.g., UL for electrical components), China (e.g. CCC) and Russia and Eurasia (e.g. EAC). "Of course, all additional requirements in any given country or region will be respected and taken into account when delivering ANDRITZ tissue machines," adds Nager.

Under the European Machine Directive, which is the legal basis for machine safety in Europe, every machine that is placed on the market must have a risk assessment that is the core tool to ensure that safety has been seriously taken into account. This means identifying where any hazardous areas may occur and taking defined steps to make those areas safe.

"This is not simply a case of ticking boxes," says Nager. "This really is about reducing risks in the work environment, often in tight spaces. For example, it is quite common in the tissue industry for space to be a problem, and subsequently squeezing a machine into a tight area. If this happens, it is particularly challenging to keep people a safe distance away from the hazardous areas."

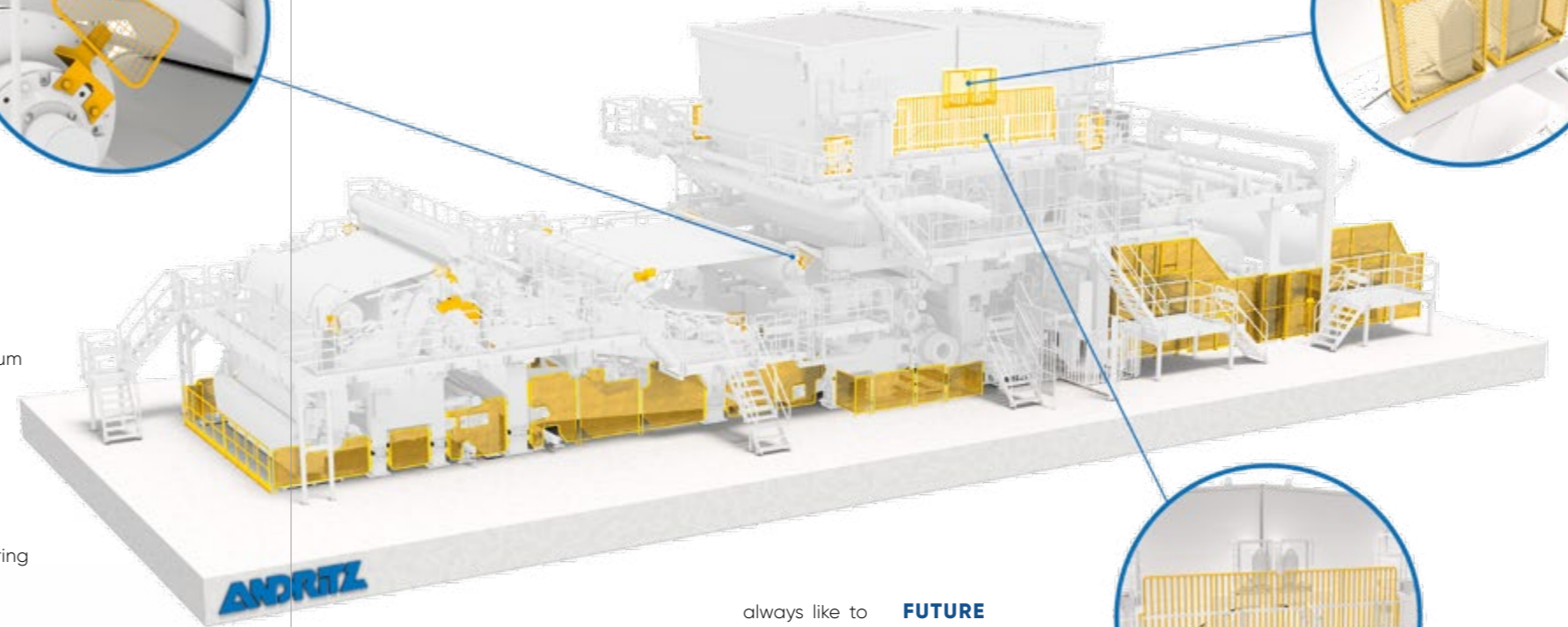
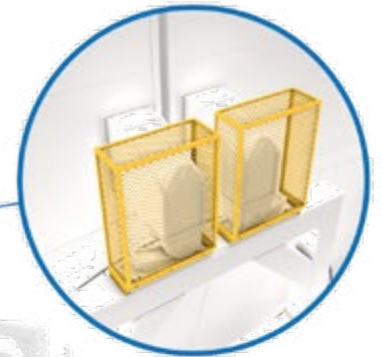
We work closely with our customers to improve the safety of their tissue production process; for example: Which safety elements need to be eliminated or bypassed; which kind of





"It must be noted that functional safety, although an important asset, is costly at the outset and has to be maintained on a regular basis."

Thomas Nager
Machine Safety Expert
ANDRITZ



smart solutions can we offer or develop conjointly to create a safe environment?"

THE ABC OF SAFETY ON ANDRITZ TISSUE MACHINES

The risk assessment ensures that nothing is left out or forgotten when it comes to all aspects of safety on tissue machines. ANDRITZ realizes this with its high competence in various fields, fully understanding the mechanical demands and with all process know-how in house. This involves making a list of all important factors relating to risk on a tissue machine and defining measures how to mitigate these risks.

"These standards are split into A-, B-, and C-standards," explains Nager. "A-standards are general safety related standards, such as ISO 12100 which defines what a risk assessment must contain; B-standards are more precise, related to different types of risk, and C-standards which break the safety topic down to individual components such as tissue making equipment.

"This is complex and difficult to do; however, this long list ensures that every area is covered, and no part of the machine or process is left out or forgotten."

Essentially, making tissue machines safe is not all about lists and standards. Ultimately, the aim is to identify any risk area and make it as safe as possible while at the same time allowing full and maximum efficiency of production to take place. This is where ANDRITZ expertise comes into its own.

GETTING DOWN TO BASICS

ANDRITZ concentrates on three areas to ensure all parameters are covered when it comes to

machine safety and maximum usability:

- An inherently safe design – "safety by design"
- Guards and fences where interaction is not necessary during operation
- Functional safety where interaction is necessary during operation

Nager says, "The basic approach to making tissue machines safe is that first of all we try to avoid a hazardous location altogether, for example, by avoiding the interaction between human and machine. This makes the machine inherently safe.

However, we all know that tissue production is a labor-intensive activity and it's not possible to avoid hazardous areas completely. This means that dangerous areas, for instance, roll nips, must have nip guards, and other areas need a fence to avoid operators getting too close. We have also carried out a lot of work on the design of machines at ANDRITZ where the operator is able to avoid a hazardous area altogether by being able to carry out a task without entering a hazardous zone, for example, by being able to pull out a lubrication point on the machine."

The third area is the important one for functional safety where interaction is necessary during operation, quite common when operators need to check the quality of the tissue being produced. Nager says, "The reel section is where operators

always like to go in and touch and feel the quality of the paper being produced. For this case, ANDRITZ has designed certain movements and interlocks within the machine where it is possible to enter the reel section at given intervals and perform tasks safely. Another example I would like to point out is our fully cantilevered shoe press concept, which allows for faster felt and shoe press belt changes while greatly increasing the safety of this process.

"It must be noted that functional safety, although an important asset, is costly at the outset and has to be maintained on a regular basis," continues Nager.

The subject of safety while carrying out cleaning and maintenance tasks is also an important factor, particularly in tissue making. "Both cleaning and maintenance are very relevant areas when it comes to safety of operation," says Nager. "Tissue production requires a high level of cleaning. We have focused our efforts on making sure that not only areas of the machine are more accessible for cleaning and maintenance, but we also have specially designed CE marked lifting equipment to avoid any accidents or injuries during maintenance such as roll changes."

FUTURE CHALLENGES

Safety and the attitude toward safety have come a long way in the last decades. However, there is still work to be done when it comes to regional approaches to safety. "Improvements in safety have increased over the last 25 years; 'common sense' used to be an integral part of the safety concept," says Nager. "Now safety relies much more on the machine to keep people safe in a way to take out the human element, and safety engineers are working more and more to prevent operators from manipulating the safety measures put in place, for instance, disabling guards to make the job easier."

One important factor ANDRITZ is working on as a global company is that in different regions there is a different approach to safety. Nevertheless, ANDRITZ always provides the very best safety solution for the respective market with additional features from which to choose.

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Tune in to our podcast

TAILOR-MADE SOLUTION DOUBLES STEAM RECOVERY

SAVING MONEY AND PROTECTING THE ENVIRONMENT

(S)TEAMWORK AT
PERLEN PAPIER AG

Perlen Papier is Switzerland's only producer of newsprint and magazine paper. The company runs a two-machine mill that features one of the largest, fastest, and most modern newsprint machines in Europe. The mill is highly focused, making only publication papers and produces 360,000 t/a of newsprint and 200,000 t/a of LWC magazine papers.

ANDRITZ has been working with Perlen since 1995, when it installed the mill's thermo-mechanical pulp (TMP) plant – a 100,000-ton per year, 100% spruce-based line that feeds both paper machines. Since then, ANDRITZ has carried out upgrades every couple of years, although the TMP plant's high-speed RTS refiner line had been soldiering on for 27 years with its original Cyclone and Swept Orifice Discharge units. Perlen's Project Manager, Michael Stokowy, explains, "We wanted to upgrade the units because they were no longer in the best shape, and it was difficult to get spare parts. Added to this, the mill management wanted to increase the steam recovery, which would reduce costs and prepare for any future increase in TMP capacity."

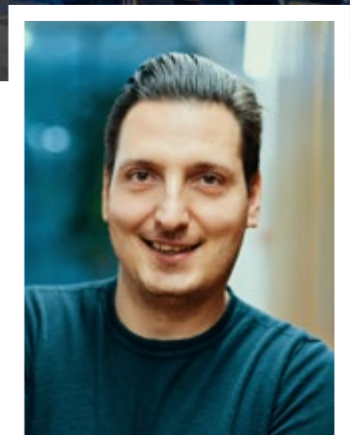
Perlen decided to replace the old units with a pair of new Cyclones and Plug Screw Dischargers (PSD). The management wanted maximum steam-separation capacity for the available space, and as Robert Pfeiffer, Head of Project Management Refining Systems Service at ANDRITZ, explains, "It had to fit in the existing building, otherwise it would have been too expensive." Unfortunately, this meant that ANDRITZ's existing PSD 600 and 800 models were too big, while the PSD 400 was smaller than desired.

So, with instructions to deliver maximum capacity in limited space, ANDRITZ agreed to design and manufacture a unique new model – just for Perlen.

"Instead of having to be cleaned every three days (taking 45 minutes each time), now it's only once every 10-11 days, at least."

Zoran Jovanovic

TMP Line Manager, Perlen Papier AG



To make the best use of the available space, the new PSD 500L is wider than the 400 and narrower than the 600, but also longer ("L") than all the standard models, increasing the compression zone by 50%. This ensures optimum fiber compression and density on the screw, while also treating the fibers as gently as possible. Meanwhile, the new ANDRITZ standard Cyclone CYS1400 that feeds into the PSD effectively separates the steam and feeds it into the heat recovery system to be used for a range of different purposes, which saves money and benefits the environment.

TAILOR-MADE SOLUTION FITS GIVEN SPACE

Installing such precisely tailor-made equipment into such a tight space would normally take at

least several weeks. But in this case, the installation had to take place in just five days of downtime that were already planned for the mill's annual maintenance. Nevertheless, ANDRITZ and Perlen worked quickly and efficiently and succeeded in meeting the very tight deadline. Perlen placed the order in January 2022 and the unique, new equipment arrived just six months later. The pre-installation work took place in August and installation and start-up in September 2022.

Keeping the installation on schedule was helped by good collaboration between ANDRITZ and Perlen. Stokowy explains, "It wasn't easy – it was a nerve-wracking week! We couldn't do everything at the same time, because there was not enough



Perlen Papier AG,
Switzerland



"We believe in 'small steps, big success'. It's not all about just getting a one-time sale, but on continuing a successful long-term partnership."

Robert Pfeiffer
Head of Project Management
Refining Systems Service, ANDRITZ



Christoph Ernet, Director Technology, ANDRITZ; Michael Stokowy, Operations Engineer, Perlen Papier; Robert Pfeiffer, Head of Project Management Refining Systems Service, ANDRITZ

→ space. It was fairly complicated, but we planned it by the hour, with 24-hour working days. The electrics were a particular challenge, because they could only be hooked up and tested from day three. But we had the site really well under control, with daily updates."

Pfeiffer notes, "We solved problems together," and in that context, Stokowy was especially pleased with the support from Heinz-Peter Wiedenhofer, ANDRITZ's Assembly Supervisor. "He is very customer-friendly and did very, very good work. He turned up early, he was always available, very prepared to work a few more hours and he always found a solution for any problem. Identifying problems was half of my role during the installation, so Wiedenhofer made things very pleasant for me, because I personally didn't have much problem-solving to do."

ROI EXCEEDS ALL EXPECTATIONS

The new units were still in the optimization phase just a couple of months after start-up, but even so, Perlen had already considerably exceeded some of its process-related targets. For example, the aim was to increase steam recovery volumes from

6 to 9t/h, but the new units are already operating consistently at 14.5t/h. This means more steam for use in the paper machine dryer section and for heating the paper machine hall, which saves Perlen money on buying steam from the local waste-powered energy plant. It also lowers the temperature of the refined fibers in the latency chest, and once optimized, that should improve fractionation efficiency in downstream screening, easing the load on the reject circuit, resulting in even more energy savings. The lower temperature should also limit fiber yellowing and reduce consumption of bleaching chemicals, as well as minimizing wear on thickening units. Zoran Jovanovic, TMP Line Manager at Perlen Papier AG, also adds that the new units are running far more cleanly: "Instead of having to be cleaned every three days (taking 45 minutes each time), now it's only once every 10-11 days, at least."

Exceeding the project goals also means a faster return on the investment (ROI) than Perlen had planned. The target was 1.7 years, but that is now expected to be less than one year. "It's saving us quite a lot of money," confirms Stokowy. "More than

that, it's saving our nerves! It's working well and we have fewer worries about maintenance."

Pfeiffer explains that this project reflects ANDRITZ's philosophy of focusing on the papermaker's day-to-day reality, along the whole production line. "We believe in 'small steps, big success'. It's not all about just getting a one-time sale, but on continuing a long-term partnership. So, we want to provide what will help mill the most, within the budget." It also demonstrates that an innovative ANDRITZ upgrade can help save both money and the environment.



ANDRITZ tailor-made PSD500L plus proven cyclone technology on top

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T-Piece with counter pressure device

SIMPLE & SMART

Lime mud drying just got easier

In further efforts towards maximizing efficiencies of white liquor plants, ANDRITZ has developed LimeDry-H™, a uniquely simplified and ultimately more efficient technology for lime mud feeding. The new system also allows the option for the latest ANDRITZ autonomous white liquor plant solutions for increased autonomous operation.

As pulp producers come under increasing pressure to maximize efficiencies across the whole mill, ANDRITZ has identified key areas where gains can be made in the white liquor plant. After the success of its recently released LimeWhite-H and LimeFlash-H technologies, the next area on which ANDRITZ has focused for improvement is lime mud drying.

Utilizing some of the proven concepts featured on the latest LimeWhite-H White Liquor Disc Filter, for example, the implementation of center shaft axial movement, a hollow shaft and fixed scraper – ANDRITZ has applied similar, tailored principles to its LimeDry-H lime mud drying system.

The end result is a much more simplified vat construction and stable feeding system, providing increased homogenous lime mud, which enables less swinging of temperatures in the flue gases of the lime kiln, and ultimately savings in energy.

The new system also comes with a smaller footprint, which saves space and investment costs, as well as an updated design that improves maintenance access and provides a safer working environment.

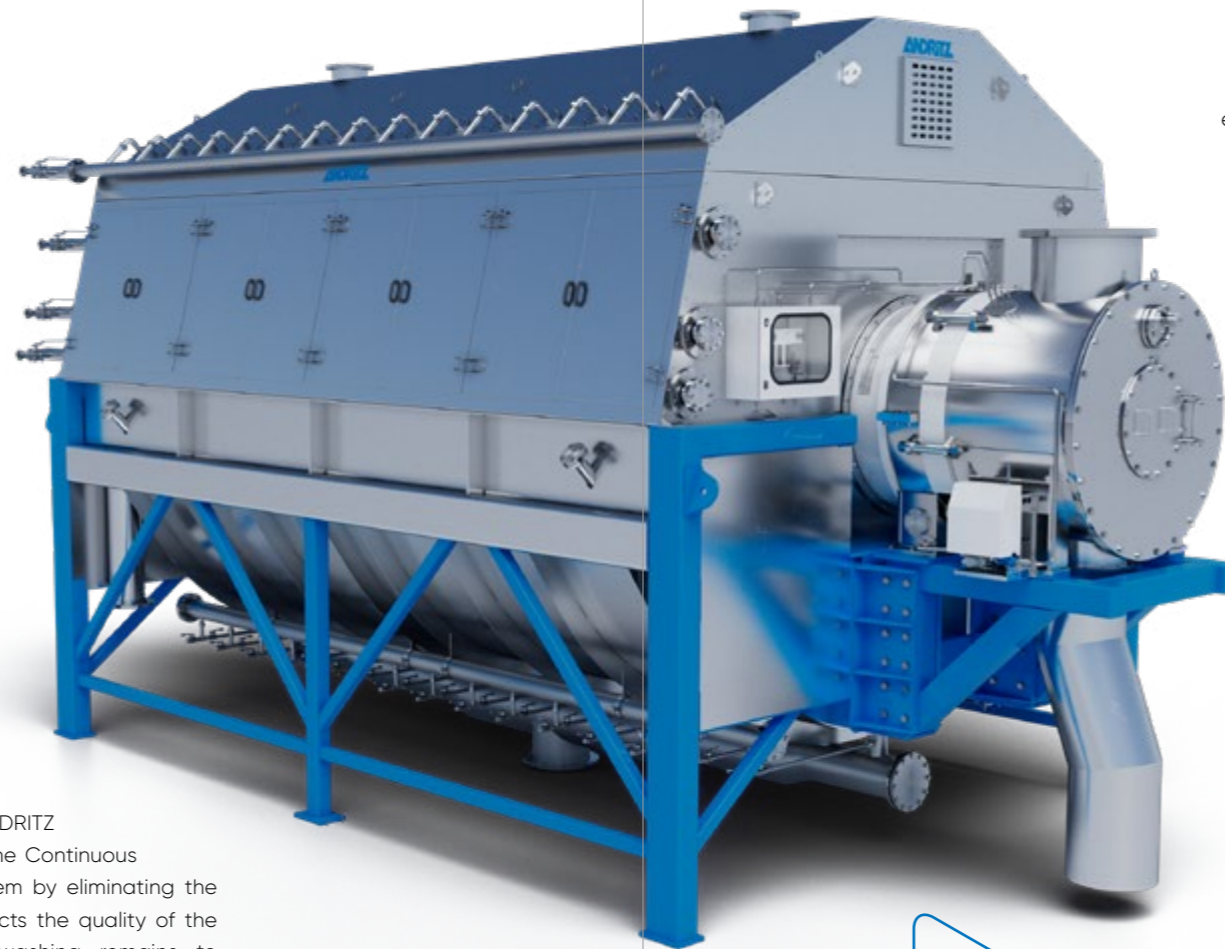
Additionally, ANDRITZ is bringing smart technologies into the lime mud feed area with the intro-

duction of various tools to help operators analyze and manage the system remotely, further improving efficiencies.

SIMPLICITY IS KEY FOR EFFICIENT LIME MUD DRYING

One of the most important developments to be applied to LimeDry-H is the introduction of an oscillating hollow central shaft that moves back and forth in an axial direction of up to 6 mm. With the fixed scraper, this movement allows the constant renewing of the surface of the lime mud.

This feature has provided ANDRITZ the opportunity to modify the Continuous Precoat Renewal (CPR) system by eliminating the low-pressure wash that affects the quality of the lime mud. High-pressure washing remains to ensure the continuous renewal of the precoat and



“Our success with LimeWhite-H has allowed us to confidently apply the same features and methodology to lime mud feeding”

Ville Seppänen
ANDRITZ Sales Manager
White Liquor Plant



efficient cloth wash. All this results in a more simplified process, which ensures more stable dryness and feed of lime mud to the lime kiln.

“Our success with LimeWhite-H has allowed us to confidently apply the same features and methodology to lime mud feeding,” says Ville Seppänen, ANDRITZ Sales Manager, White Liquor Plant. “With the back and forth axial movement of the shaft we get continuous precoat renewal, which allows for a more homogeneous feed to the lime kiln and a reduction of temperature swings.

“Ultimately, this means a more steady operation and energy savings in the lime kiln.”

ANDRITZ has also improved vat mixing with the LimeDry-H. Seppänen continues, “In the present model, the vat mixing is done with a lime mud feeding agitator. In the new system, we can have even better lime mud mixing results by introducing a stationary mammoth pump in the feed that allows for improved circulation in the vat. This means we can further improve the issue of the settling of lime mud with less moving parts and enable a more simplified vat design.”

The vat design has also been simplified, thus making the running and operating of the system much easier. And, improvements have been made to the operation with doors now on both sides of the hood for more convenient maintenance access and a safer working environment.

An additional development applied to LimeDry-H is the introduction a new feature in which separating of filtrate and gas takes place in the hollow shaft, alleviating the need for the usual large vacuum tank. “Our experience has shown that separation of filtrate and gas take place effectively in the hollow center shaft,” says Mika Mussalo, ANDRITZ Head of Product Management, White Liquor Plant. This gives us the possibility to leave out the



Watch our video





1 Lime mud feeding 2 Filtrate outlet 3 Gas outlet 4 Lime mud outlet

→ traditional large vacuum tank. This has reduced the footprint of the system by around 30%.”

“The new features applied to the LimeDry-H system mean that our customers can expect better and more stable running of the lime mud feeding and a simplified system at the same time as reducing footprint and investment costs,” concludes Seppänen.

GETTING SMART

In one of the latest developments, ANDRITZ is now offering SMART technology as an option to be applied to LimeDry-H by utilizing machine vision and other new instrumentation. This is part of ANDRITZ’s main goal and vision to enable increased automation levels in the white liquor plant, as well as across all mill processes. These additions will improve operator transparency, at the same time as enabling a more autonomous operation of the plant, for instance, allowing automatic start-up sequences. SMART tools are con-

nected to the Distributed Control System (DCS) controls as well as to higher level controls including KilnACE & RecaustACE.

Vision via cameras can now be installed at various points across the process, allowing the viewing of possible build-ups as well as monitoring the status of lime mud chutes and doctor blades. This means operators will be able to monitor the system from the control room as opposed to manual checking. Visual technology can also be used to monitor the condition of disc and filter fabrics. In addition, an automated cleaning system for lime mud scraping and chutes has been developed. These new developments reduce the need for operator checks and manual action, therefore taking another step towards a fully autonomous mill operation.

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“Our experience has shown that separation of filtrate and gas take place effectively in the hollow center shaft.”

Mika Mussalo
ANDRITZ Head of Product Management
White Liquor Plant



ELECTRIC STORM

As tissue mills seek to optimize their energy consumption for optimum sustainability, ANDRITZ’s introduction of a hood air system based on electrical heating is very timely.

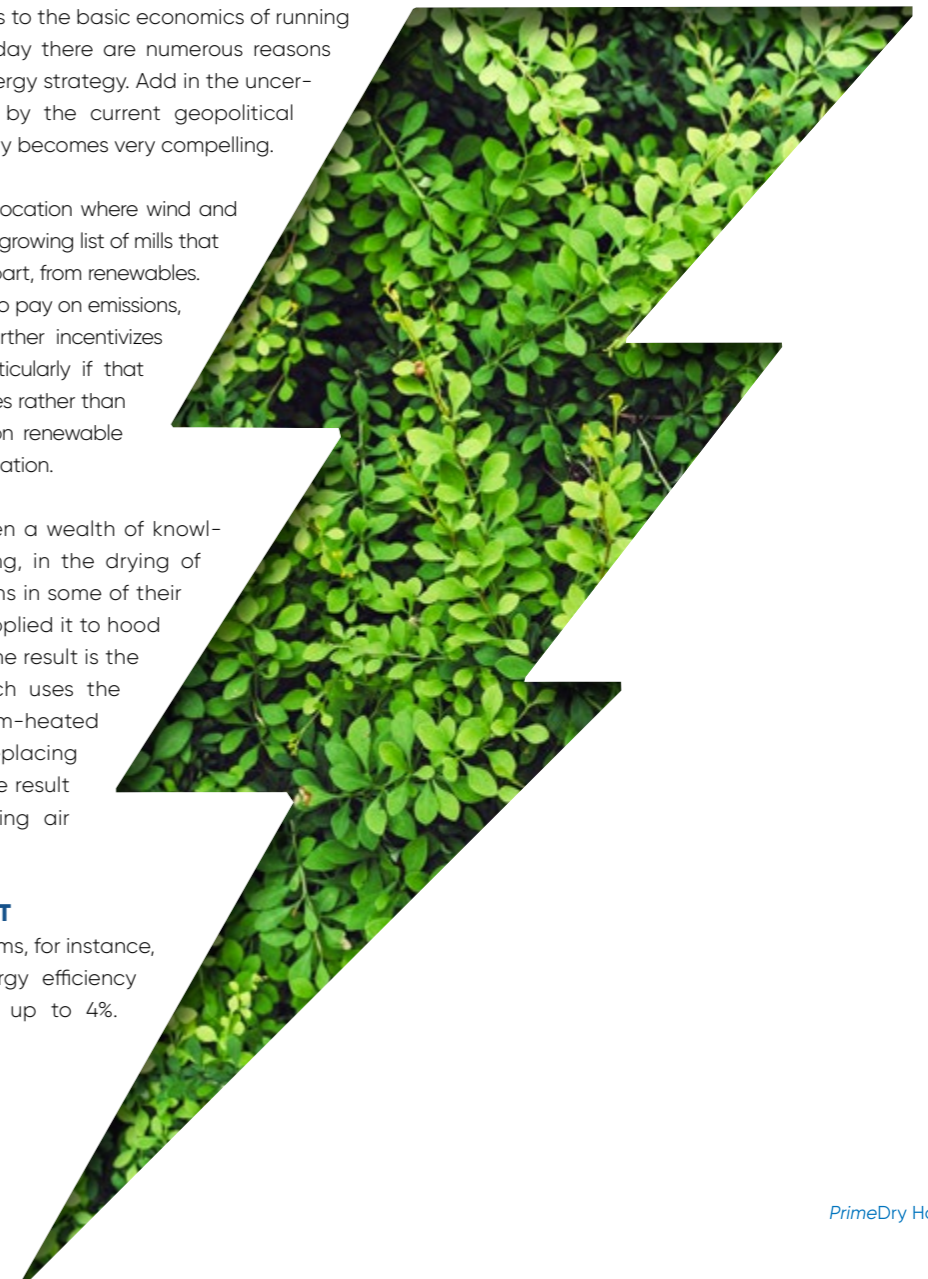
From environmental considerations to the basic economics of running any energy-intensive process, today there are numerous reasons for tissue mills to examine their energy strategy. Add in the uncertainty over gas supply created by the current geopolitical situation and the case for electricity becomes very compelling.

This is particularly the case in any location where wind and sun are in plentiful supply. There is a growing list of mills that source electrical energy, at least in part, from renewables. In Europe and the USA, there is tax to pay on emissions, including carbon dioxide, which further incentivizes solutions based on electricity, particularly if that electricity is sourced from renewables rather than fossil fuels. Government subsidies on renewable energy are another factor in the equation.

In this context, ANDRITZ has taken a wealth of knowledge regarding electrical heating, in the drying of spunbond materials for nonwovens in some of their installations, for example, and applied it to hood air systems for tissue machines. The result is the ANDRITZ PrimeDry Hood E, which uses the same air system as gas- or steam-heated hoods, but with electric heaters replacing gas burners or steam heaters. The result is a system capable of achieving air temperatures of 400 - 450°C.

ENERGY EFFICIENCY BOOST

Compared with gas-heated systems, for instance, PrimeDry Hood E increases energy efficiency for the hood drying system by up to 4%.

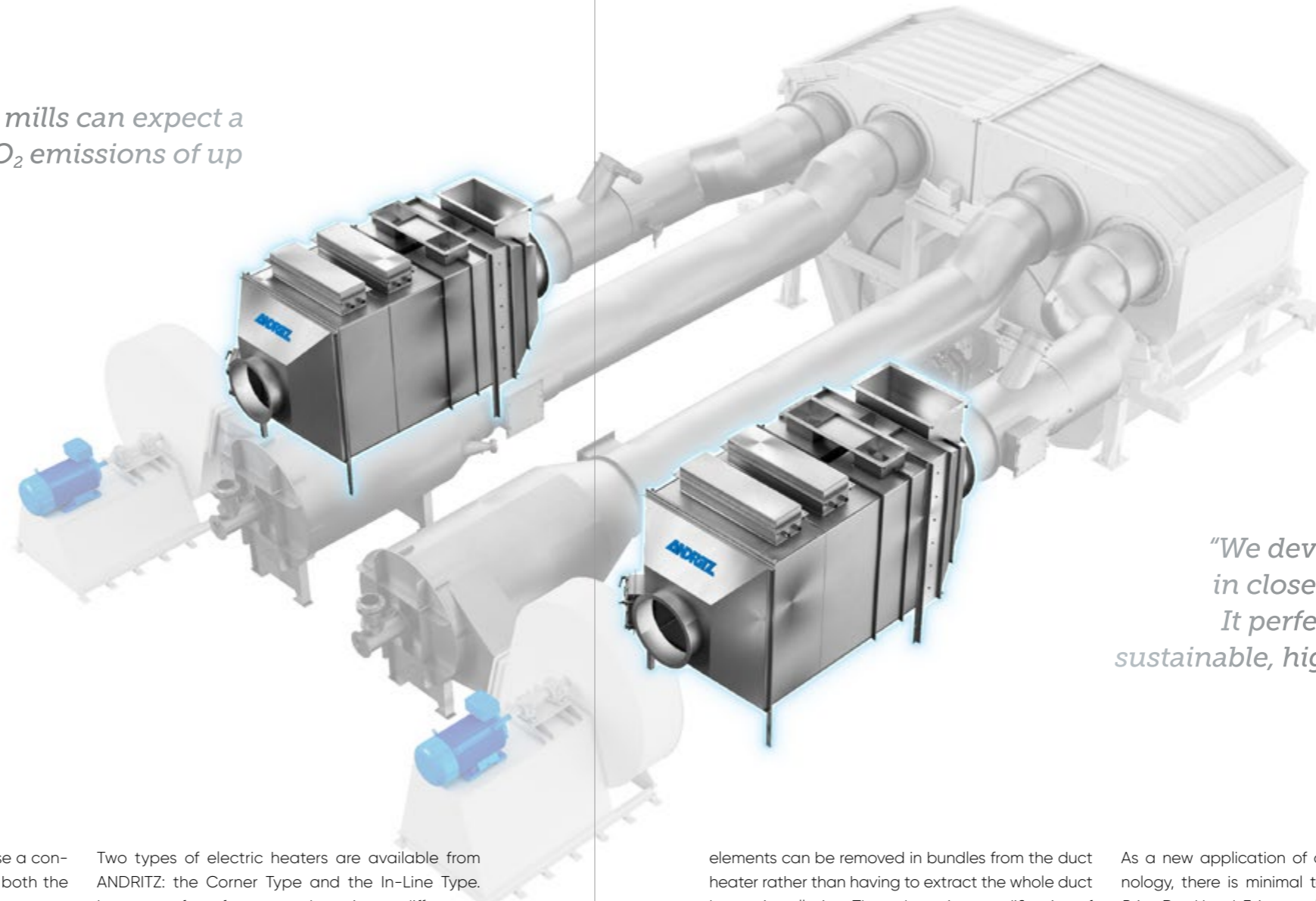




“Overall, tissue mills can expect a reduction in CO₂ emissions of up to 70%.”

Marco Cattani
Product Manager
ANDRITZ Novimpianti


Tune in to our podcast

“We developed the new heating hood in close cooperation with customers. It perfectly matches today’s need for sustainable, high-quality tissue production.”

George Nowakowski
Vice President Tissue Drying
ANDRITZ Canada

→ Electrical heating is more efficient because a conventional gas burner requires heating of both the combustion air and drying air for the burner to function, while electrical heating does not require combustion air. And in theory at least, 100% of electrical energy is converted into thermal energy. Compared to steam-heated systems, the PrimeDry Hood E can increase production through its capability to achieve elevated temperatures.

Electrical heating offers the further advantage that no combustion residuals are emitted to the air. Overall, tissue machines can expect a reduction in carbon dioxide emissions of approximately 70% compared to a conventional gas-heated system. In many parts of the world, Europe and the USA included, mills pay tax on emissions to the atmosphere, so there is a clear economic argument for electric heating as well.

The potential for lower availability compared with gas-heated air systems is mitigated by the use of filters with automatic cleaning in case of low temperatures, as is already implemented with steam-heated hoods.

Two types of electric heaters are available from ANDRITZ: the Corner Type and the In-Line Type. In terms of performance there is no difference, but each format is suited for a particular mill layout and recommended on a case-by-case basis. Electrical heating comprises the main body of the electrical resistor, a terminal box and control panel, the placement of which is flexible.

While the application of electric heating for hood air in tissue production is new, electrical heating in industrial contexts where drying is involved is not. So, it has the benefits of being proven technology – for instance, in some ANDRITZ nonwoven installations. It also means that there are existing design solutions to manage specific situations, such as the potential for seismic activity.

The electrical heater has been specifically designed with minimally disruptive maintenance in mind. The standard solution enables easy removal of both top/bottom and laterally affixed resistors by unbolting them from the plates. ANDRITZ proposes an even more convenient solution, in which the heating

elements can be removed in bundles from the duct heater rather than having to extract the whole duct heater installation. Through a minor modification of the duct heater design, this refinement facilitates maintenance of a single heating bundle while the tissue machine continues to operate at a lower capacity, rather than being shut down completely.

A POSITIVE ADDITION IN A CHANGING WORLD

Electrical heating is a positive addition to ANDRITZ’s portfolio in a changing world. It is not going to suit every situation, but its flexibility makes it widely applicable. Renewable energy sources might not be available 24/7, but a hybrid system that can switch between gas and electric heating for hood air enables a mill to switch to the fuel source, which is most suitable for prevailing climatic conditions, time of day, or even changing tariffs for gas and electricity over a 24-hour period. It is a question of optimizing both energy cost and security. And if drying capacity is a limiting factor in any tissue-making scenario, the addition of electrical heating can increase capacity.

As a new application of a tried and tested technology, there is minimal technical risk to the user. PrimeDry Hood E is equally suitable for dry-crepe tissue production as well as for textured or structured (TAD) tissue machines. With zero carbon dioxide emissions from combustion, there is also a benefit in terms of the final product’s ecological credentials. This will appeal to the consumer and therefore the retailer. A genuine marketing opportunity born out of technology – and based on hot air!

ANDRITZ’s air and energy system solutions have a pedigree that includes the installation of hundreds of air and energy systems delivered worldwide. With centers of excellence in Lucca, Italy, and Montreal, Canada, ANDRITZ is driving innovation especially with regards to CO₂ footprint reduction. The combined expertise with additional know-how stemming from other ANDRITZ business areas has created a superb range of engineered solutions, specifically for tissue and paperboard production.

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TEN YEARS ON: ELDORADO CONTINUES TO RUN ... FASTER AND FASTER ...

The start-up of the Eldorado mill in Três Lagoas, Brazil, in 2012 was big news in SPECTRUM magazine and across the global industry, and it hasn't stopped there. The mill has often been in the news since then, it has broken all sorts of records and has produced many more tons of pulp than it was originally designed for. In fact, on its 10th anniversary of start-up last year, the mill was recorded as having produced a total of 11 years of production – a full year of additional pulp!

The Eldorado project was undoubtedly one of the most exciting of its kind just over a decade ago, but it also presented a major challenge. Carlos Monteiro, Eldorado's Technical Industrial Director says, "The main challenge was that we had to build the company from scratch. The owners had a large forest, and decided they wanted to be involved in pulp, but had no experience.

"The beginning was really difficult; however, the owners' dream soon became a reality as we were able to attract some of the best professionals available in the area to complete the set-up of the company. These professionals came and joined us, and the vast majority are still with us today. And this is the great differential for Eldorado – it's the people."

ANDRITZ HELPED US CREATE A MILL THAT RUNS WELL ABOVE EXPECTATIONS

ANDRITZ was chosen to supply the major part of the process islands for Eldorado Celulose e Papel S.A on an EPC-C basis, with contracts being signed in November 2010. The scope of supply included the delivery of the bleaching systems; and white liquor plant with recausticizing and lime kiln. The delivery also included the latest generation of pulp drying plants, including two parallel twin wire former pulp machines, two airborne dryers, two cutter-layboys with a 6,670 mm working width; and four baling finishing lines.

"Many professionals who joined the Eldorado mill project had previously worked with ANDRITZ from other pulp producers in the industry, so they already knew the quality of technology and expertise that the company provided in the pulp area," continues Monteiro.

The mill was successfully started at the end of 2012 and has since broken a number of production records, including an outstanding record of 5,576 admt/d in September 2019 when it also ran for 200 days without a sheet break on its MS2 line.



Complete fiberline with cooking, washing, and bleaching systems



Two parallel pulp drying lines

However, the mill has continued running faster and faster with more and more pulp being produced. Marcelo Martins, General Industrial Manager at Eldorado says, "Choosing ANDRITZ was definitely the right move for us at Eldorado. From the woodyard and chip preparation to the fiberline and drying, as well as the implementation of Metris OPP digital solutions for optimizing production at the mill, the numbers speak for themselves; we originally had what we saw as a challenging target of producing 1.5 million t/y and we have now exceeded that with our latest production figures of 1.8 million t/y for 2022.

"ANDRITZ helped us create a mill that goes beyond our expectations. We also plan to go beyond those records in the future; in fact, we are already challenging ourselves to reach even higher goals."

MORE PRODUCTION, BUT ALSO MORE EFFICIENCY

Martins says that it's not just the increase in production over the last decade at the Eldorado mill that has been impressive, overall efficiency has also improved dramatically with the implementation of Metris OPP. "Our chemical consumption at this mill is now a reference for the industry," says Martins. "In Brazil, Eldorado has the lowest consumption of all mills and is close to the lowest numbers worldwide. This is really down to our excellent production staff and our technologies, including the low consumption of chemicals in the ANDRITZ bleaching plant. But also a great deal of this efficiency is down to the Metris OPP system, AI and other digital solutions.

"We also have the latest Metris technology in our drying area where our low sheet break records are the envy of our competitors. We recently went 404 days without one sheet break, which we again put down to excellent production skills, as well as the Metris AI system that positions the sheet for maximum efficiency in the feeding of the dryer."

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"Many professionals who joined the Eldorado mill project had experience of ANDRITZ from other pulp producers in the industry, so they already knew the quality of technology and expertise that the company provided in the pulp area."

Carlos Monteiro
Technical Industrial Director
Eldorado



REMOVE RECYCLE RECYCLE REPEAT

ANDRITZ has become the market leader in systems for the removal of chlorides and potassium from the kraft recovery cycle, components which often reduce recovery boiler efficiency in terms of fouling or corrosion. Pulp giant Suzano recently started up an Ash ReCrystallization (ARC) chloride removal plant at its Aracruz unit in Brazil.

The main function of the ANDRITZ ARC chloride removal plant in pulp mill operations is to treat the ash that is collected from the ElectroStatic Precipitators (ESP). The plant removes harmful chloride and potassium from the ESP ash and returns valuable chemicals to the chemical recovery cycle. In the case of Suzano Aracruz, the plant supplied has been designed to handle 550 tons of ash daily.

Rafael Silva Pinto, Project Manager, Suzano Aracruz Unit, says, "At Suzano Aracruz we have three recovery boilers, and the role of the ARC is to remove the components that are harmful to the process, namely chloride and potassium. These two components are responsible for clogging the lines and cause corrosion of equipment, leading to low efficiency."

The accumulations of the elements such as chloride and potassium often lead to significant increases in the frequency of the recovery boiler shut-downs boiler due to plugging of the heat exchanger passages. Furthermore, the corrosion of the heat exchange surfaces causes expensive material damage.

"The ARC removes these components taking care not to lose the sulfate and sodium that are important to return to the system," continues Silva. "It processes

the ash that has been diverted to the plant by removing the harmful components and returning the uncontaminated part of the ash. Previously, the falling ash was returned to the process still containing the chloride and potassium. This means the incrustation of the boilers is now reduced which allows us to extend our campaigns."

Antti Frigård, Development Manager, Evaporation Technology at ANDRITZ adds, "This reduction of incrustation in the boiler will continue to improve in the long run as the ARC operates for longer periods. What generally occurs is that the chloride and potassium are reduced in the recovery cycle and boiler operation is even further improved."

ANDRITZ was chosen to supply the ARC, the second of its kind to Suzano, as it represented the best cost option for Suzano. The ARC+ plant was ordered in late 2021, and is complete with the latest improved and more efficient system when compared with the traditional ARC. The plant replaces ash leaching technology that the mill was using for its ash recovery requirements.

"When we compare the ARC technology with the ash leaching process, there are differing factors as the throughput capacity and efficiency rates are totally different," says Silva. "Ash leaching has a removal efficiency rate of around 45% compared to the ARC at around 95%."

The ARC plant was also chosen by Suzano for its energy efficiency, an important factor for the company. Silva says, "First and foremost, energy is money, and we are in a period of expensive energy. The less energy we are consuming, the more we can be selling to the grid. So it is very important to us that we have the most energy efficient technology operating in the mill and the less steam energy the ARC consumes the better."





"This reduction of incrustation in the boiler will continue to improve in the long run as the ARC operates for longer periods."

Antti Frigård
Development Manager
Evaporation Technology at ANDRITZ



"We were very impressed at the speed the plant went into operation."

Rafael Silva Pinto
Project Manager, Suzano Aracruz Unit

→ **A CHALLENGING PROJECT – WITH A FAST START-UP**

The project to install the ARC plant was a challenging one; it had to be installed in a tight space between a maintenance shop, sulfate system, and the boilers, which meant limitations when it came to crane movements. There were also the usual challenges thrown up by the pandemic to contend with. Silva explains, "The main challenge was to install the ARC in a tight space with equipment still in operation and work in a corrosive area with a lot of vibration and heat. There was also a lot of scaffolding needed that complicated the task further. All in all, this project was a major challenge for ANDRITZ and the mill team.

ANDRITZ had sent a designer to the site early on in the project, and many details of the challenges were already identified at the assembly stage. During the project ANDRITZ spared no resources, and there were no holidays between Christmas and New Year to affect the productivity of the project. I have never seen so much commitment for a delivery. All this during the COVID pandemic!"

The plant started up in April last year and went into operation immediately. The ANDRITZ commissioning team introduced the ARC plant process in stages with stability being quickly achieved. "We were very impressed at the speed the plant went into operation," says Silva. "We saw the centrifuge running on the first day and we saw chloride coming out right away. As far as we know, this is the first crystallizer with this design installed in the world. We are very pleased and optimistic that we will achieve the expected performance results very quickly."

Silva concludes, "Suzano has a strong belief in ANDRITZ's ability to handle a project like this, and for decades the company has always provided services on time and with top quality."

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The ANDRITZ ARC Ash ReCrystallization plant removes the harmful chloride and potassium from the ElectroStatic Precipitator (ESP) ash and returns valuable chemicals to the chemical recovery cycle. In the case of Suzano Aracruz, the plant supplied has been designed to handle 550 tons of ash daily.

Technological audit unlocks nice surprises

At their mill in Spokane, Washington, USA, the team at Inland Empire had been struggling with unpredictable pulp quality, and that was holding back their paper production. Having tried everything else they could think of, they asked ANDRITZ to carry out a Technological Audit on the mechanical pulping line. The results surprised them – in the best possible way.

Inland Empire operates a single-machine mill, with a capacity of around 175,000 tpa of mainly standard and improved/hi-brite newsprint. They use both virgin and recycled fiber, but had for some time been suffering with inconsistent quality from their thermo-mechanical pulp (TMP) line. As Production Manager, Donnie Ely, points out, "Some days the quality was good, some days it was bad, and we didn't know why." Tanner Gerety, Pulp Mill Supervisor, agrees, "We'd been trying everything and asking a lot of different people, but something wasn't adding up. So we decided to call ANDRITZ."

The Technological Audit assessed the TMP line step by step, taking samples of the pulp at different stages. The main focus was on the



Main focus of the Technological Audit was the high-consistency (HC) refiner, with very positive results. Since the audit, the mill has had a lot more homogenous and better pulp quality.

high-consistency (HC) refiner, which was also suffering from large motor load fluctuations, varying by 100% from minimum to maximum. The audit recommended several process changes, and this is where the nice surprises began for Inland Empire.



Read the complete story online!



Tanner Gerety, Pulp Mill Supervisor, Inland Empire, in front of the HC refiner

Minimum downtime and maximum efficiency

PrimeService for air and energy systems for paper machines



Read the complete story online!

Just like the motor industry, service packages for tissue, paper, and board machines have come a long way in recent times and now most breakdowns are completely avoidable with the right and timely maintenance. ANDRITZ offers scheduled packages for maintaining complete machines and processes to ensure maximum efficiency with minimum downtime.

It seems obvious that maintaining equipment is the best way to maximize efficiency of tissue, paper, and board machines; however, what is not clearly known is just how much difference good service plans make. Analysis confirms that regular scheduled maintenance reduces downtimes by as much as 75% when applied to paper and tissue machines and processes.

"It's all about the critical components," explains Riccardo Pierini, Customer Care Manager, ANDRITZ Novimpianti. "With

our decades of extensive experience and knowledge we know exactly how, when, and what parts in our technology and systems need to be regularly maintained, as well as optimized for maximum efficiency."



ANDRITZ offers scheduled packages for maintaining complete machines and processes to ensure maximum efficiency with minimum downtime.

Primed to deliver

The energy and investment-intensive nature of paper and board production demands technology and solutions that are constantly extending the boundaries of production and resource efficiency. In a highly competitive market with many global challenges, only the most competitive and innovative solutions will prevail – ANDRITZ is the optimal partner for this.

"Our complete technology portfolio for pulp and paper mills puts us in an exclusive club in the paper and board sector, with the expertise, experience, and minimal interfaces this brings. From complete virgin fiber or RCF pulp lines to PrimeLine paper and

board machines for all grades, including fabrics, rolls, pumps, and automation, this range of expertise also gives us special insights into global investment projects when making proposals.

"We are talking about everything from small rebuilds and major rebuilds, which can include a grade conversion and replacement of whole machine sections, to brand-new complete lines. At ANDRITZ we have the capability and references for all three levels of investment", concludes Gerald Steiner.



Read the complete story online!



"We bring proven technology to the table, with advanced digital capability and the experience and know-how to deliver our promises in sustainable, successful rebuild and new-line projects."

Gerald Steiner
Vice President Paper and Board, ANDRITZ



Laura Liukkonen
Global Director, Fiber R&D Centers
ANDRITZ



Thomas Pabst
Tissue Machine Operator, PrimeLine TIAC
ANDRITZ

ANDRITZ has a number of dedicated research and development centers around the globe that can test and evaluate almost anything that might go through the pulp or tissue production processes. These centers also offer ANDRITZ experts the opportunity to proactively keep ahead of the game in trialing different machine setups as well as experimenting with various raw materials from around the world in order to create the best possible fiber-based products.

The design and equipment of the ANDRITZ Fiber & Tissue R&D Centers are tailored to cater not only to customers but also to research institutes, universities, and industry suppliers. These state-of-the-art facilities provide a unique opportunity for all stakeholders to conduct trials under authentic industrial conditions. Customers can mitigate risks associated with venturing into new markets, exploring novel raw materials, or testing innovative production technologies for their existing operations. Simultaneously, research institutes, universities, and industry suppliers gain valuable insights and collaboration opportunities in a realistic industrial setting.

The setup of the Fiber & Tissue R&D Centers is optimized to provide an ideal environment for

customers to bring their samples and attend their trials in person. Alternatively, customers can also send their samples to ANDRITZ for analysis. In recent times, our Fiber & Tissue R&D Centers have been primarily dedicated to sustainability initiatives, with a strong emphasis on reducing water, chemicals, fiber, and energy consumption. Additionally, at ANDRITZ we are actively exploring alternative raw materials together with our customers to further enhance the sustainability efforts. Another key focus of our centers is the development of cutting-edge technologies for the digitalization of production processes. By prioritizing these areas, we strive to stay at the forefront of innovation and contribute to a greener and more efficient industry.

The Fiber R&D Center in Graz, Austria, was built in 1982 for customer trials and internal R&D and comes with full-line capabilities. The center provides for process R&D as well as direct work for customer trials. Limits of raw material usage, from virgin and recycled to annual fibers, can be explored as well. The center is flexible enough to accommodate single machine testing and complete process lines.

Built and opened just five years ago, the PrimeLine TIAC Tissue Innovation and Application Center in

GETTING KNOW YOUR EXPERTS

Graz can be configured to produce dry-crepe, textured, and structured tissue with various sub-categories. The plant comes complete with two TAD drums and a steel Yankee installed in one machine, enabling several energy and quality features to be tested and trialed.





Special project: bamboo refining for two elderly panda bears at the world's oldest zoo, Schönbrunn Zoo in Vienna



Laura analyzing samples in the internationally certified laboratory

→ **GET TO KNOW LAURA LIUKKONEN, ANDRITZ GLOBAL DIRECTOR, FIBER R&D CENTERS**

Since studying paper technology at Aalto University in Finland, Laura has spent over 10 years in the pulp and paper industry. She now heads up ANDRITZ's three Fiber R&D Centers located in Graz, Austria, Springfield, Ohio, USA, and Foshan, China.

Although responsible for all Fiber R&D Centers, Liukkonen spends most of her working life in Graz, dealing with customers from across the globe and making sure the whole operation runs as smoothly as possible.

"I am an early bird," says Laura. "I like to get to the Fiber R&D Center by 6:30 in the morning so I can answer all my emails and make a list of all the most important tasks for the day."

"We have customers all over the world, from Asia over to Latin America, so my inbox is pretty full in the morning with enquiries, for example, from Japan, and from the night before in Brazil. I try to answer our customers' enquiries as soon as possible as our customers get very excited about receiving their results."

The center accommodates customers from around the world, and a majority of them prefer to personally visit the facility to witness their trials firsthand. "Around 90% of our customers like to come here in person so they can witness their raw materials being trialed and tested for themselves," says Laura. "Although it can be stressful, it is the most effective method as it allows for immediate collaboration and resolution if any issues arise, which they often do."

"Pandemic-related visitor restrictions posed a challenge. However, we overcame this obstacle by leveraging IIoT in conjunction with our Metris extended reality solution (Metris XR), enabling customers to watch the trials live from abroad. This way of operating was challenging, but we made it work and successfully obtained the desired results."

One of the most interesting tasks Laura has taken part in is supplying refined bamboo for two elderly panda bears at Vienna's Schönbrunn Zoo who were experiencing difficulties chewing raw bamboo. "With our dispersing technology, we refine the bamboo for them, which highlights our ability to process various raw materials and to respond very flexibly to customer requirements and challenges, even with 'customers' like Panda bears."

Laura manages a team of seven highly skilled experts who work in the laboratories and oper-

AVAILABLE EQUIPMENT IN THE FIBER R&D CENTER

PULPING

- FibreSolve FSR, FSV and FSH pulper for low- and high-consistency pulping
- FibreFlow Drum FFD

SCREENING

- Different types of ModuScreens for coarse, fine, and headbox screening as well as fractionation including PrimeRotor

DEINKING/FLOTATION

- SelectaFlot SFL flotation

CLEANING WITH HYDRO-CYCLONES

- Various cleaner types including PrimeClean TO

DEWATERING

- Pulp Screw Press SCP
- Vertical Screw Thickener VST
- DiscFilter DF with various filter segment designs (including bagless Conical cell CC technology)

ATMOSPHERIC AND PRESSURIZED DISPERSING

- Ultra-high dispersing with CompaDis CDI dispersing systems with heating screw or compact heating

DEFLAKING

- DeFlaker DFL

REFINING

- TwinFlo Prime disc refiner
- Papillon refiner with cylindrical refining zone

REMOVAL OF ASH OR FINES AND FIBER RECOVERY

- RotoWash
- Mobile RotoWash

HIGH-CONSISTENCY BLEACHING

- Peroxide bleaching in industrial scale
- Laboratory bleaching

EFFLUENT / REJECT TREATMENT

- RejectCompactor ReCoL, ReCoC und ReCoF
- Mobile sludge dewatering unit

AGITATION

- Several chests with TurboMix TMX agitator

AS WELL AS:

- Pumps
- Metris Automation solutions and equipments
- Twin-wire sheet drying line for pulp drying trials available at the same facility

ate the trial machines. The trials conducted in the facility span across different durations. Along with customer quotations, taking care of customers on site, and monitoring ongoing trials, she also looks after international standards, making sure that the measurement results are compliant and accurate.

"This is a really interesting job where no day is ever the same!" concludes Laura. "Although I am a very

technically oriented person, structured and precise, I love getting back to nature when I am not working and going for long hikes in the countryside."

On the day we spoke to Laura, she was overseeing a trial to optimize pulp refining for tissue production in order to increase tensile strength and stretch without generating too many fines or losing bulk.



PrimeLine TIAC TISSUE MACHINE CONFIGURATION

For dry-crepe, textured, and structured tissue

Paper grades from 10 to 50 g/m²

Yankee speed up to 2,500 m/min

Reel speed up to 2,000 m/min

Sheet width 600 mm

- *PrimeFlow*: headbox in 1-, 2-, 3-layer configuration
- *PrimeForm*: CrescentFormer, TwinWire former
- *PrimeDrum*: two TAD drums, 14 ft diameter
- *PrimePress*: suction press, shoe press
- *PrimeDry Steel*: Yankee, 16 ft. diameter
- *PrimeDry Hood HT*: gas-heated Yankee hood
- *PrimeRun*: sheet run with passive/active air foils
- *PrimeReel*: centerwind assisted reel



Watch
our
video

→ GET TO KNOW THOMAS PABST, TISSUE MACHINE OPERATOR, PrimeLine TIAC TISSUE INNOVATION AND APPLICATION CENTER

Thomas studied pulp and paper technology at the University of Graz and is a fully qualified paper technician with over 13 years of practical experience.

The machine hall at the PrimeLine TIAC houses the world's most modern tissue pilot plant with a machine that offers virtually limitless flexibility. All kinds of tissue can be produced on the machine including dry-crepe, textured, and structured products as well as continuously developed prototypes.

"We conduct trials for customers, R&D institutions, and, of course, for ourselves to turn visions into industry solutions," says Thomas. "Our day begins by turning on the steam boiler and feeding the pulper."

The PrimeLine TIAC allows customers the opportunity to conduct trials with completely new technologies that have not yet been launched on the market, as well as trials to improve end product quality. Testing possibilities include trials for pulp, chemicals, refining, and clothing, different press concepts, hot air, steam, vacuum concepts, and much more. The experts at PrimeLine TIAC collaborate closely with customers to define the objec-

tives, develop a trial schedule, and ensure that the entire production line is set up optimally, starting from pulp and progressing through various technologies to the final product. Their collective efforts are aimed at maximizing the outcomes and successfully attaining the desired targets.

"An important area for us at the moment is sustainability, as the industry is experiencing challenges with energy consumption in particular," says Thomas. "We are actively exploring methods to minimize water usage, reduce chemical usage, and minimize emissions in tissue production. Our focus is on developing sustainable practices that allow tissue to be produced with the least possible environmental impact."

"I work in a team that I call my 'tissue family'. The machine I operate is a full lane, industrial scale pilot plant, accounting for all the parameters and challenges that an innovative tissue producer could possibly think of."

The pilot machine has more than 3,000 sensors that record real-time information and data for detailed production analysis and future tissue projects. The Tissue R&D center also comes complete with Metris All-in-One Platform that controls and monitors the stock preparation system and tissue machine in operation. This allows the operators to work with the highest efficiency and get the best result out of each trial.



Tissue pilot plant: trials and training for tissue producers, pulp producers, suppliers to the tissue industry, converters, and R&D institutes



PrimeLine TIAC: Tissue Innovation and Application Center, Graz, Austria

After a hard day working on the pilot machine, Thomas can be found at the local model airfield in Graz, where he flies his model aircraft. "There is a saying that 'only the sky is the limit'," says Thomas. "This is my theme – it perfectly characterizes my hobby as well as the work done on the pilot machine.

"There are limitless possibilities for new ideas for tissue production when we have pilot plants like the one at PrimeLine TIAC and the Fiber R&D Centers," concludes Thomas.

CONTACT

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A major step to REDUCE footprint in pulp mills

Biomass Gasification for Lime Kilns – Going fossil fuel free is an urgent sustainability topic that has become even more critical due to the current global energy crisis. It is clear we must reduce our dependence on fossil fuel.

The largest heat demand in a kraft pulp mill comes from the lime kiln and gasification is a prime solution to reduce the usage of fossil fuels.

Jean Taillon, Director Business Development of Gasification at ANDRITZ, says, "With the high price of oil and natural gas, as well as carbon pricing and low biomass costs, there is a real push for the replacement of fossil fuel used in lime kilns.

"Pulp mills are in an ideal situation to introduce gasification due to their ability to source woody biomass efficiently."

The biomass Taillon refers to is mostly a low-cost biomass side stream from the woodyard at a pulp mill, for example, bark and chip screening rejects of various species that are ideal for the gasification process.

THE GASIFICATION PROCESS

A typical gasification plant package supplied by ANDRITZ is mainly composed of a belt dryer, biomass handling equipment, gasification plant with some auxiliary systems, and lime kiln burner (for existing lime kilns).

"This is really a benefit that all of these areas are in-house technologies at ANDRITZ and that the gasification, lime kiln, and causticizing processes are supplied by the white liquor plant product group with common technology and project execution resources," says Taillon.

Typically, wet biomass is fed to the dryer. The initial moisture may be as high as 60%-w and dried to as low as 5%-w. The dried biomass is then conveyed through a flight chain conveyor to minimize the distance between the dryer and the gasification plant.



"Pulp mills are in an ideal situation to introduce gasification due to their ability to source woody biomass efficiently."

Jean Taillon
Director, Business Development
of Gasification at ANDRITZ

The gasifier itself is an air-blown, circulating, fluidized bed (CFB) gasifier operating at atmospheric pressure. "The purpose of gasification is to convert the carbon from the biomass into a combustible gas, called product gas," says Taillon. "In simple terms, to do this, a small quantity of air is used, just enough air to create some heat but not enough to fully oxidize the carbon so as to be able to deliver a combustible gas composed mainly of H₂, CO, and CH₄."

A gasification plant is equipped with various sub-systems, such as heat supply to dry the wet biomass, biomass handling to feed the material, bed material feeding to help the fluidization of the biomass inside the reactor, start-up burner – also an in-house technology – to warm up the reactor when cold, gasification air to provide the necessary air to favor the thermo-chemical gasification reactions. Hot air from the lime kiln sector cooler can be used.

Plant safety also plays an important role in the design of the overall plant to fulfill EU Machine Directives and various HAZOP reviews.

GASIFICATION AT PULP MILLS: A TREND FOR THE FUTURE

ANDRITZ's references currently in operation are at Metsä Fibre, Joutseno (48 MW) in Finland, Chenming Group Zhanjiang (65 MW) and Meilun (80 MW) mills in China and Klabin, and Ortigueira (51 MW) in Brazil. Deliveries under project execution are Suzano Cerrado (2 x 67 MW) in Brazil and Liansheng (115 MW, largest CFB capacity in the world) in China.

"Biomass gasification for lime kilns was used in the 80's and 90's followed by a long pause in the market," says Taillon. "However, as the usage of fossil fuels came under the spotlight, we have seen renewed interest for lime kiln biomass gasification. This message can be heard from many other actors and consultants to pulp mills' owners. So we believe this technology will be used more and more in kraft pulp mills around the world," concludes Taillon.

GETTING TECHNICAL

Gasification is the combination of various thermo-chemical reactions of biomass with air under sub-stoichiometric conditions. The energy in the product gas is approximately 5-7 MJ/Nm³ where approximately 80% comes from the chemical content of the product gas in the form of H₂, CO, CH₄. The rest of the energy comes from the high temperature of the product gas and the unburnt carbon contained in the product gas. Finally, the product gas is fed and burned in the multi-fuel lime kiln burner.

CONTACT

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A GREENFIELD MILL: A CLEAN SHEET FOR ENERGY MINIMIZATION

Significantly less energy and top quality: the brief for two new *PrimeLine* tissue machines in Romania perfectly matched ANDRITZ's strengths.

MG TEC INDUSTRY S.R.L is a relatively new company in Romania's rapidly growing hygienic tissue market. However, it was launched by entrepreneurs who have nearly 20 years of experience in the industry, for example, installing new tissue machines before MG TEC was established.

So when it came to ordering two new lines for the company's greenfield mill in Dej in northwest Romania, CEO Dorin Mocan, and the team knew what they were looking for as they considered the appropriate technology for this long-term investment.

With sustainability, innovation, and competitiveness at the top of the agenda, the key challenge MG TEC set for the machine builders was to achieve no less than a 15% reduction in energy consumption per tonne of tissue produced compared with the previous installations they had experienced. The closed-loop strategy that MG TEC has adopted, including the incineration of biological and deinking sludge to generate process steam, just goes to show their dedication to sustainability and the circular economy.

DEFINING THE ROUTE TO ENERGY SAVINGS

ANDRITZ was the only supplier able to define the route to such energy savings while providing high-level technology that could meet MG TEC's stringent product quality standards. Consumers in Romania demand soft, bulky tissue, while MG TEC's domestic and export jumbo reel customers also have high expectations, particularly for mechanical strength and reliable converting performance. As a new entrant to the market, the business needed to be particularly competitive, hence the need for minimum energy consumption, in addition to the significant sustainability benefits.

Following the successful start-up of the first tissue machine in April 2021, the second 100 t/d (35,000 t/y) line started up on schedule during the first quarter of 2023, with equally impressive results.

The scope of supply for the identical installations comprises a 2.85 m wide ANDRITZ PrimeLineCOMPACT tissue machine with a design speed of 1,900 m/min, equipped with a Prime-

Flow single-layer headbox. The optimized step diffuser turbulence generator includes tube bundles with inserts for optimal formation over a wide range of headbox flow rates and consistencies. In combination with the optimized nozzle geometry, this produces the superior paper quality that is of critical importance to MG TEC. One special design feature is the low recirculation flow achieved thanks to the tapered header mounted directly on the headbox.

Moving along the line, the PrimePress single suction press roll features drive-side exhaust to facilitate felt and roll changes. ANDRITZ is renowned for its full range of press solutions, including the shoe presses with patented shoe loading system.

The 15 ft PrimeDry Steel Yankee on MG TEC's two new tissue machines, combined with the PrimeDry Hood G (gas-heated Yankee hood), ensures efficient, safe drying. The PrimeReel comes with nip-load compensation to preserve the all-important bulk through the complete winding process. It also has a reel spool magazine to store reel spools and feed them to the reel via the reel spool lift to ensure efficient, automated operation.

The scope includes PrimeDustEXT dust extraction and PrimeMistEXT mist extraction. Automation, digitalization, and electrification were part of the turnkey package, as were all pumps and the hall ventilation.

ANDRITZ pumps for tissue production fulfill the highest expectations in terms of efficiency, life-cycle, maintenance friendliness, and economic efficiency. Particularly noteworthy are the headbox pumps of the ASP series, which achieve efficiencies of over 90% with their pulsation-optimized hydraulics. The pumps can be equipped with a sensor concept that is unique on the market. This makes it possible to control the operating mode of the pumps, thus obtaining important information on the process and on operation under different conditions.

MG TEC is using the Metris All-in-One Platform for real-time monitoring of energy consumption and plant efficiency as well as enhanced process solutions to optimize production and ensure maximum quality control.



→ All service work and post-start-up optimization can be conducted through the Metris Performance Center, located at ANDRITZ's headquarters in Graz, Austria, thus bringing additional cost and time savings.

STOCK PREPARATION

The complete ANDRITZ stock preparation system and broke handling includes a single pulper and state-of-the-art TwinFlo TF20 disc refiner technology to optimize fiber properties, using the wide variety of fillings available. One refiner is dedicated to softwood while the other is a flexible swing refiner for both hard and softwood fiber. The ANDRITZ ShortFlow approach allows MG TEC to take advantage of very low storage volumes, enabling fast grade changes: the advanced control of stock blending includes a combined machine and blending chest with a short retention time. The system was completely pre-engineered as part of the turnkey package to reduce capital and operating costs.

In terms of stock preparation, one requirement was furnish flexibility. The two ANDRITZ tissue machines have proven to be capable of handling recycled fiber from MG TEC's existing deinking line without excessive dust, while also allowing an increase in the use of short fiber pulp to more than 70% in the virgin-fiber mix. "We have changed our hardwood pulp to eucalyptus to increase quality, but the machines will run well and offer good control over the paper profile with any furnish," says CEO Dorin Mocan.

ROLL COVER AND MACHINE CLOTHING: PERFORMANCE AND SUSTAINABILITY

Machine clothing consists of WeCare Prime forming fabrics that enable excellent formation, maximum machine efficiency, and top sheet qual-

ity. The StrataPress T press felts offer sustainable dewatering performance and energy savings at high machine speeds. Using recycled polyamide materials for our press felts helps to reduce the carbon footprint. With its textile recycling activities and pilot plants, ANDRITZ Fabrics and Rolls perfectly supports the circular economy approach of customers such as MG TEC.

The two Polysoft PU suction pressure roll covers bring engineered surface venting for improved sheet dryness and longer running times compared with conventional rubber covers.

DAILY GRADE CHANGE

Having two high-performance tissue machines, MG TEC can now dedicate one line to away-from-home (professional) tissue and the other to consumer products. Supplying tissues ranging from facial and bathroom tissues to napkins and kitchen towels, the mill appreciates the grade-change flexibility the PrimeLineCOMPACT machines offer – daily grade changes are quite normal for the mill.

"It was clear from its design that the ANDRITZ machine was especially engineered to achieve our strict target for energy consumption," says CEO Dorin Mocan. "The machine is very compact, with short flows, which is also good for maintenance. And various aspects, including the hood control system with automatic dampers, reassured us that the technology was designed to meet our needs and requirements. As a result, we can now produce consistent quality with low energy consumption."

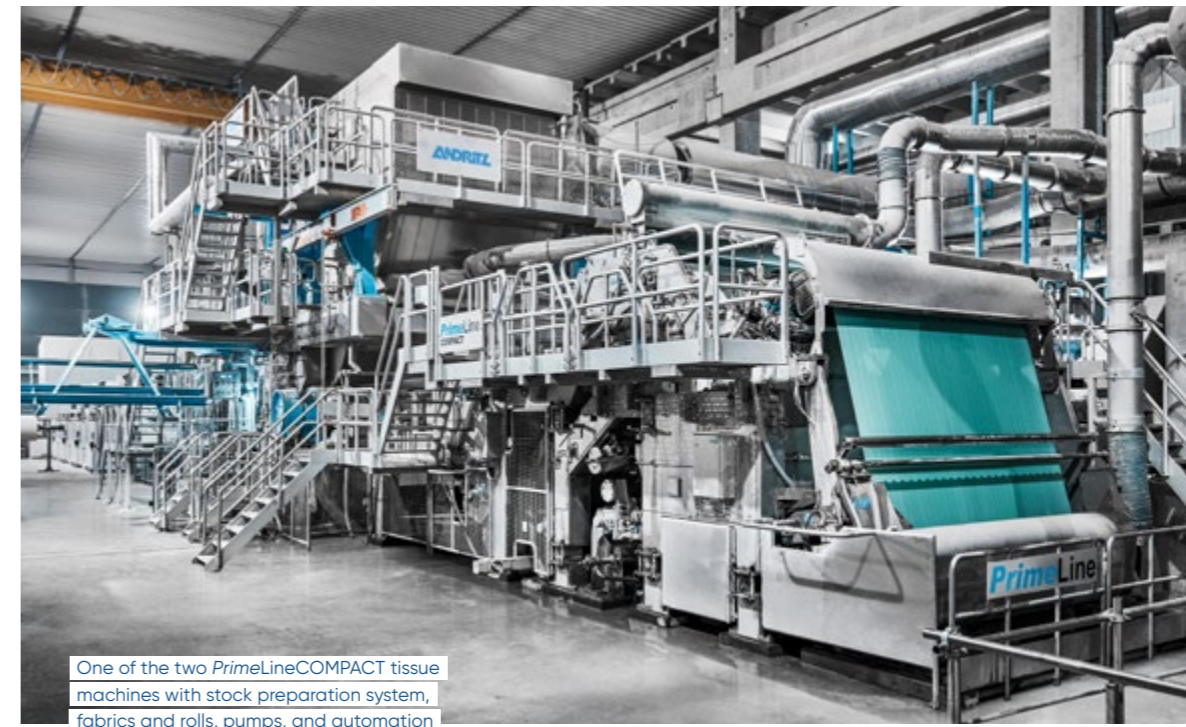
CEO Dorin Mocan was also pleased with the outcome of the installation and start-up, "ANDRITZ adapted its team and structure well to our needs



Dorin Mocan, CEO, MG TEC INDUSTRY and Erwin Walcher, Senior Sales Manager Tissue, ANDRITZ



State-of-the-art TwinFlo TF20 disc refiner



One of the two PrimeLineCOMPACT tissue machines with stock preparation system, fabrics and rolls, pumps, and automation

and our way of working. The pandemic and conflict in Ukraine have not made it the easiest period to undertake a two-machine project, but it has been a big success for us and for ANDRITZ."

It was certainly successful as far as ANDRITZ is concerned. "We were able to apply our knowledge from similar lines to achieve the very specific energy savings and quality targets that MG TEC set for us," says ANDRITZ Senior Sales Manager Erwin Walcher, who has been working in close cooperation with MG TEC throughout the project. "Our expertise in all aspects of tissue technology enabled us to take a holistic approach to energy efficiency in this turnkey installation. Thanks to the compact design of the headbox, the optimally engineered suction press, the state-of-the-art steel Yankee, and the gas-heated hood, right down to the design of the felts and fabrics and many other aspects, we have been able to achieve class-leading efficiency without compromising the end product."

LIVING WITH THE LINES

With both tissue machines now running, it is the day-to-day experience of operating them that provides the greatest evidence of their effective design. The low dust level with recycled fiber has already been mentioned, and another feature of the PrimeLineCOMPACT design is the low mist. As Erwin Walcher puts it, "Good housekeeping is the basis for high machine efficiency."

Through PrimeService and the Metris Performance Center, MG TEC can be sure of obtaining the ser-

vice and parts it requires, as well as the necessary tests such as testing of the static and dynamic press rolls, checking crowning during operation, and analyzing the bearing condition to ensure the machines run smoothly.

As the MG TEC case study demonstrates, ANDRITZ has the knowledge, skills, and experience to provide optimum solutions for complete turnkey tissue lines. However, the company also has a formidable reputation for rebuilds and the provision of key components.

So what comes next for MG TEC? Having installed two PrimeLine tissue machines since the ground-breaking ceremony for their greenfield site in 2019, it is perhaps time to consolidate their achievements before considering the next move in one of the EU's fastest-growing economies.

The vision of the company's founder was to establish a modern, technically advanced, and sustainable business for the next generation to take forward. This has clearly been fulfilled with the installation of two supremely efficient, high-performance tissue lines with associated stock preparation.

"The next investment, in due course, might involve dedicating one tissue machine to recycled fiber. Another possibility might be colors," suggests CEO Dorin Mocan. Certainly, ANDRITZ's extensive pilot facilities will always be available to test such options, as one would expect from a strong and experienced partner to the world's tissue industry.

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Transforming a Pulp Mill into a Biorefinery for Renewable Fuels

The demand for e-fuels and biofuels is growing stronger and stronger as regulation comes in and industries across the globe seek ways of lowering their carbon footprint. Pulp mills are now in a prime position to take advantage of the production of new, alternative fuel concepts from ANDRITZ, which allow producers to pursue new revenue streams from the capture of CO₂ and other side streams coming from the manufacturing process.

The development of technologies for e-fuels and advanced biofuels are part of the ANDRITZ CircleToZero initiative.

SPECTRUM speaks to **Henrik Grönqvist**, the newly appointed Director of e-fuel Business at ANDRITZ.

Can you tell us about the market for e-fuels and advanced biofuels and what are the driving forces that are creating the demand?

GRÖNQVIST: E-fuels and advanced biofuels are gaining increasing attention as alternatives to traditional fossil fuels due to their potential to reduce greenhouse gas emissions and dependence on traditional fossil fuel resources.

The biggest driver for this change is our environmental concerns. We need to do something to alleviate climate change and it is clear we all need to reduce our greenhouse gas emissions. Other drivers are the policy support in various countries and the new directives by the European Council, RED III, which sets the bar for the need of these fuels by 2030. Also, technological innovations and advancements have made the production of different renewable fuels more viable and cost-effective.

Why are a pulp mills ideal contenders for the production of these fuels?

GRÖNQVIST: Pulp mills emit the largest amount of available biogenic CO₂ when compared to other types of industrial plants. Today, this CO₂ is released into the atmosphere and contributes to mills' emissions. What we are aiming for is to turn these emissions into new value-added products by capturing the CO₂ and utilizing it for e-fuel production.

What is the difference between e-fuels and advanced biofuels?

GRÖNQVIST: The main difference between e-fuels and advanced biofuels lies in their production methods: e-fuels are fully synthetic fuels made from carbon dioxide (CO₂) and renewable hydrogen through electrolysis, while advanced biofuels are derived from a biomass feedstock.

In the EU's regulations, the e-fuel term is used interchangeably with Renewable Fuels of Non-Biological Origin (RFNBO).

Can you tell us about the experience ANDRITZ has in the development of technology in this area?

GRÖNQVIST: For e-fuels, we already have our own green hydrogen and carbon capture technologies, which we are developing further. For the different synthesis we are partnering with the right players depending upon the project and our customers' needs. Our aim is to be an integrated solution provider that can combine all needed parts of this puzzle and add it to our different levels of automation solutions and existing aftermarket services.

In addition to this, we are also providing solutions for making advanced biofuels. In this area we have two possibilities:



→ **1) Purification of methanol**, where raw methanol created in the pulp mill process can be extracted and purified by using an ANDRITZ patented process and then sold as commercial grade biomethanol on the market. The great thing with this is that the methanol generated in this way contributes towards reducing the amount of fossil greenhouse gas emissions and at the same time adds new streams of income for our customers.

2) ANDRITZ gasification technology is well known and has the most references on the market as of today. This technology can also be used for producing various types of advanced biofuels. In this process we do not burn the gasified gas coming out of the gasification reactor; instead we clean the gas, called Syngas, which is converted into liquid fuels through a synthesis process. In this process, the Syngas goes through a reaction over a catalyst under specific conditions to produce a range of hydrocarbon fuels, such as gasoline, diesel, or aviation fuel.

All these various renewable fuels can be blended with conventional fuels or used as standalone alternatives, contributing to reduced greenhouse gas emissions and increased energy sustainability.

Can you tell us what types of e-fuels can be produced by implementing ANDRITZ technology at pulp mills? And what are the potential qualities and quantities of fuels that can be produced?

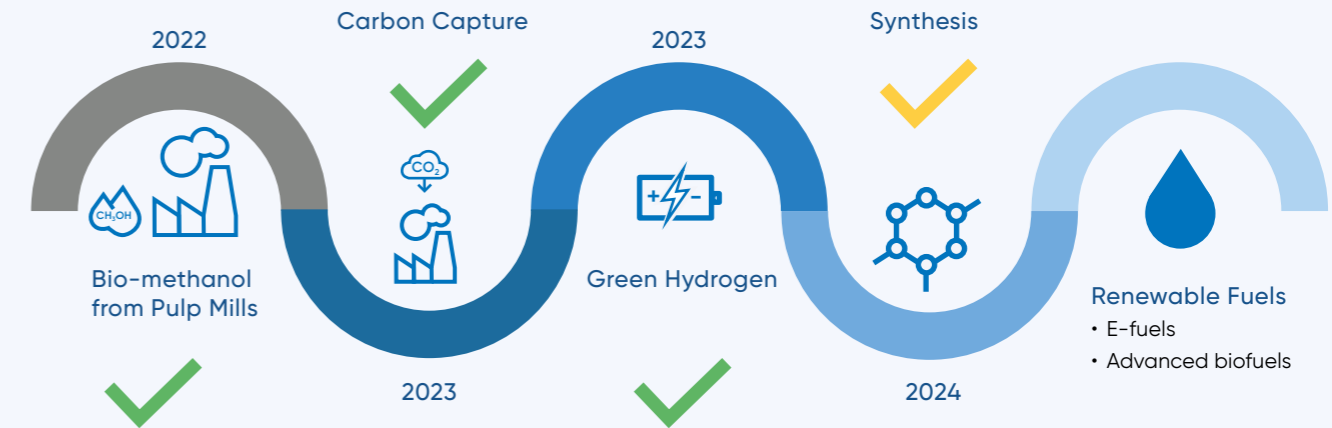
GRÖNQVIST: Pulp mills can be a versatile platform for all kinds of different renewable fuels. However, ANDRITZ is focusing on the most sustainable renewable fuels; advanced biofuels and e-fuels. The type of fuels we are specifically focusing on are the drop-in renewable fuels used for aviation and road transport, as well as for the chemical industry and methanol applications. Methane and ammonia are also interesting for us, but it is a bit too early to say where the market and demand is going.

The amount of renewable fuels that can be produced within a mill mostly depends on the amount of green electricity and feedstock that is available. But for example, a 100,000 t/a methanol plant could be a decent size of a plant to be integrated with a pulp mill. For this size you need roughly 100 MW of green electricity and about 120,000 t CO₂/a if you also utilize the raw methanol from the pulp process itself.

In this decade, the demand within Europe is now defined and stated in the various directives which

*Tonne of oil equivalent (toe)

The tonne of oil equivalent (toe) is a unit of energy defined as the amount of energy released by burning one tonne of crude oil.



have been published. Around 8-9 M/toe* of advanced biofuels and e-fuels are needed before 2030.

What type of industries or customers would use the e-fuels produced?

GRÖNQVIST: The companies that are producing fuels today, chemical industry players and aviation and maritime players, the ones that are required to react to the growing need of renewable fuels for the future.

Do you have any references of any installations already in place?

GRÖNQVIST: We do not yet have references for a complete e-fuel plant; however, we have references for the different parts and all the building blocks needed for these kinds of installations.

ANDRITZ has experience in turnkey and other large-scale projects globally and a high competence in best-cost manufacturing with active cooperation with different partners. We aim to be an integrated solution provider with the right cooperation models for our customers and to enable a full EPC project execution model.

How do customers find out more information about the production of e-fuels and advanced biofuels at their mills?

GRÖNQVIST: Our customers can contact their key account manager from ANDRITZ or visit our website. We would be delighted to answer any questions and discuss specific needs further and together we can make this planet a better place in which to live.

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RENEWABLE FUEL TYPES

RENEWABLE FUELS CAN BE CATEGORIZED INTO DIFFERENT TYPES BASED ON THEIR SOURCES AND PRODUCTION METHODS.

Crop-based fuels are the most commonly used renewable fuels today, which have their own advantages but restrictions like land use.

Biofuels from used cooking oils and animal fats is the next category that are getting more focus nowadays. The growing demand puts strains upon available feedstock issues that can already be seen in Europe.

Advanced biofuels are the third category. Advanced biofuels are derived from biomass, which includes organic materials, e.g., forest residuals, etc. Today in this category, ANDRITZ is already a player with some production sites running.

E-fuels are categorized as their own category mainly because they are known as synthetic fuels and are produced using renewable energy sources. The main components are CO₂ and hydrogen (green hydrogen). These components are then combined to synthesize liquid or gaseous fuels, providing an alternative to fossil fuels.

ANDRITZ is focusing upon the most sustainable renewable fuel categories, which are Advanced biofuels and E-fuels.

The last category is **recycled carbon fuels (RCF)**, which are fuels produced from fossil wastes, that cannot be prevented, reused, or recycled, e.g., plastic waste. This is also interesting for ANDRITZ, but we are monitoring the development of this category since up to now the EU has not yet supported RCF in any regulations.

GLOSSAR

E-FUEL

Wide term used for any synthetic fuel made using electrolyzer hydrogen.

RFNBO

Renewable fuels of non-biological origin are fuels where electrolysis is powered by renewable energy, excluding biomass. This term is defined by the EU for classification purposes.

BIOFUEL

Fuel with energy derived from biomass. Term is used more loosely in USA as regulations were built for biofuels.

ADVANCED

Produced from a list of waste and residue-based feedstocks specified by regional regulations. In the EU, this is Annex IX Part A. In the USA, advanced biofuel refers to biofuels with GHG reduction above 50% and not made from corn.

RENEWABLE

Fuel or electricity with energy derived from non-fossil sources. All biofuels and biomass energy are included.

DROP-IN FUEL

Fuels that are molecularly similar to conventional fuels and can be substituted like-for-like.

RECYCLED CARBON FUEL (RCF)

Any fuel reliant on a source of inorganic carbon that would otherwise reach the biosphere and be recorded as such, e.g., plastic waste syngas or a coal power plant exhaust.

Addressing Industrial Cybersecurity Risks

Affecting the Industry

ANDRITZ partners with OTORIO to safeguard production operations

The pulp and paper industry continues its rapid digital transformation. This makes pulp and paper manufacturers' industrial networks more connected, more productive – but, unfortunately, more exposed to cybersecurity risks. Safeguarding IT and operational technologies (OT) is critical to ensuring business continuity and resilient operations at the heart of pulp and paper manufacturing.

As industry leader ANDRITZ's OT cybersecurity partner, OTORIO knows how crucial safety, uninterrupted energy supplies, plant operations, and reliable utilities are to the pulp and paper manufacturing processes. The sophisticated industrial machines crafted by ANDRITZ rely on multiple technologies, data sources, automation, and digitalization, as well as procedures to optimize process performance.

Manufacturers worldwide have been hit with real-world industrial cybersecurity attacks that halt industrial operations, lead to ransomware demands, harm business continuity, and affect shareholder value. The pulp and paper industry is no exception. Over the past two years, cyber attacks have impacted the manufacturing operations of at least three different paper and packaging companies in North America and Europe.

Whether they deal with recycling OCC, packaging board, and mixed waste, securing production lines, drying processes, or power and boiler generation, OTORIO's industrial-native cybersecurity solutions enable pulp and paper manufacturers to minimize digital and cyber risks to their industrial operations. OTORIO's solutions prioritize risk mitigation, add business context, and allow plants to manage multi-site OT, IT, and IIoT networked environments from one central dashboard.

WHY THE INDUSTRY FACES CYBERSECURITY VULNERABILITIES

Whether producing paper, boards, or tissue, the various stages of pulp and paper production and the technologies that support it increase a manufacturer's digital attack surface. Producing panelboard, for example, involves heavy industrial machinery and automated, networked technolo-

gies for raw wood processing, preparation, cleaning, and pressurized refining. If a cyber attack impacts even one stage of the process, this can have a domino effect on related processes, potentially disrupting or halting operations until the security breach is resolved.

PROVEN CYBERSECURITY VALUE FOR INDUSTRY CLIENTS

OTORIO has extensive, proven experience working with global pulp and paper industry manufacturers to assess, monitor, and manage digital risk. This includes ensuring comprehensive visibility of industrial assets, reducing 'noise' caused by high volumes of false-positives and irrelevant OT security alerts, prioritizing the mitigation of industrial

cyber-security risks based on their context, and potential impact on your business.

→ OTORIO has experience reducing ransomware risks and helping companies fight phishing attempts that target thousands of employees at hundreds of worldwide locations. It leads to improved customers' security controls to ensure their OT, IT, and IIoT network environments are resilient against future attacks.

OTORIO has extensive experience performing vulnerability and penetration testing ('pen testing') for pulp and paper manufacturers.

OTORIO AND ANDRITZ HELP SAFEGUARD YOUR OPERATIONS

ANDRITZ helps its global pulp and paper customers minimize digital and cyber risks through its partnership with OTORIO. Founded by leading OT cybersecurity experts, OTORIO's portfolio of industrial-native cybersecurity solutions ensures continuous digital risk management and compliance. These solutions are now fully integrated into the ANDRITZ Automation & Digitalization portfolio, providing customers with safer machines and a significantly more resilient infrastructure.

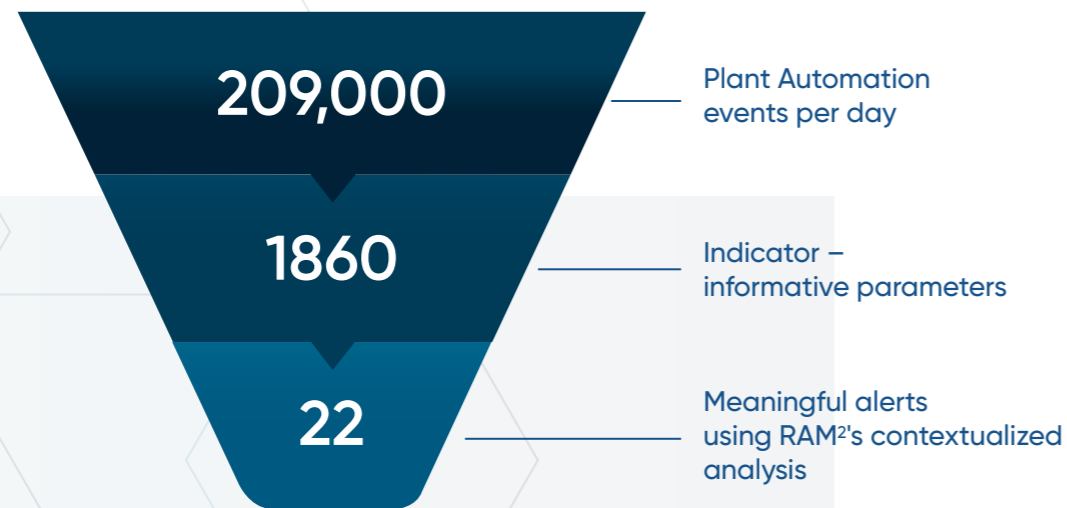
In a multi-generational, constantly changing threat environment, customized OT cybersecurity measures are an critical part of the automation development process. That is why ANDRITZ embeds

OTORIO's innovative solutions in its market-leading solutions and services, ensuring that every pulp and paper machine meets the highest cybersecurity standards. The advanced services are delivered in the safest way, ensuring the customer's continuous efficient and effective production, along with proprietary commercial data security.

In today's rapidly evolving industrial operations environment, protection against cybersecurity risks and compliance with industrial security standards is expected with every machine delivery and commissioning. ANDRITZ ensures that each machine it delivers is secure, regulatory compliant, and meets the customer's contractual requirements for continuous, safe production.

With OTORIO's spOT Lifecycle solution, ANDRITZ can also provide post-delivery Security-as-a-Service over the machine's entire lifecycle on the customer's premises. spOT Lifecycle periodically checks configurations and vulnerabilities during ANDRITZ service calls (whether remotely or on-site), and performs "virtual querying" of the machine's fingerprint for new, publicly-known vulnerabilities. This solution provides clear, practical recommendations on how to remediate compliance and security gaps and harden against ransomware attacks.

Plant Automation events per day



Cyber security for the complete plant lifecycle

The result is a detailed report on compliance confirmation that delivers accurate, in-depth security verifications of the delivered machines. spOT Lifecycle enables ANDRITZ to remediate each vulnerability, security gap, and compliance deviation prior to a machine's delivery, and include details on any mitigation steps taken in the issued report. The information is also used to ensure that new deliveries are secure by design.

ANDRITZ's Automation & Digitalization embeds OTORIO cybersecurity into the automation lifecycle of new and existing machines for safe, resilient, and efficient operations. The company's Security-as-a-Service offering ensures that each machine it delivers is secure, regulatory compliant, and meets contractual requirements. Every customer is assured that ANDRITZ deliveries provide continuous, safe production throughout their entire lifecycle.

For secure remote access to operational assets, ANDRITZ Automation & Digitalization utilizes OTORIO's remOT to deliver secure, simple, and fully governed remote access to the operational environment.

ANDRITZ applies remOT zero trust security architecture as a service in customers industrial environments

in compliance with IEC standards for single sign-on controlled access to operational assets. Alternatively, clients can easily manage remote connections for all their third-party vendors by using remOT.

COMBINED EXTENSIVE EXPERIENCE IN MANAGING INDUSTRIAL RISK

Industrial cybersecurity risks and ransomware demands affecting pulp and paper manufacturers' production are an unfortunate reality. Companies must proactively assess, manage, and mitigate OT security risks to protect business continuity and maintain resilient operations.

OTORIO and ANDRITZ bring their extensive experience and industrial-native cybersecurity expertise to help you assess, monitor, and manage industrial risks. From helping to ensure safe pulp and paper manufacturing operations to reducing risks and vulnerabilities that can impact your production, worker safety, critical infrastructure, and regulatory compliance, our combined proven OT security solutions and services can enhance your cybersecurity posture and help safeguard your industrial production.

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New Recovery Boiler Concept

Ultra-Low Emissions, Maximum Energy Efficiency

As part of its CircleToZero initiative to reduce emissions and waste at pulp mills, ANDRITZ never stops innovating to obtain maximum results. One of the latest developments for pulp mills has resulted in a new recovery boiler concept with low emissions while maintaining high energy efficiency at the same time.

The recovery boiler has come a long way since it was first invented in the early 1930s. At the time it was a revolution and is now often described as the "beating heart of a pulp mill", as it performs its duty of recovering the inorganic chemicals, burning organic chemicals so they are not discharged from the mill as pollutants, and recovering heat in the form of steam to generate power.

Over the years, that first revolutionary recovery boiler design has developed and evolved into a showcase of sustainability for all pulp mills around the world. Hamilton Brandao, Technology Director, Recovery Boilers, ANDRITZ, says, "The recovery boiler design and function has come a very long way since its invention back in the 1930s. Safety, mechanical design, process performance, opera-

tional controls, and environmental emissions make the modern recovery boiler unrecognizable when compared to the first ones.

"Over the past two decades, in particular, recovery boiler capacity has increased steadily, while thermal performance improvement has enabled customers to not only be self-sufficient in power generation, but also create a valuable new revenue stream by selling surplus green energy to national grids."

NOX EMISSIONS: THERE IS STILL MORE WORK TO BE DONE

The modern recovery boiler may be a showcase of sustainability, but there are still some areas that need working on, in particular, NOx emissions. NOx emissions are becoming strictly monitored as they impact the environment in the long term and most countries have their own rules on allowed emissions. One example is China, which has recently seen a rapid tightening of NOx emission regulations in high density urban areas. It is expected that Europe will follow suit in regards to NOx emissions, leading to similar limits.

"In general, environmental emissions from the recovery boiler have decreased substantially over the last decades, for instance CO₂, particulates and low sulfur emissions," continues Brandao. "But this trend is not applicable to NOx, which still requires new technologies to enable a further decrease in its emissions."

The challenge of NOx emissions from the recovery boiler is an area that ANDRITZ has been working on over the last two years and has successfully come up with a solution. Naveen

"After testing different technologies, we have now devised proven ways to reduce NOx emissions from the recovery boiler by as much as 95%."

Naveen Chenna
Director of Research and Innovation
ANDRITZ



Chenna, Director of Innovation and Research at ANDRITZ, says, "More than 70% of the NOx coming from a pulp mill emits from the recovery boiler. This means if a pulp mill produces 1.5 kg of NOx per tonne of pulp, about 1.2 kg is coming from the recovery boiler.

"For the last two years we have built and operated a demo plant containing various solutions at pulp mills in Finland along with earlier studies in Sweden. After testing different technologies including electrostatic precipitators (ESP), fabric filters (FF), and catalysts, we have devised proven ways to reduce NOx emissions from the recovery boiler by as much as 95%."

THE TECHNOLOGY – HOW IT WORKS

The dramatic reduction of NOx emissions is made possible by secondary methods that ANDRITZ experts have configured by using a FF for recovery boiler dust after the ESP and selective catalytic reduction (SCR). The FF ensures low dust emission and safe operation of the SCR. There are no other references of this configuration in the pulp indus-

try worldwide, with the demo plant tests showing normal collection and release of the dust on the fabric surface.

Kasper Skriver, Global Product Manager ESP and FF, ANDRITZ, explains, "The reduction or elimination of NOx is made possible by secondary methods that can be designed to reach 95% efficiency of reduction. Particulate reduction can be achieved down to 5 to 10 mg/Nm³ with conventional ESP technology. Typical levels today range from 10 mg/Nm³ in China all the way up to 70 mg/Nm³ in Brazil.

"By applying the fabric filter technology, we will enable continuous particulate emissions less than 5 mg/Nm³, which is what we consider close to zero."

The technology for NOx reduction and elimination, the Lo-NOx recovery boiler concept, is now available for ANDRITZ customers worldwide, and can be part of a greenfield mill project or retrofitted to existing mill operations.

CONTACT

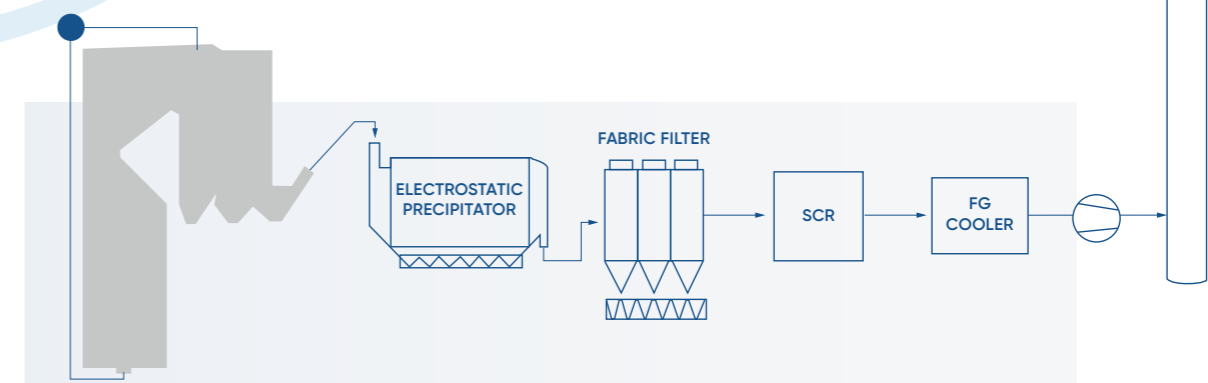
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The innovative Lo-NOx recovery boiler concept combines various well-proven ANDRITZ technology solutions to achieve minimum dust and NOx emissions from the boiler.

THE COMPACT PRESS

Completing the ANDRITZ Pulp Washing Range

The COMPACT PRESS is the latest addition to the high-efficiency pulp washing solutions available from ANDRITZ.

Along with the well-known DD-Washer, the introduction of the COMPACT PRESS now means ANDRITZ covers the complete range of solutions available for effective and efficient pulp washing for all capacities of pulp mills, from the very small to the very large.

The COMPACT PRESS has been named for a good reason; it has a small footprint and is compact in design, making it the perfect retrofit washer for all sizes and capacities of pulp mills, including those with limited space in the fiberline. The presses are available in nine different sizes starting from a capacity of 400 t/d up to 6,000 t/d and are designed to suit all pulping processes, including kraft, semi-chemical, and mechanical pulp. The latest development at ANDRITZ has seen the introduction of a press for the dewatering of mechanical pulp, which is based on the same technology.

The presses have a number of proven advantages that set them apart from other wash presses, including a highly efficient process with high discharge consistency, tough, durable components, and easy maintenance. Over 150 COMPACT PRESS units have been sold to date with the first one being delivered in 2000 and still operating successfully.

HOW IT WORKS

Depending on the applications, the presses can be fed from 2% up to 10% feed consistency. What is unique about the COMPACT PRESS in the ANDRITZ washer range is the high discharge consistency – around 30% from the machine, which is beneficial when separating mill waters from the acidic stage to the alkaline stage.

Uniformity of pulp is very important when creating an efficient process, and it is essential to have distribution of pulp evenly spread across the perforated drum. This even distribution is ensured by unique, specially designed screws that are speed controlled so the transport capacity is adjusted to meet the needs of the pulp fed into the machine.

The COMPACT PRESS enables high consistency starting at the dewatering phase where consistency of the pulp is increased by a converging gap between a perforated drum and the static sliding surface of the press. When the consistency has been increased, the wash liquor is then added in two zones. The benefit of the increased consistency means there is less free liquid in the pulp to displace and the wash liquor is used more efficiently, thus saving on chemical costs.



“Along with its minimal footprint, the COMPACT PRESS has many advantages, including highly efficient washing for producing clean pulp, made-to-last durable components with a long-life cycle, and low cost of ownership due to easy maintenance.”

Anders Lindström
Product Manager, COMPACT PRESS
ANDRITZ



The second phase of the washing takes place when the pulp is distributed across the full width of the perforated drum and the wash liquor is distributed via a large number of nozzles in two zones to ensure maximum displacement.

The final pressing is done between the two drums where the pulp is pulled by the perforated drum through the press nip where the free liquid is squeezed out.

Another unique feature of COMPACT PRESS is the integration of the dilution screw into the press itself, which eliminates the need for a separate dilution screw or device and makes the layout more compact and efficient.

TOUGH, LONG-LASTING COMPONENTS WITH EASY MAINTENANCE

The main component of the COMPACT PRESS is the MaxDrum, which has been developed with a solid

support structure. The drum is built to last, with some examples already having been in operation for over 20 years. The main feature of the drum is the screen plate, which is over 4 mm thick, and the support structure underneath, which is 70 mm in depth giving maximum strength and support. Along with added strength, this means the drum is extremely fatigue resistant.

The MaxDrum also comes with several safety features, including an overload protection system that allows both drums to move should a foreign object enter the process.

When it comes to maintenance, the COMPACT PRESS has been designed with maximum efficiency in mind. The press is fitted with a service hydraulic system that allows the opening of the machine for access to the drum surface and seals. The vat can be lowered to get access underneath the press, so there is no need to use a powered crane, and full maintenance can be carried out with minimal person hours.

CONTACT

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KRAFT TO DISSOLVING PULP MADE EASY

Textiles made from cellulose fibers are becoming more and more important as the world rapidly moves away from fossil-fuel derived products and seeks more environmentally friendly raw materials. ANDRITZ has developed the A-ConFlex™ continuous cooking method for bleached dissolving pulp production to make it easy for pulp producers to switch between dissolving pulp and kraft pulp according to market demand.

ANDRITZ has made it easy for pulp producers to switch between producing kraft and dissolving pulp, but it is by no means a simple process. There are major differences between the two pulps when it comes to qualities and production processes. However, with the A-ConFlex concept, ANDRITZ has taken a complex challenge and transformed it into a user-friendly and reliable solution.

The A-ConFlex is the only potential system available on the market for continuous dissolving pulp production and is already a proven technology with 10 systems delivered to ANDRITZ customers around the world.

ing pulp. Sampsa Laakso, Manager Technology, Fiberline Cooking, explains, "The most important change to the fiberline is the installation of a pre-hydrolysis vessel before the digester; this is for the removal of hemicellulose. This is carried out by adding steam and heat to the chips with the reaction then hydrolyzing the hemicellulose."

When it comes to lowering the viscosity, the process has been adapted to reduce the level by up to half at the oxygen delignification stage. Taneli Alajoutsijärvi, Technology Specialist, Fiberline Washing and Bleaching, ANDRITZ, says, "In dissolving pulp we want to have a low viscosity, around 400-500 ml/g,

MAKING THE

SWITCH

KEY CHANGES TO A KRAFT MILL FIBERLINE

There are a number of differences in the production of kraft pulp and dissolving pulp. Viscosity is the main difference as it needs to be much lower in dissolving pulp than in kraft pulp. Another difference is that the pulp needs to be much cleaner. All hemicellulose has to be removed along with all traces of metals and impurities such as sand. The third main difference is that the water supply needs to be changed to purified waters, to ensure purity of the final pulp.

whereas in kraft pulp we want as high viscosity as possible, around 800-850 ml/g. So, we have to significantly reduce the viscosity levels. This we do in various ways on the fiberline, including the possibility of introducing an ozone stage, which gives more flexibility to the control of viscosity.

"The viscosity issue is very important, as if it is too high, the dissolvability of the pulp is reduced."

ANDRITZ DD-Washers in the fiberline are also put to good use in the production of dissolving pulp; Alajoutsijärvi says, "Production rates are higher for kraft pulp and lower when it comes to producing dissolving pulp, so we use DD-Washers more efficiently by adding more washing stages for dissolving pulp production. For example, there can be two washing stages per DD-Washer for kraft and three for dissolving pulp due to the lower production level. These changes can be flexible according to quality parameters and are carried out by the operators on the run.

ADAPTIONS TO THE DRYING LINE

When it comes to pulp drying, the majority of the drying machine remains unchanged with just some

minor adaptations. The main difference is that the drainability is far higher as the dissolving pulp is cooked longer and does not hold as much water as in the kraft process. Also, adaptations can be made to ensure that the pulp is as clean as possible with minimized traces of metals or foreign particles such as sand.

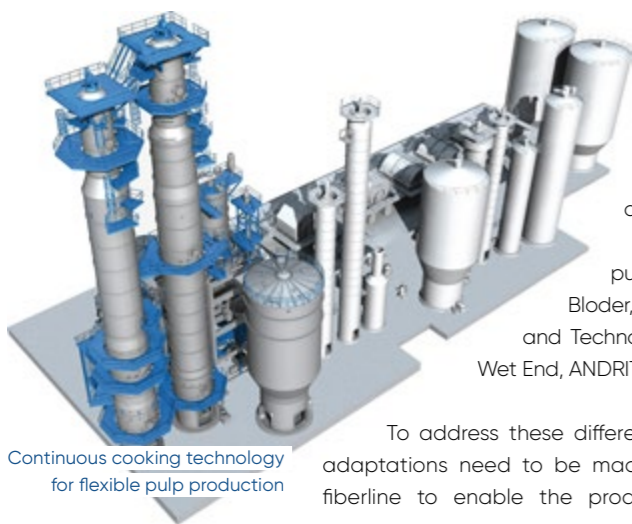
"The biggest change we need to make in the drying area is to replace the post screening installed for the kraft process with a pure cleaner plant to ensure that silicates and any other heavy impurities are removed," says Bloder. "The cleaner plant removes heavy particles such as sand and silicates in a very efficient way."

Cleanliness of the pulp before drying is further ensured by adding a hot shower in the forming section, as well as a final berol surfactant spray. Bloder explains, "In kraft pulp production, we usually add steam to the pulp to heat it up in the forming sec-

MAKING THE SWITCH WITHOUT STOPPING THE LINE

Once the pre-hydrolysis vessel is heated, and chip feeding and transfer lines are in dissolving mode, the switch from producing kraft pulp to producing top quality dissolving pulp takes place. The time taken during this part of the process is dependent on the grade of dissolving pulp required. "First, we fill up the pre-hydrolysis vessel with chips while making room in the digester," says Laakso. "Pre-hydrolysis chip filling is the only time when the digester blowline is closed. After the pre-hydrolysis vessel is full of chips, we then start transferring the chips to the digester. At the same time the digester blowline is opened again. It depends on the digester size, but normally it takes a couple of hours before dissolving pulp comes out of the digester."

Alajoutsijärvi continues, "Transition from the cooking plant drying machine takes about 24 hours. It takes some time to fine-tune the process to meet the



Continuous cooking technology for flexible pulp production

"Basically the quality of the dissolving pulp needs to be at a much higher quality level, when compared to kraft pulp," says Michael Bloder, Head of Product and Technology Management, Wet End, ANDRITZ.

To address these differences, a number of adaptations need to be made on a kraft pulp fiberline to enable the production of dissolv-

tion. However, when switching to dissolving pulp, we usually add a hot water shower instead, again to make sure that remaining metals such as magnesium and calcium can be removed properly."

Just before the sheet enters the dryer, a berol spray is added that produces a chemical reaction with the fiber itself. This is important when it comes to the production process of dissolving pulp end user products.

Due to the changes in properties and conditions when operating with dissolving pulp, the risk of creating dust increases. The dryer is designed for minimal dust creation including, for example, the blow boxes, which are from the beginning designed and manufactured for optimal performance and run-ability for different types of fibers.

When it comes to the bale finishing, the duo wrapper is usually replaced or bypassed and a so-called 'paper wrapper' is installed.

prime quality properties of the dissolving pulp. However, with the A-ConFlex concept, you can continuously control the reaction degree of the hemicellulose hydrolysis, adjust the viscosity of the pulp, and ensure cleanliness of the pulp to meet the highest criteria of dissolving pulp, such as Lyocell grade which can be produced with the ANDRITZ concept."

When it comes to drying, there are only minor adjustments to be carried out. Bloder confirms, "In the pulp drying area, there are only small adjustments, such as adapting the production and basis weight, to be made, which are usually done within the few hours before the dissolving pulp arrives in the pulp drying area.

"This is not a totally easy process, but with the A-ConFlex technology we have developed a solution that works really well," concludes Alajoutsijärvi. "Most importantly, we can continuously make a change from kraft to dissolving pulp and back, without stopping the process."

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Suzano Cerrado

PLANTING THE FUTURE

Progress continues on the construction of Suzano's immense Cerrado pulp project situated in Ribas do Rio Pardo, Mato Grosso do Sul state in mid-western Brazil. When to start up in June 2024, the mill will be the largest single line eucalyptus mill in the world, producing 2.55 million tons per year of pulp. ANDRITZ is currently supplying all the process islands for the mill, as well as being responsible for civil construction, commissioning, and start-up on an EPCC basis.

The Cerrado project will be a giant of the pulp industry when it starts up in less than a year's time. It will also be one of the most advanced of its kind when it comes to implementing the latest technology for efficiency and circularity, and environmental protection. Suzano CEO Walter Schalka, says, "The Cerrado project is one of the most impressive and competitive pulp mill developments the global industry has ever seen. Very importantly, it will have a positive impact on economic, environmental, and social aspects of the Ribas do Rio Pardo region in Brazil."

The project is located on the outskirts of the small administrative city of Ribas do Rio Pardo, Mato Grosso do Sul state. Here the highly fertile soil and abundant water courses present the perfect conditions for growing eucalyptus as well as the best site for a modern, highly efficient pulp mill. Schalka continues, "When building a pulp mill, we have to closely

look at and combine several prerequisites to ensure competitiveness; forest location – very important as we need to reduce the average radius between forest and the mill – water supply, outward bound logistics and, of course, connections to the grid.

"With the Cerrado mill, we have managed to combine all of these prerequisites at an optimum level."

PROGRESS AND CHALLENGES

The project is about three quarters completed and presently there are around 10,000 people working at the site, from laborers and construction workers to skilled engineers, technicians, and site managers. André Luis de Campos, Site Manager of the Suzano Cerrado project, says, "The civil works are nearly completed and now the electromechanical installation phase is taking place. We are going beyond the normal with this project, so we have

a specially designed management system that is concentrated on ensuring the safety and comfort of the workforce here."

To give an idea of the scale, 64km of roads have been built within the Cerrado project so that movement of some of the largest pieces of equipment ever seen at a pulp mill can be freely transported into place.

The mill has its own hospital, complete with ICT unit and two ambulances in case of emergencies. "So far, we are very pleased with the health and safety aspects of the project; we have a very low incident rate and have had no major event to deal with," says de Campos. "This is an outstanding result considering that we have already had more than 20 million hours of working time on the project."

Looking after and feeding the thousands of people working on the project demand planning and scale of military precision. "In terms of the well-being of the workers at the site, as well as health and safety aspects, we also make sure they are well looked after when it comes to sustenance at the mill," says de Campos. "It is quite an operation to feed 10,000 people for breakfast, lunch, and dinner every day."

A ZERO FOSSIL FUEL OPERATION

Environmental performance has been number one on the list when it comes to the selection and implementation of the technology at the new mill. Schalka explains, "This will be one of the few mills in the world that will run with zero fossil fuels based on a raw material of 100% planted trees. To enhance our environmental performance, we are installing a gasification process, sulfuric acid plant, and an operation that will sell 180 MWm of electricity to the national grid.

"This operation is going to not only be competitive when it comes to cost per tonne, but will also be a showcase of environmental sustainability when it comes to production performance. We have also planned the location of the site as to ensure a very low distance from forest to site – an average of just 65 km – so there will be fewer emissions from logging transportation as well."

ANDRITZ was contracted to supply all the process islands for the project, including the wood processing plant with five chipping lines, the world's largest fiberline with a capacity of over 8,000 adt/d, the complete pulp drying system, evaporation plant, recovery boiler and power boiler, white liquor plant, and gasification plants. The mill will also have one of the first SulfoLoop concentrated sulfuric acid

ENVIRONMENTAL
PERFORMANCE

→ plants installed. In addition, ANDRITZ was selected to supply the latest automation and digitalization technology for the process islands.



The mill has its own hospital, with two ambulances in case of emergencies.

Schalka says, "We have significant and long standing, experience with ANDRITZ and we are very pleased with our track record on projects we have developed with the company, in particular with the success of the Horizonte 2 project in Três Lagoas that started up in 2017. This is why we discussed the potential opportunity to work on the Cerrado project together, and right now we are very pleased with the performance."

"Our experience is that right from the top, from ANDRITZ's CEO Joachim Schönbeck, to the project directors, engineers, and technicians on site, there is a positive attitude throughout the organization. When embarking on an EPCC project such as Cerrado, one has to have trust and reliability, and we have both of those with ANDRITZ."

ON THE GROUND

Progress on the ground at the Cerrado project continues despite a few challenges presented with the sheer size of the process islands, as well as local difficulties obtaining skilled workers and weather conditions in the region.

Joel Starepravo, Project Director, ANDRITZ, says, "We are around less than a year from start-up and we are in the critical phase of the erection, getting ready for the commissioning and start-up phase. In general, the project is going very well but, of course, on a project of this size and in a location such as this, there are always challenges that are thrown at us, which we must solve."

"However, Suzano and ANDRITZ have a superb, proven working relationship and we work closely together to find solutions."

With ANDRITZ's proven technology in the protection of the environment, including some of the latest in



ANDRITZ was contracted to supply all the process islands for the project.

CircleToZero applications of gasification and the SulfoLoop sulfuric acid plant, Starepravo is looking forward to the start-up next year. He says, "I am very confident that the Cerrado mill will be an excellent reference when up and running, in terms of the environment, production efficiency, and availability."

Mauricio Miranda, Suzano's Director of Engineering for the Cerrado project says, "In May of this year, we celebrated two years since the beginning of this project, and it is amazing how far we have come already. The site is around 4.6 km wide and 1.5 km long, and now it's clear to see the spaces being filled with all the ANDRITZ islands that are coming together nicely and on schedule."

"This is going to be a highly competitive mill, as well as being 100% fossil fuel free. With the gasification of the lime kiln, as well as the installation of the SulfoLoop plant, we have installed the very latest and best available technology from ANDRITZ to help us achieve our goals."

Miranda comments on the successful working relationship between the two companies, "A lot of us at Suzano have a long and experienced history with ANDRITZ on other major projects, including the Horizonte 2 project in Três Lagoas, where our motto was "One Team One Goal". Again, we have the same spirit on the Cerrado project. What we have noticed working on these projects with ANDRITZ is that the relationship between the two companies gets better and better the more challenges we solve together."

PLANTING THE FUTURE

The Cerrado mill will finally provide full employment for around 3,000 people after start-up next year, as well as offer huge opportunities for local people in various ways, including business opportunities for local entrepreneurs. Leonardo Pimenta, General Manager of the Cerrado mill says, "The Ribas do Rio Pardo region will benefit greatly from the mill being located here. Around 35% of our mill team,

including operations, maintenance, environment and quality control are from the local area. Also, we are encouraging local people to set up small businesses to provide services and products."

"On the social front, we are also developing the infrastructure of the region, as well as assisting in building hospitals and schools and generally improving the quality of life in the area. We are in a very advantageous position with this new mill; we have great technology and equipment from ANDRITZ, and we have great people to operate and maintain it. This mill is a dream, but over the fence the development of the local community is also a dream."

The mill project at Cerrado was comprised of a total of a \$3.5 billion investment and is set to be one of the most competitive pulp producing sites in the world. Schalka concludes, "This project is a flagship for the pulp industry across the globe. The average cost of producing pulp is around \$180 per tonne; at Cerrado the cost will come down to just \$100 per tonne. This impressive efficiency is due to the advancement of technologies such as those ANDRITZ is delivering to our project."

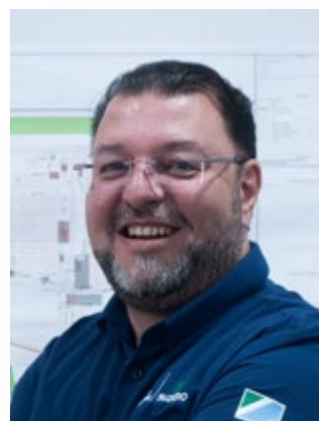
"With this mill we believe that we are planting the future, and we believe that planted trees will help to transform our planet for years to come. I am very proud to be part of this journey."

CONTACT

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The Cerrado project will be a giant of the pulp industry when it starts up in about a year's time.

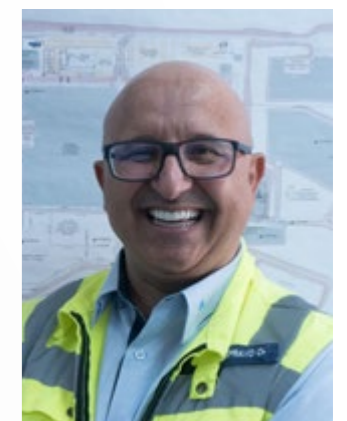


"This is going to be a highly competitive mill, as well as being 100% fossil fuel free."

Mauricio Miranda
Director of Engineering for the Cerrado project
SUZANO

"I am very confident that the Cerrado mill will be an excellent reference when up and running, in terms of minimum environmental impact, production efficiency, and availability."

Joel Starepravo
Project Director
ANDRITZ



Walter Schalka, CEO of Suzano

speaks to SPECTRUM magazine



Walter Schalka has been CEO of Suzano since January 2013, and has played a major role in the evolution of the company as it has risen to be the largest producer of market pulp globally. Schalka successfully led the merger with another Brazilian pulp giant, Fibria, in 2019, and has received numerous CEO and leadership awards in the pulp and paper industry and beyond. Schalka was recently recognized as the recipient of Brazilian-American Chamber of Commerce's 2023 Person of the Year Award.

Can you tell us about Suzano and its position in the rapidly growing bioeconomy in Brazil?

SCHALKA: There are many companies in Brazil that are doing an extremely good job when it comes to the bioeconomy, and on the pulp front, in particular, it's amazing how producers here are becoming so competitive in the global market. I think congratulations are in order for the whole of the Brazilian pulp industry.

Suzano is one of the largest enterprise-value companies not only in the Brazilian bioeconomy, but in the nation's economy as a whole. Suzano is, for sure, the most relevant company in the pulp sector at this point in time. But we firmly believe that this is not about being the biggest, it's about collaboration;

we need everyone working together and going in the same direction as we address climate change – one of the greatest challenges of our generation. It is becoming clear that planted trees will be part of the solution to this challenge.

On the subject of trees, can you tell us about Suzano's biodiversity program that has been introduced around its eucalyptus plantations?

SCHALKA: High on the list of priorities for Suzano is also the one of ensuring biodiversity in and around our plantations. We have an extensive program of increasing biodiversity in our operations where we connect fragmented native areas with corridors. We are already seeing successful results from our first programs where we are aiming to have around 500,000 ha of areas connected. We are very impressed with the early results of this initiative and will be implementing exactly the same program in Mato Grosso do Sul for the Cerrado project.

What are the major challenges Suzano is facing with its operations, including the Cerrado project?

SCHALKA: One of the major challenges the whole industry is facing in Brazil is the pace of growth and having enough skilled people. The industry is growing much faster than we have been preparing for, and therefore the major challenge is to get more people qualified to work in our mills.

In the case of Cerrado, we have the very latest in technology at the mill, so we have to bring people in from the outside to operate and run the equipment. However, we have an extensive program where we are training more than 2,000 people to operate at the mill and surrounding forested areas. Fortunately, the pulp industry in Brazil is an attractive area to work in; the salaries and compensation packages tend to be higher than other industries and there is a good career path for those people wanting to advance.

Personally, what are your thoughts on the pulp and paper industry and its future?

SCHALKA: I love working in this industry; it's an industry that is playing a part in saving the planet and doing some good. We also have a positive social and economic impact wherever our mills are located.

Furthermore, this industry is not just about achieving revenue from pulp, paper, and energy; there are so many other positives going on, including carbon absorption, replacement of plastic, and the opportunity to enter different parts of the economy, for instance, textiles and biofuels.

In the case of Cerrado, the mill will be the most relevant operation in Suzano for decades to come and will play an important role in the future of the company.

LELIN GROUP

A MODEL OF THE CIRCULAR ECONOMY IN FORESTRY

Guangxi Chongzuo Lelin Forestry Development Company is part of the Lelin Group, which is headquartered in Nanning, Guangxi, China.

The Lelin Group has been operating in the wood panel industry for more than 22 years and has four wood-based panel manufacturing sites with a total fiberboard output of 1,300,000 m³ a year. The company focuses on producing top-quality fiberboards as well as formaldehyde-free board and furniture board. The company also owns and operates three biomass power plants. The group is seen as a role model for the circular economy in forestry covering two major renewable business sectors, Lelin Plate (wood-based panels) and Deli Energy (biomass power plants). The output and production processes of the two businesses are interlinked and recycled, ensuring a circular approach to both industries.

THE WORLD'S LARGEST CHIP WASHING AND PRESSURIZED REFINING SYSTEM

Guangxi Chongzuo Lelin Forestry Development Company has started up the world's largest chip washing and pressurized refining system, supplied

by ANDRITZ. The system was installed as a key part of its greenfield MDF line in the city of Chongzuo in southern China.

THE PERFECT LOCATION

The new MDF line was built by Guangxi Chongzuo Lelin Forestry Development Company on a new industrial site in Chongzuo City in a mountainous region of southern China's autonomous Guangxi Zhuang region. Chen Zhuo, ANDRITZ's Sales Manager, Panelboard, China says, "The Lelin Group, has developed a reputation for producing high-quality wood products used for the production of furniture for the booming domestic market in southern China, as well as for export."

QUALITY IS THE KEY

As consumer awareness grows regarding sustainability and health concerns, the company specializes in crafting high-quality fiberboards, placing a strong emphasis on their environmentally friendly nature.

The company has significantly set itself apart from the hundreds of other MDF producers in the region. The location of the new line has been carefully selected bearing in mind both the availability of raw materials and the location of furniture producers, which are mainly situated in the neighboring Guangdong Province.

GOING LARGE

In 2020, in view of the booming market, the Lelin Group decided to enhance its growing reputation in the production of quality fiberboard by building a high-capacity, energy-efficient MDF line to meet the demand for its products. "MDF is a cost-driven commodities industry," says Michael Rupp,

Vice President Panelboard at ANDRITZ. "And it is essential that the fiberboards are of a high quality. To be successful and profitable, an MDF plant has to meet a number of prerequisites; enough raw material nearby, a well-organized and energy-efficient production line, and good logistics infrastructure for delivery to customers. The same number of people are needed to run an MDF plant whatever its size. So after some consultation, the company made the decision to go large."

ONLY THE VERY BEST

The Lelin Group wanted only the very best in energy efficient equipment for its new MDF line, so that it could not only produce more high-quality fiberboards, but also operate with minimum energy consumption. ANDRITZ was chosen to supply chip washing and pressurized refining equipment for a number of reasons, says Rupp, "We already have some of the world's largest and most energy-efficient references in the MDF industry, including what was the largest line located in South America. But it's not just about size. We are the market leader in this area across the board, with a majority share



"The complete system has been built for outstanding production rates with the highest energy efficiency on the new MDF line."

Michael Rupp
Vice President Panelboard
at ANDRITZ



"Despite all challenges, the installation of the equipment went very well."

Yang Kun
Project Manager
at ANDRITZ



The world's largest chip washing and pressurized refining system at Guangxi Lelin Group, China



Team on site at Lelin

SCOPE OF SUPPLY

- Chip washing system
- Chip bin discharger for high capacities
- 28" plug screw feeder; 2.2 MW power
- 84" vertical digester and discharger
- Constant feeder (C-feeder) concept
- World-record S2074M refiner
Capacity: 1,920 t/d
Raw material: Hardwood
Final product: MDF board



ANDRITZ is an expert for complete front-end systems and key components for innovative MDF industry.

of the global market." Zhuo adds, "In the case of the Lelin Group's new line, we have supplied over 180 MDF lines to Chinese producers, so we are already well known in the country. In addition to this, we have a full team of ANDRITZ technology experts based at our service center not far from Chongzuo City in Foshan, Guangdong Province."

CHALLENGES AND OPPORTUNITIES

This was a mammoth project, presenting a real challenge in terms of not only the size and weight of the equipment, but also the enormous hurdles that came with COVID-19 during the entire project phase from sales to start-up.

ONE MACHINE INSTEAD OF TWO

Delivery and installation took place over the space of 13 months, with equipment coming from both in Austria and China. "This was a big project, and unique in its design and size," says Rupp. "The main challenge was to supply a pressurized refining system that could handle a high capacity with just one line. Processing 80 tons of fiber per hour is not really an issue with two lines, but to do it with one line requires a major rethink in terms of the technology needed."

THE NEED FOR CREATIVITY

Yang Kun, Project Manager at ANDRITZ in Foshan, commented on the installation of the equipment, "The plug screw feeder was probably the most challenging part of the installation as its weight and dimensions meant that we had to assemble it on the platform itself because we didn't have a large enough crane on site to lift it."

INFLUENCED BY THE PANDEMIC

Another challenge thrown at ANDRITZ and the Lelin Group was the onset of COVID-19, which coincided with the exact time the decision was made to go ahead with the new line. "The onset of the pandemic made it impossible to have face-to-face meet-

"With our reputation, experience, and service teams, we could assure the company that we could confidently take on a project of this size and scope."



Chen Zhuo
Sales Manager Panelboard
at ANDRITZ

ings with the customer, so we became very experienced in online meetings across time zones and countries as the project developed," says Rupp. "This is where we were really rewarded by having such a good team of people on the ground in China and Austria, and it has to be said that the cooperation across the whole project from customer to supplier was brilliant."

The real challenge came in the installation phase when we sent two engineers from Austria to manage and supervise things and they had to go into quarantine for weeks before engaging in the project. But again, the team in China was exemplary, and some of the skilled workers stayed with the project for months. The whole new line started up pretty much on time, despite these challenges," says Rupp.

ALL TARGETS MET

The brand new MDF line started up in 2022 and is running well and at full capacity. "We are really pleased with this project," says Rupp. "The goal was to enable the customer to save both thermal and electrical energy and we have achieved what we planned to. The line has excellent cleaning efficiency and stable feeding over the complete production rate with our C-Feeder. Moreover, because the line has just one plug feeder and one refiner, only one set of refiner plates needs to be exchanged, thus essentially halving ongoing operating costs. With our design, we succeeded in supplying a system that handles 80 tons of chips per hour, on one line, and which now has huge benefits for the customer when it comes to energy efficiency and operating costs," concludes Rupp.

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Joining Dots to Create a Circle

Recovering and Reusing Secondary Heat Across Pulp Mill Islands

When looking at circularity and sustainability at a pulp mill, it's easy to just focus on individual process islands, for example, cooking, evaporation or drying in order to improve environmental performance. However, when zooming out and looking at the whole picture, there are huge opportunities for linking islands and recovering and reusing secondary heat.

ANDRITZ is firmly committed to helping customers reach their sustainability goals as they seek ways to reduce carbon footprint and minimize raw material use. The fiberline and drying islands at pulp mills have enormous potential to reuse each other's secondary heat by installing technology to capture and transport the excess heat and use it in other process areas, thus lowering the carbon footprint as well as making major savings in energy and raw water usage.

WORKING ACROSS BORDERS TO OBTAIN ADDED BENEFITS

"When dealing with secondary heat utilization in pulp mills, the focus up until now has been very much on the individual islands, for instance, cooking, evaporation or drying," says Jussi Piira, ANDRITZ Director, Sustainable Solutions. "However, at ANDRITZ we have been stepping back and taking a more holistic view and working on solutions that cross the borders of the process islands and identifying any secondary heat that can be utilized in another process on another island."

"This has been quite difficult to explain to customers in the past as they tend to be focused on one

area in particular," adds Paavo Tolonen, ANDRITZ Vice President, Global Product Group Manager, Cooking. "So, it's when we zoom out and take a wider look at the mill, a bigger picture emerges of where secondary heat opportunities can be identified across the process islands."

Basically, the idea is that relatively small-sized equipment is installed around the mill's "receiving" process islands that can convert secondary heat to generate clean steam for the process without having to use valuable boiler generated steam. This heat is pumped to the process island from the heat exhaust of the "supplying" process island – the one generating secondary heat.

Several benefits are obtained from this heat recovery, including savings in energy, recovery of clean condensates, optimized water, and secondary condensate utilization. Secondary heat can also be recovered from effluent and other sources.

As well as environmental benefits, there are also financial rewards. "The cost benefits come when we return the primary condensate to the boiler house and we don't need to create boiler water from raw

water," says Aki Muhli, ANDRITZ Technology Manager, Cooking. "In this way we save energy, raw water and demineralization costs, which can add up to substantial amounts of retained revenue.

"Furthermore, the maximum utilization of raw water is becoming increasingly important as we have seen with record high temperatures and drought being experienced across Europe and other parts of the globe recently."

MINIMIZED ENVIRONMENTAL IMPACT - MAXIMUM SAFETY

ANDRITZ has developed several solutions to utilize secondary heat across fiberlines at pulp mills by closing loops across the following processes.

DIRECT STEAM REPLACER

The direct steam replacer enables reduced boiler and raw water usage. In this case, clean low-pressure steam is generated from condensate. The heat resource is low pressure steam from the boiler.

Benefits of a Direct Steam Replacer: reduced boiler water consumption, less boiler water to be heated,

Vapor reboiler converts clean condensate to fresh steam.



Patented Direct Steam Replacer (DSR) process produces steam from mill condensate.

→ increased clean condensate recovery and less condensate to wastewater handling.

Highlights:

- Clean condensate from fresh steam is returned to the boiler water.
- Secondary condensates or other suitable clean water streams are used as a steam source for direct steam applications.

Patented Direct Steam Replacer (DSR) process produces steam from mill condensate.

VAPOR REBOILER

Clean condensate is converted to fresh steam using the flash stream as a heat source.

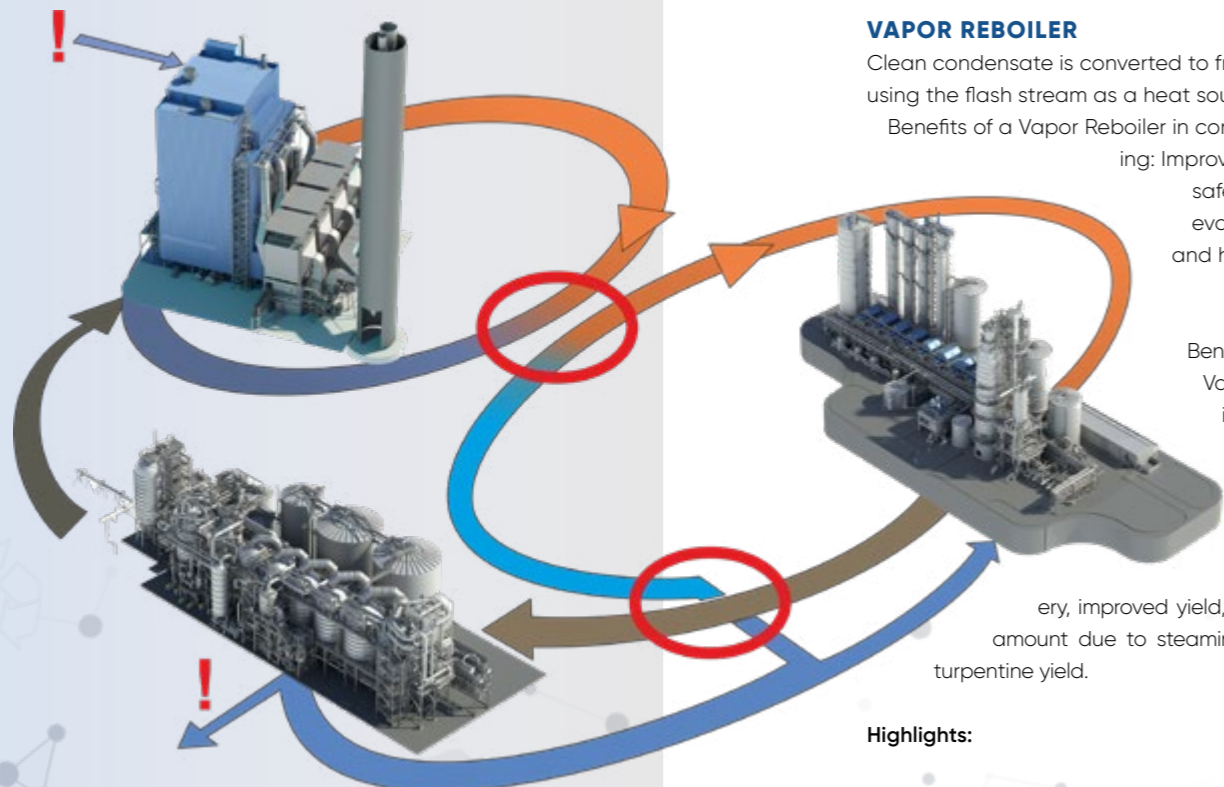
Benefits of a Vapor Reboiler in continuous cooking: Improved health and safety, decreased evaporation load, and high turpentine recovery.

Benefits of a Vapor Reboiler in batch cooking: reduced consumption due to secondary heat recovery, improved yield, reduced shive amount due to steaming, and higher turpentine yield.

Highlights:

- Health and safety is one of the major benefits with the utilization of the Vapor Reboiler as it reduces or eliminates sulfuric compounds, turpentine and tall oil process based risk when collecting gases from the chip bin.
- Flash steam condenses inside the tubes.
- Falling film of condensate keeps heat transfer surfaces clean from fibers.
- Clean steam generated from secondary condensate is removed through a central pipe upwards.

Vapor reboiler converts clean condensate to fresh steam. The heat resource is flash steam.



DIGESTER EVAPORATOR

Steam to the digester is generated from black liquor using MP steam as a heat source.

Benefits of a Digester Evaporator in continuous cooking: Higher black liquor dry solids content to evaporation, smaller heating surface and steam consumption in the evaporation plant, and increased return rate for primary condensate.

Benefits of a Digester Evaporator in batch cooking: Energy savings from reduced steam consumption, increases dry solid content in the black liquor and decreased evaporation load.

Highlights:

- Evaporation of water from weak black liquor from digester upper extraction to be used in digester top for heating.
- Medium pressure secondary vapor from DEvap to digester top replaces direct steam injection to the digester top.
- High dry solids liquor from DEvap increases overall dry solids and decrease black liquor to evaporation.

REACHING SUSTAINABILITY GOALS

Maximizing secondary heat usage at pulp mills is now well within reach of all pulp mills and ANDRITZ customers are already seeing rewards with the various technologies being installed around the world. Whether a greenfield development, or an existing mill, the utilization of secondary heat at pulp mills represents an excellent opportunity to further circularize production across the mill, at the same time as make major financial savings.

Piira concludes, "As environmental regulations get tighter, and pulp producers focus on their sustainability goals, it makes perfect sense to utilize every possible area around the mill where reuse of resources is possible."

"Secondary heat utilization is an excellent solution for our customers to assist them as they aim to reach their sustainably goals at the same time as making major financial savings on energy, water, and raw material usage."

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IMPROVED ENERGY BALANCE WITH SECONDARY HEAT IN PULP DRYING

There is a lot of R&D development going on at ANDRITZ as it seeks to reuse secondary heat from mill processes also in the drying line at pulp mills – and excellent results are already being obtained.

Ola Larsson, Director, Technology and R&D, Drying, ANDRITZ, says "This is an area where we have a lot of development going on right now, looking at all possibilities of where secondary, low value heat can be reused. We already have an impressive example at a mill in Sweden where we are saving up to 30% of fresh steam in the drying process by using secondary heat obtained from the boiler stack."

The ANDRITZ Steam Saving System in this case is taking energy from the stack, producing hot water and releasing the pressure of the water as low-pressure steam, which is then fed to the dryer. The recovered energy is supplying some 20–30% of a pulp dryers need.

"This is a classic case of circularity at pulp mills as we recover energy, and in a long run, save fresh water," continues Larsson. "Both resources are under the spotlight as mills try to reduce costs and improve on raw material and energy usage."

ANDRITZ is also working on recovering energy from the drying process, which will again be utilized elsewhere in pulp mill processes.

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Case Study:

Recovering and Reusing Secondary Heat in Action

Installation of a Digester Evaporator (DEvap) at Heinzl Pöls, Austria

Heinzl Pöls was looking to make improvements to solve a bottleneck in its evaporation plant in order to increase pulp capacity. The mill is one of the largest producers of elemental chlorine-free (ECF) bleached softwood sulphate pulp in Central and Eastern Europe.

After close collaboration with ANDRITZ experts, the mill made the decision to install the world's first DEvap digester evaporator at an existing mill, retrofitting the new concept during a project that took place in 2021. The first greenfield installation took place at Metsä Fibre's Äänekoski bioproduct mill in Finland.

The DEvap concept has been designed by ANDRITZ to save energy and water use in several areas of the pulping process, as well as the possibility of increasing capacity in the evaporation plant. The concept works by replacing medium pressure steam (MPS) used in the digester top with secondary vapor evaporated from the discharged black liquor. In the DEvap evaporator unit, MPS is used as an energy source. The heat of the condensation of the fresh MPS is used to generate secondary vapor from the black liquor.

"We were convinced by the concept of the DEvap system right from the beginning simply because it's such a good idea," says Siegfried Gruber, Head of Project Engineering, Heinzl Pöls. "The system has now been retrofitted onto our digester at the mill, which is nearly 40 years old, and has made a big difference in terms of higher

capacity from the evaporation plant as well as greatly improving energy and water efficiency at the mill."

In terms of benefits, the DEvap system enables higher black liquor dry solids and lower black liquor flow going for evaporation, which leads to reduced steam consumption in the evaporation plant and lower boiler water consumption. In the DEvap pre-evaporation of the black liquor takes place, so less evaporation needs to be done in the actual evaporation plant, thus resulting in the saving of steam consumption. This also means less capacity is used in the evaporation plant.

"The big benefit to us is that we save the whole middle pressure steam condensate, which is about 40 tonnes per hour," says Gruber. "Before the installation of the DEvap system the steam went direct to the digester. Now we heat indirectly so we get back the whole condensate and save a lot of water; before the installation we were taking 40 tonnes per hour or more of water from the river, and then we had to make it ready to produce condensate and steam out of it by heating it up from 12 °C. Also, the condensate is very hot, around 160 °C, which we then put back into the recovery boiler system, so we also save a lot of energy there.

"One of the most important benefits of the installation was that it solved one of the biggest bottlenecks in the mill in the evaporation plant. Now this is resolved, and we have a surplus capacity in the plant of 7-8%."

Robert Zaiser, Pulp Mill Manager, Heinzl Pöls, agrees, "From the production side we are very happy with the DEvap system, despite being a little skeptical to begin with. We need to run the digester at this mill with a very high load, and we cannot have any negative influences or disturbances to the operation. However, we have had only minor problems with the operation since the installation, and our fiberline operators are really satisfied with how it performs.

"There is also an added, hidden benefit we have noticed; since the installation of the system, we immediately saw a 5% decrease in bleaching chemical usage, which was a very pleasant surprise."

The project to increase capacity at the mill was carried out over the space of a year, which included the installation of the DEvap system from ANDRITZ. Gruber concludes, "Solving the bottleneck in the evaporation plant allows us to quickly increase capacity. We are now running at a capacity of 460,000 t/y with 470,000 t/y possible in the near future.

"We have seldom had a project at this mill which has ended up with so many advantages and benefits as we have seen with the installation of the DEvap system."

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DEvap installation at Heinzl Pöls, Austria

RESEARCH PROJECT ABOUT CIRCULAR ECONOMY FOR FORMING FABRICS STARTED

Reutlingen, Germany, September 2022. Conservation of resources, reduction of energy consumption, CO₂ reduction, closed-loop circular economy - these are all firmly established cornerstones of ANDRITZ's sustainability strategy. Bringing its economic, environmental, and social objectives in line with the major challenges of a raw material and energy environment going through radical changes globally is an urgent task faced by the company. ANDRITZ's R&D specialists explore and develop new technologies to make the valuable resources used in paper production sustainable during unprecedented climate change.

The R&D project "Tex2Mat" for the recycling of waste materials in the production of press felts at the main site in Gloggnitz, which has received funding and been awarded a national prize for environmental technology in recent years, shows how seriously the company takes its responsibility to ensure a future-proof, sustainable transformation. This results in the production of paper machine clothing that

mitigates climate change. As a result of the consistently positive feedback from customers who have used felts made from a mixture of new and recycled material for the

first time, the proportion of recycled material in press felt production is continuously being increased - thus promoting a circular economy that is sustainable in the long term.

AIMING TO ACHIEVE A CLOSED-LOOP MATERIAL CYCLE WITH FORMING FABRIC RECYCLING

Based on this success, ANDRITZ is now pursuing its next recycling research project about Paper Machine Clothing (PMC) for forming fabrics that are made from polyamide (PA) and polyethylene terephthalate (PET). The main aim of the new research project named "ReFibreValue", which is funded by the FFG (Bridge2 funding programme No. 895423) following the EU Green Deal Waste Framework Directive 2008/98 and the EU Circular Economy Framework.

Directive 2018/851 is the research and development of a completely carbon-neutral material cycle. From

the transport of the used forming fabrics from paper production sites and the following recycling processes, including cleaning and separation of the PA and PET, to the subsequent return of the recycled material to the production of new monofilaments and production of new forming fabrics, there should ultimately be a continuous, closed-loop, resource-saving and energy-saving cycle, with the up to now usual thermal disposal of material waste associated with high CO₂ emissions being reduced to zero in the long term.

Together with partners from the paper industry and Montanuniversität Leoben (MUL - Montanuniversität Leoben), including its departments for Polymer Processing, Materials Science and Testing of Polymers, Resources Innovation Center, Waste Processing Technology and Waste Management, as well as Mineral Processing, the R&D team at the Reutlingen production site is now starting the research project and in order to achieve a positive result similar to the outcome achieved by their colleagues in press felt production at Gloggnitz.

FUNDAMENTAL RESEARCH AS THE BASIS FOR NEW TECHNOLOGIES IN SYNTHETICS RECYCLING

The new ANDRITZ Recycling Technology Center - known as the ART Center - enables recycling trials to be conducted under real production conditions with industrial-sized equipment. The units can be used for primary and secondary shredding as well as for fine granulation of composite materials. ANDRITZ also has a polymer sorting process at

its disposal that is characterized by high separation performance, especially when high-purity products are required and when polymer mixtures with a wide range of different particle sizes and shapes are also present. The core unit of this process is the CENSOR ACZ, a sorting centrifuge that separates, washes, and dewateres the raw material simultaneously. As a result, tests are possible with very different waste streams and complete recycling processes can be replicated.

The same site also accommodates the newly opened Digital Waste Research Lab of the University of Leoben - a research center for waste processing and waste management. The cooperation between ANDRITZ and the Montanuniversität Leoben creates synergies between research and business leading to the development of technologies and products needed to meet the future requirements of the recycling industry.

Circulyzer GmbH - a start-up and spin-off of Montanuniversität Leoben is also a vital part of the research project and supports the project with its separation technology. As the separation



Step 2: Reduced to coarse shredded pieces.



Step 3: Cutting unit in the ART Center and fine shredding

Step 1: Used ANDRITZ forming fabrics return



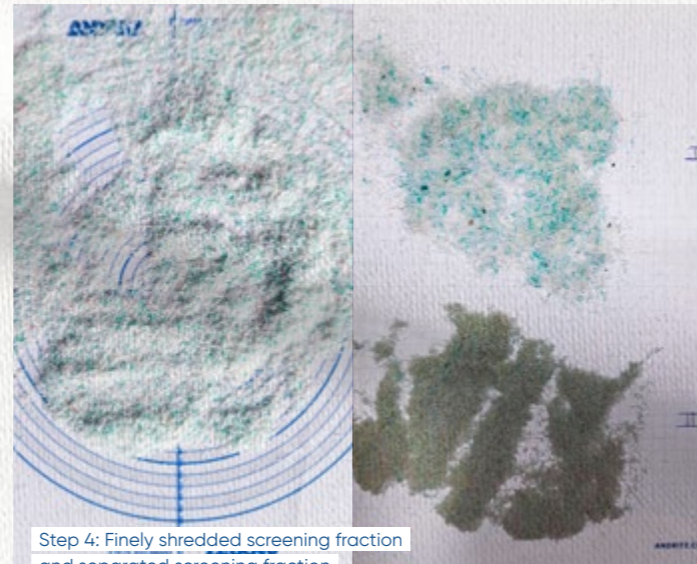
SPECTRUM PODCAST



Mark Rushton,
Host of the ANDRITZ
SPECTRUM Podcast



Home base for R&D inventors: the new ANDRITZ Recycling Technology Center – for short ART – in St. Michael



Step 4: Finely shredded screening fraction and separated screening fraction

of the two main components of the forming fabric, (PA) and (PET) mixtures, is much more difficult than with PA synthetics exclusively used for press felts, special attention is given to this process.

So far, there have been no processes for this that make separation worthwhile in terms of economics and the environment. This shows that well-founded basic research is necessary as a starting point for the entire recycling process, so that real future-oriented technologies can be developed rather than just striving to achieve quick, superficial results that then fail to achieve a closed-loop recycling economy when implemented.

This joint research initiative combining science and industry is all the more valuable when the aim is to meet the long-term requirements in polymer recycling. This may become even more important, given the sharp rise in energy prices and availability of raw materials and the need for sustainable CO₂ reduction in the future based on legal requirements, e.g., through the introduction of mandatory recycling quotas for industrial waste. Jan Freudenberg, Director R&D Forming Fabrics Global, who is in charge of the research cooperation at ANDRITZ, and his team are convinced that at the end of the research and development phase, involving intensive analysis work and extensive tests, a recycling technology will have been created that is both economically and environmentally sustainable.

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HELLO TO ALL FRIENDS & FANS OF THE PULP, PAPER, AND BIOPRODUCTS INDUSTRY! WELCOME TO OUR EXCITING ANDRITZ SPECTRUM PODCAST – SEASON 2.

In the second season of our podcast, we will bring together the trends, challenges, and solutions that matter most to ANDRITZ customers when it comes to sustainability.

You will have the chance to listen to expert views on all aspects of sustainability as we discuss the latest developments in our industry. We will deep dive into the world of the latest innovations and solutions for reducing the carbon footprint and managing energy use, as well as exciting journeys into the latest mill and technology start-ups.

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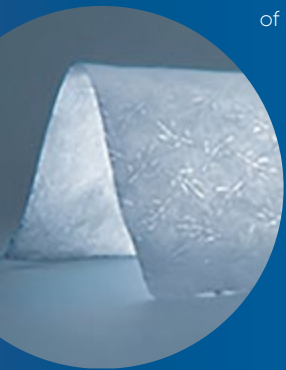
Season 2

DID YOU KNOW THAT...

... ANDRITZ ACQUIRED DAN-WEB MACHINERY A/S, DENMARK TO FURTHER EXTEND AND STRENGTHEN ITS PRODUCT AND SERVICE PORTFOLIO IN THE FIELD OF NONWOVENS?

Dan-Web engineers, designs, and builds customized machines and turnkey plants to produce airlaid nonwovens for baby diapers, fem care, incontinence products, wipes, and other applications. With 50 employees at the facility in Galten, the company has been a successful provider of equipment and services to the airlaid industry for almost 50 years.

With this acquisition, ANDRITZ is not only adding competence in airlaid technology to its comprehensive nonwoven and textile product portfolio; Dan-Web is also active in the development of standardized equipment for Dry Molded Fiber (DMF) to replace single-use plastics with affordable, fiber-based alternatives, mainly optimized for packaging and ready for food-grade production.



... ANDRITZ WILL PROVIDE A CARBON CAPTURE STUDY FOR PORI ENERGIA HEAT AND POWER STATION IN FINLAND?

ANDRITZ has received an order from Pori Energia Oy, Finland, to conduct a feasibility study on a carbon capture and storage plant planned to be built at the city of Pori's Aittaluoto combined heat and power station (CHP).

The study will provide the design and cost calculation for a turnkey carbon capture plant with a capacity of 100,000 t/a, including liquefaction, intermediate storage, and off-loading. In addition, ANDRITZ will also investigate the benefits of oxy rich combustion for increased CO₂ concentration in the flue gases and thus overall reduced capital investments.



... ANDRITZ, PELLENC ST, AND NOUVELLES FIBRES TEXTILES HAVE JOINED FORCES TO START UP THE FIRST INDUSTRIAL-SCALE AUTOMATIC TEXTILE SORTING LINE IN FRANCE?

All three partners have expert knowledge from decades of experience in sorting technologies, textile machinery and processes, as well as post-consumer textile value chains from sorting to manufacturing.

The new textile sorting line being built is the first to combine Pellenc ST's automated sorting technologies with ANDRITZ's recycling technologies. It will be mainly dedicated to R&D activities and process post-consumer textile wastes to produce recycled fiber engineered for the spinning, nonwoven, and composite industries. The launch of the project marks a significant milestone in the textile industry's efforts to revolutionize recycling.

