

met



GLOBAL TISSUE OUTLOOK

MENA tissue producers

Upheaval of the
bioindustry sector

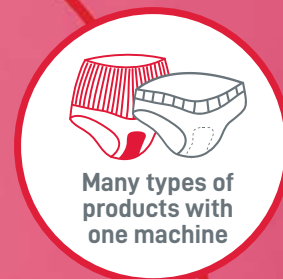
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GREECE

A.Celli Tissue line supplied to Intertrade Hellas enters operation

The A.Celli tissue line has been successfully started up at Intertrade Hellas plant in Inofyta, Viotia (Athens), perfectly in line with the contract timelines and with great satisfaction for both companies.

The supply includes the following solutions: stock preparation line, A.Celli iDEAL® Master 2000L tissue machine with web width of 5600 mm, design speed of 2100 mpm and working speed of 2000 mpm, 16" Forged Yankee Dryer, with a width of 6085 mm, 5600 mm wide three-ply E-WIND® T200 slitter rewinder, with a speed of 1800 mpm, R-WAY® automatic reel handling system composed of conveyor belt, wrapper, up-ender and labeling system.

A.Celli also provided its exclusive designed DCS process control system and an Industry 4.0-ready automation platform, developed to integrate the numerous systems implemented in Intertrade Hellas' plant.

The tissue line is expected to reach a production capacity of 244 tpd or 221 tpd, respectively for tissue paper with basis weight of 20 gsm and 16 gsm. "The A.Celli iDEAL® Master 2000L combines high efficiency and superb tissue quality with minimum energy consumption. Over the last 2 years A.Celli has been proven a valuable partner in every stage of the process. We are indeed very happy with our decision: A.Celli fulfils the highest standards in Tissue machines" says Ioannis Delidimos, CEO of Intertrade Hellas S.A.

Alessandro Celli, member of the A.Celli Paper Board of Directors, says: "This project started in full spirit of collaboration with Intertrade, defining all the guidelines together. The successful start-up of the supplied line, which includes our exclusive forged Yankee Dryer, an automatic reel handling system and innovative Industry 4.0 solutions, is the result of the excellent collaboration between our two companies and trust placed by Intertrade in our know-how and technology".



A.Celli iDEAL® Master 2000L at Intertrade Hellas plant in Inofyta, Greece.

FRANCE

Toscotec to install 250th TT SYD Steel Yankee Dryer at WEPA

WEPA France has selected Toscotec to install a TT SYD Steel Yankee Dryer on PM11 at its Bousbecque plant near Lille. The new Yankee will replace an existing cast iron cylinder. This order is an integral part of WEPA's strategic plan to boost the energy efficiency of its operations and reduce CO2 emissions. Toscotec's Steel Yankee will ensure the highest possible energy efficiency in the drying section of the tissue machine, with substantial thermal energy savings compared with the existing cast iron cylinder.

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Since WEPA installed its first Toscotec's Steel Yankee in 2006, it never went back to the old technology of cast iron dryers. Riccardo Gennai, Toscotec's Sales Manager, says: "It is a pleasure to work again with WEPA France after a series of successful rebuilds of PM11, and the start-up of PM18 turnkey tissue project at their mill. This order strengthens our partnership with the WEPA Group that began more than 20 years ago". WEPA is among the three largest European manufacturers and leading the market in the production of hygiene paper from recycled fibre. Its annual turnover is roughly 1.3 billion euro.

With over 250 TT SYD sold, Toscotec is a market leader of Steel Yankee Dryers holding a large majority of the global market share. Toscotec's TT SYD was the first Yankee dryer made of steel to start up in a tissue mill in 2000, it is present in more than 45 countries across 5 continents, and in Europe alone it has close to 95% of the market share. TT SYD embraces a whole breadth of applications: conventional tissue, TAD, MG paper, and tobacco.



Toscotec TT SYD Steel Yankee Dryer



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ANDRITZ

POLAND

Velvet CARE buys Almus

Velvet CARE has signed a preliminary agreement to purchase of 100% shares in ALMUS, the Polish manufacturer of toilet paper and paper towels in Słomniki, Małopolska Province.

After finalisation and merger of the companies, the Velvet CARE Group (currently consisting of Velvet CARE Sp. z o.o. and the Czech company Moracell) will increase the processing capacity by almost 40% to the level of approx. 250,000 tons annually. The Velvet CARE Group will then have at its disposal 23 processing lines, three paper machines and five warehouses located in three production plants in Klucze, Słomniki and Žabčice (Czech Republic).

ALMUS has a modern production plant with five processing lines producing of 70,000 tons annually of toilet paper, paper towels and professional products for institutional clients.

ALMUS is a supplier of products sold under private labels by commercial brands in Poland and abroad and a manufacturer of paper products under the Almusso brand.

Artur Pielak, president of Velvet CARE comments: “The acquisition of ALMUS is a strategic decision that reinforces our position as a leader in the paper industry in the Central Europe region. After the historic moment in 2022, namely when the threshold of PLN 1 billion turnover was exceeded and after incorporating ALMUS in the structure of the Velvet CARE Group, the Management Board is ready to designate new ambitious goals. Another milestone that we plan to accomplish by 2025 is the turnover on the level of PLN 2 billion.”

ITALY

Taiprora becomes part of Italia Technology Alliance (A.Celli Group)

Italia Technology Alliance (ITA Holding) continues its strategic development and welcomes Taiprora S.r.l., a well-established company from Abruzzo that has been developing Software and Automation systems for production and intralogistics for 30 years, into its social structure.

ITA Holding, with the aim of strengthening its presence in both the national and international market for advanced intralogistics solutions, has identified Taiprora S.r.l. as the ideal company to integrate its knowledge for the supply of fleets of vehicles and stacker cranes for automatic warehouses, as well as development of software for internal logistics flows (WCS - WMS). The objective of this operation is part of the larger development plan that ITA Holding carries out at a strategic level: that is, to promote technological innovation not only in the traditional paper, tissue and nonwoven industries, but also in other markets such as pharmaceutical, automotive, food, multipurpose, etc. With the entry of Taiprora S.r.l., technological expertise increases with a view to maximum integration of complex solutions provided by a single reliable and qualified supplier of state-of-the-art technology.

Commenting on the news, Francesco Alfieri, President of Taiprora, said: “The operation is the result of the integration of two different worlds and sectors, but which share an extremely wide and interesting area of contact. The basis of the agreement with ITA Holding is the common factor of a great aptitude towards innovation and internationalization. Our goal is to continue growing by valuing the identity of Taiprora. We want to increase research and focus on creative innovation to achieve ambitious goals in a future full of opportunities and challenges for us and our territory.”

Mauro Celli, shareholder of ITA Holding, said: “Our development model is based on the acquisition of new skills to create more value for our customers, ensuring proven solutions and measurable results with the best practices of the global market. We invest in leading companies in their sector that have a history of reliability and good reputation. The entry of Taiprora corresponds exactly to these success criteria and complements the group’s digital offering: from the user interface of the production line to logistics and warehouse management, to IoT and Big Data analysis.”

ITA Holding, of which the best-known brand is A.Celli, is the holding company of the Celli family that includes a series of manufacturers of industrial machinery and technological solutions for the paper, tissue and nonwoven markets as well as other companies active in digital development, IoT, machine learning and AI. Taiprora customers include Sanofi, Pfizer, Menarini, Dayco, Honda, Yanfeng, De Cecco, Ferrero, Findus, Aptar, Tod’s and many others.



Mauro Celli, shareholder of ITA Holding and Francesco Alfieri, President of Taiprora during the signing ceremony.

SWEDEN

Valmet receives a tissue line order for Metsä Tissue's new Future Mill project

Valmet will supply a new tissue production line with the latest technology to Metsä Tissue's mill in Mariestad, Sweden. The delivery also includes an extensive package of stock preparation, automation and service solutions. The order is part of Metsä Tissue's development program "Future Mill", aiming for world class environmental and technological performance in tissue production.

The order is included in Valmet's orders received of the first quarter 2023.

Valmet and Metsä Tissue have a long history of cooperation. Recently the PM 10 machine at the customer's Mänttä mill in Finland was successfully rebuilt.

"With the new tissue machine, we will increase the offering of locally produced sustainable virgin fiber-based tissue paper to the Scandinavian market. It enables reliable local deliveries of high-quality tissue to the consumers. The new technology brings big environmental benefits. In addition to the energy savings, we can reduce the process water in the paper making process by 50 percent," says Esa Paavolainen, Vice President projects, Metsä Tissue.

The new tissue machine will have a design speed of 2,200 m/min and is optimized for low energy consumption and enhanced quality of the final product.

Valmet's scope of delivery will comprise a complete tissue production line featuring full stock preparation with bale handling and a Valmet Advantage DCT 200 TS tissue machine with latest technology for high efficiency, low energy and water consumption and reduced CO2 emissions.

The new line will add 70,000 tons of tissue made from virgin fiber to the mill's current production. The mill's total annual capacity will increase to 145,000 tons.

Metsä Tissue is one of the leading tissue paper suppliers to households and professionals in Europe and one of the leading greaseproof paper suppliers globally. Their brands are Lambi, Serla, Mola, Tento, Katrin and SAGA. With production units in five countries, it employs around 2,450 people. In 2022, their sales totaled EUR 1.2 billion. Metsä Tissue is part of Metsä Group.

UNITED KINGDOM

WEPA Group doubles production capacity in UK

The WEPA Group has started up a new paper machine at its Welsh site in Bridgend, thus doubling its production capacity for the British market. The paper produced is converted into toilet and kitchen paper for the UK consumer market in which WEPA has a leading role. The investment created over 50 new jobs at the site. The new paper machine has a production capacity of 70,000 tons of tissue paper per year and is designed to produce hygiene paper products from virgin fibres as well as 100% recycled fibres. With its high energy efficiency, the new tissue machine sourced from manufacturer Valmet also significantly contributes to cutting CO2 emissions and water usage. This saves resources and optimizes cost structures. The investment project includes new buildings to house the stock preparation equipment and the new paper machine. In parallel, several converting projects have been executed including a new line for lotioned and perfumed bathroom tissue products.

Martin Krengel, CEO of the WEPA Group: "With the largest single investment in the history of the WEPA Group, we are further strengthening our claim to both: technology leadership and market leadership for sustainable hygiene papers." The site in Bridgend has been part of the WEPA Group since 2013 – initially as a joint venture before being fully acquired in 2018. With this investment, the WEPA Group strengthens its competitive capability as one of the three largest European manufacturers in the hygiene paper market. With a total of 22 paper machines, the group has a production capacity of approximately 850,000 tons per year.

Accrol Papers will build new paper mill

The new tissue mill is expected to be operational by mid-2025 with a cost of £10M. It will have one machine producing 70,000 tonnes in a single grade, representing 40% of Accrol's annual tissue volume make.

"Over the last four years, Accrol has been transformed as an organisation to one that currently supplies c.21.5% of the UK market's tissue volumes and has considerable further capacity. Our state-of-the-art businesses are in an incredibly strong position to benefit in a private label market, which is growing rapidly and significantly. Our customer base is strong and varied and the ability to pass-on cost increases swiftly has been evidenced in the Group's Half Year Results. We look forward with increased confidence, having clearly identified where we can grow the business." said Dan Wright, Executive Chairman of Accrol.

INDIA

Gayatrishakti enters the tissue market with Toscotec machine

Toscotec will supply a complete AHEAD 1.8 tissue machine to Gayatrishakti Tissue, to be installed at their paper mill in Vapi, Gujarat. The Indian manufacturer is entering the tissue market with this new line slated for start-up in 2024.

The AHEAD 1.8 tissue machine has sheet trim width of 2,850 mm, an operating speed of 1,800 m/min, a production of over 35,000 tpy.

It features Toscotec's best-in-class drying configuration including an upgraded design shoe press TT NextPress, a third-generation design TT SYD Steel Yankee Dryer and high-efficiency TT Hood.

Shri G. N. Agarwal, Managing Director of Gayatrishakti Paper & Board, says, "We selected Toscotec because we wanted to invest in state-of-the-art tissue-making technology. We value their solid experience in guiding and sharing their expertise with newcomers in tissue. Gayatrishakti is a well-established board manufacturer in India and based on our strong background in Paper and Board, we understand the importance of choosing the right partner for this new market entry."

Marco Dalle Piagge, Sales Director of Toscotec, says, "Toscotec is committed to providing Gayatrishakti with first class support to ensure their successful penetration of the Indian tissue market. Thanks to Voith's global presence, they can also benefit from local services offered by Voith Paper India. With this new project, Toscotec strengthens its presence in Southeast Asia where we received two new orders of complete tissue lines in 2022."

Gayatrishakti Tissue is a subsidiary of Gayatrishakti Paper & Board Ltd (GSPBL). GSPBL is a leading manufacturer of a range of premium grades of duplex packaging boards and kraft paper. Established in 1996, it has a head office in Mumbai and three manufacturing facilities with a combined installed capacity of 300,000 mta in Vapi & Sarigam GIDC, Gujarat state, India.



Indian Board manufacturer Gayatrishakti enters tissue market

CHINA

Asia Symbol Paper successfully starts up ANDRITZ tissue line with double-width tissue machine

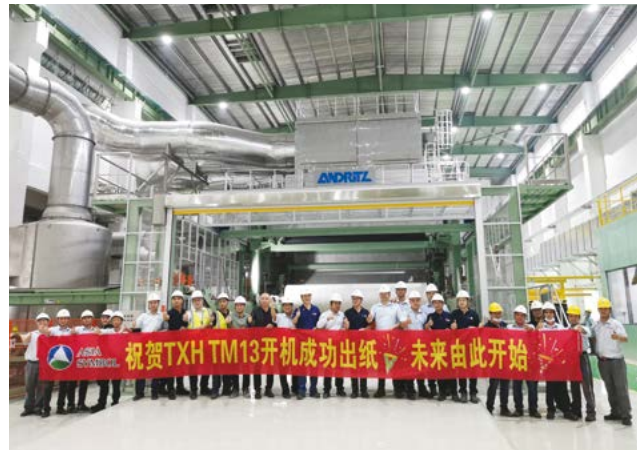
Asia Symbol (Guangdong) Paper, China has successfully started up its tissue production line delivered by ANDRITZ for its mill in Xinhui district, Jiangmen City, Guangdong Province, China.

The complete line order includes the stock preparation system with low-consistency refiners, a PrimeLine™ W 2000 tissue machine and the automation system. The tissue machine has a speed of 1,900 m/min and a width of 5.65 m and produces high quality tissue in the range of 11 – 42 gsm. It is equipped with a PrimePress XT Evo shoe press, a PrimeDry Steel Yankee and a steam-heated PrimeDry Hood ST to enable energy efficient tissue production.

To speed up the process of production, both ANDRITZ and Asia Symbol's team collaborated closely and dedicatedly during the whole stage of installation and commissioning. As a result, the first paper on reel was achieved 16 days ahead of schedule.

Steven Hung Ching Lung, General Manager of Asia Symbol (Guangdong) Paper Co., Ltd, says: "With the new TM13 we enter the tissue business. It is essential for our expansion strategy to provide our customers with high-quality tissues that have minimum impact on the environment. We have a vast experience in the production of high-quality printing and writing papers. Now we want to achieve the same success with ANDRITZ in the tissue market."

Asia Symbol Paper is a leading manufacturer of printing and writing paper in China. The company is part of the RGE Group, a global player focused on sustainable pulp and paper production.



Successful start-up of ANDRITZ tissue production line at Asia Symbol. Photo: ANDRITZ

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AUSTRALIA

A.Celli provides DCS system update for ABC Tissue's PM1

ABC Tissue and A.Celli, whose first project together dates back to 2006, joined forces again to upgrade the DCS system of the PM1 in the Wetherill Park plant, Sydney, Australia.

The planned downtime for the change of the press and felt and the installation of a new Quality Control System (QCS) was the perfect occasion for the A.Celli team to provide the needed interventions, including: the virtualization of the system, thanks to the replacement of 6 physical PCs with a pair of redundant servers, virtual machines and thin client, replacement of 2 obsolete CPUs with a single latest-generation CPU, integration of the new QCS system installed by the company, preparation for communication between the PM1 and the upcoming PM2 which will be supplied by A.Celli.

Furthermore, the new system makes the plant ready for digitization from an Industry 4.0 point of view, with the possibility of collecting data from the machines and sending them via Cloud technology for monitoring and optimization purposes. "Since the beginning of our partnership in 2006 - the start up of the first machine acquired by our company - A.Celli has always provided strong support to us in our quest for continuous improvement. This is why we decided to rely on A.Celli both for the supply of the new PM2, now in the commissioning phase, and for the upgrade of our state-of-the-art PM1, certain of the success of both projects" commented Brandon Ly, Director of ABC Paper Mills.

ABC Tissue is an Australian owned producer of well-known and trusted brands (like Quilton, Naturale, Symphony and Earthcare) of toilet tissue, facial tissue, kitchen towels and napkins. With manufacturing facilities in Queensland, New South Wales and Western Australia and more than 600 employees, the company is now the leading tissue paper product supplier in Australia.



A.Celli provides DCS system update for ABC Tissue's PM1

USA

First Quality Announces Purchase of Domtar's Dryden Mill

First Quality Enterprises and Domtar Corporation, a wholly-owned subsidiary of the Paper Excellence Group, have entered into a definitive agreement for First Quality to acquire Domtar's pulp mill located in Dryden, Ontario, Canada (Dryden Mill). The Dryden Mill produces high quality Northern Bleached Softwood Kraft (NBSK) pulp for customers in North America. Jim Dodge, Chief Financial Officer of First Quality, said, "First Quality saw this as an excellent strategic investment given the knowledgeable leadership team, premium quality NBSK coming from the mill, and the access and availability to high quality fiber supplies long term. We look forward to partnering with the existing mill team members, customers, suppliers, and community stakeholders to continue the mill's successful history of local engagement and economic development" The transaction is expected to close in the third quarter of 2023.

Paper Excellence welcomes Resolute into its family of companies

The Paper Excellence Group, through its wholly-owned subsidiary Domtar Corporation announced the successful closing of its previously announced acquisition of Resolute Forest Products Inc. The acquisition creates a stronger and more resilient diversified forest products company, manufacturing a range of pulp products and specialty, printing, writing, and packaging papers, as well as lumber and tissue.

"We are thrilled to welcome Resolute into the Paper Excellence Group. Resolute's business is complementary to our own. It introduces new products to our offering and allows us to welcome an impressive workforce, strengthening our existing team. We are well positioned with the addition of competitive lumber capacity at a time of significant shortage in housing stock throughout North America," stated Patrick Loulou, Vice Chairman and Chief Strategy Officer of the Paper Excellence Group. "Resolute has shown that it shares our values and high standards related to the environment, our communities, and our people."

Under the terms of the agreement, Resolute stockholders are receiving \$20.50 for each share of the Resolute common stock. They also receive one contingent value right ("CVR") per share (on a fully diluted basis) entitling the holder to a share of potential future softwood lumber duty deposit refunds on about \$500 million of deposits paid by Resolute. Resolute common stock will cease to be listed on the New York Stock Exchange and the Toronto Stock Exchange.

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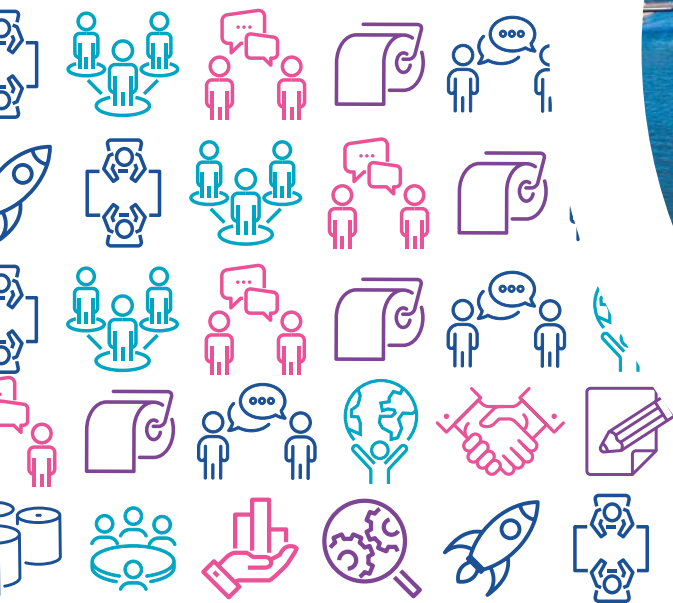
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USA

Marcal Paper Acquires von Drehle Corporation in North Carolina

New Jersey-based tissue producer Marcal Paper has acquired von Drehle Corporation, a premier provider of quality towel and tissue products for the away-from-home market. Von Drehle Corporation will operate as a division of Marcal Paper.

Von Drehle Corporation, founded in 1974, is headquartered in Hickory, North Carolina. The company's more than 500 associates operate production facilities throughout the southeast United States and in Las Vegas, Nevada. The combined company provides customers with a broad product range and enhanced scale, expanding Marcal's footprint to service customers all along the East Coast and across the country.

Founded 90 years ago, Marcal Paper is one of the oldest tissue manufacturing companies in America. Headquartered in Elmwood Park, New Jersey, the company produces tissue products for Away-from-Home and At-Home markets, along with parent rolls.

Procter & Gamble boosts capacity with a new TAD machine

ANDRITZ has received an order from Procter & Gamble (P&G) to supply a PrimeLineTAD (Through-Air Dried) tissue machine for its Family Care plant in Box Elder, Utah, USA. Equipment delivery is scheduled for 2024.

The new PrimeLineTAD machine will be supplied with state-of-the-art energy efficient process equipment to meet P&G's demanding sustainability targets.

ANDRITZ and Procter & Gamble have been strong business partners for many years. In 2007, ANDRITZ supplied and started up a TAD tissue/towel machine at Procter and Gamble's Green Bay, Wisconsin, USA site that fully met P&G's expectations. This was followed by another TAD tissue/towel machine at Procter and Gamble's Box Elder facility, which started up successfully in 2011.

Procter and Gamble, one of the largest manufacturers of premium consumer bath tissues and paper towels in North America, produces the brands of Charmin, Puffs, and Bounty.

Colombia

GrandBay Papelera Internacional starts up new tissue line

GrandBay Papelera Internacional started up a double-width AHEAD 2.2L tissue machine supplied by Toscotec at its Rio Hondo Zacapa site in Guatemala. The new PM7 line will add over 60,000 tons to the mill's annual production capacity.

The GrandBay Group has recently signed with Toscotec to install a second AHEAD 2.2 tissue line (PM5) at Papeles Nacionales' Pereira facility in Colombia. Toscotec will supply the PM5 line as a turnkey operation scheduled to come online in 2024.

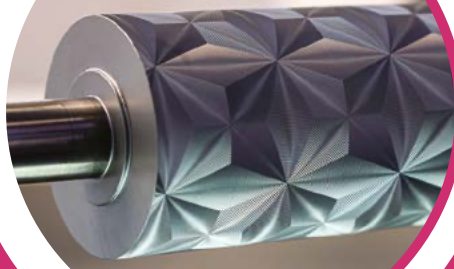
High performance and optimal energy efficiency
The AHEAD 2.2L machine (PM7) has a sheet trim width of 5,500 mm, a design speed of 2,200 m/min, and it is designed to deliver the maximum possible drying efficiency with the lowest energy consumptions.

"This is the first tissue line supplied by Toscotec that we have installed, and we are very satisfied with the project outcome" says Alberto Matos, GrandBay Project Engineering Manager. "The cooperation with Toscotec was very positive throughout the entire project. The start-up went very smoothly, and the machine is producing high quality tissue. We expect it to quickly achieve good runnability and high energy efficiency."

Pier Paolo Brunazzi, Toscotec Project Manager, says, "The partnership with the GrandBay Group is strategical for Toscotec, and we have been very much focused on achieving our common goal. We faced together the current worldwide shipment issues and managed to overcome associated delays with a strong effort from both parties. Today, it is a great satisfaction to see another one of Toscotec's machines successfully started up in the Latin America market where in last few years I personally managed three new tissue line projects."



GrandBay Papelera started up a double-width Toscotec AHEAD 2.2L tissue machine



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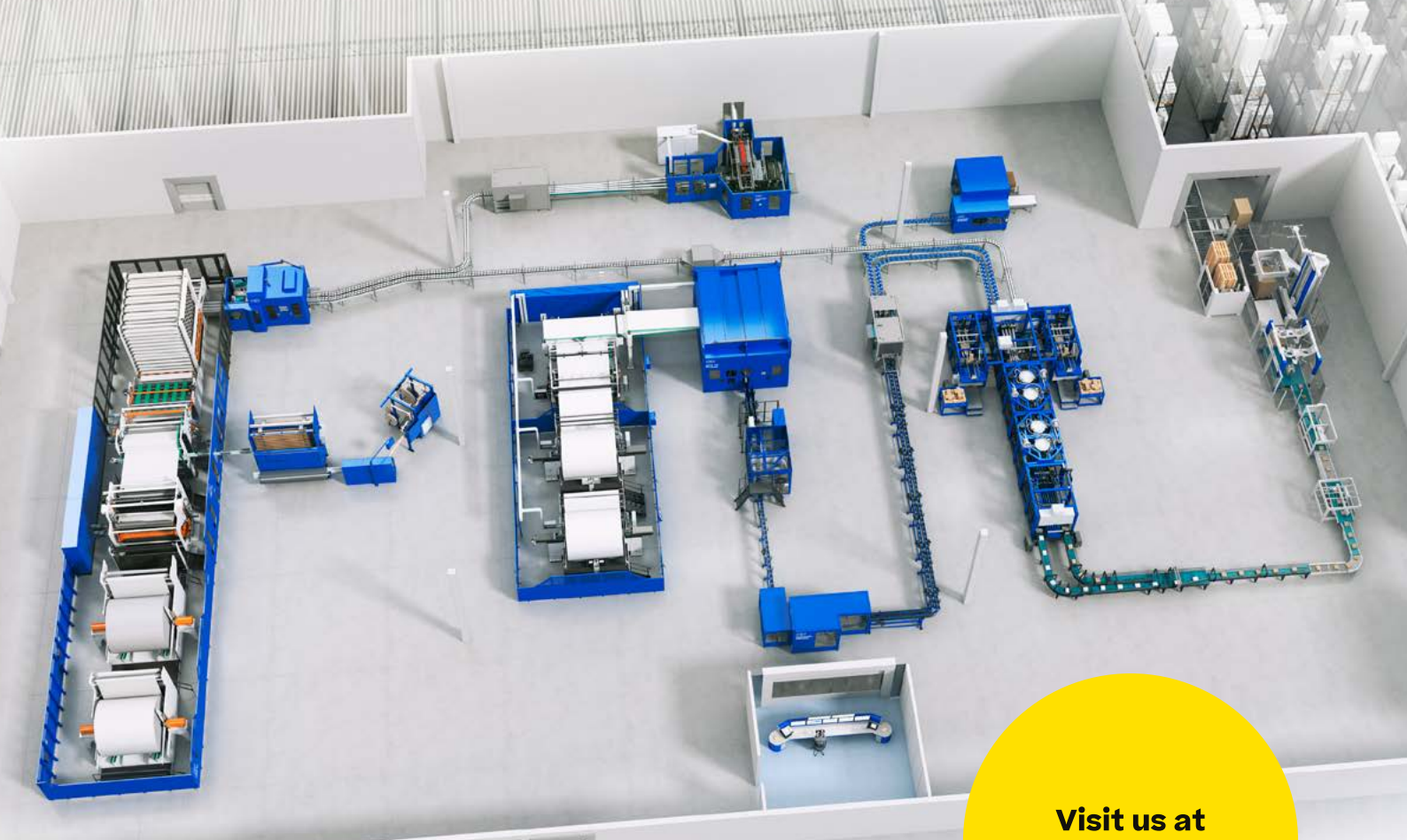
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Esko Uutela
Principal, Tissue
Fastmarkets RISI



RECENT TRENDS IN FIBER USE FOR TISSUE

Fiber use in global tissue manufacture (2001-2021)

- Average growth rate 3.7% per year
- Fiber needs of the global tissue industry have more than doubled from about 23 million tonnes in 2001 to 47 million tonnes in 2021, including all fiber types from wood pulp to recovered fiber and non-wood pulps (bamboo, bagasse, straw etc.).
- Bleached softwood (BSK) and hardwood (BHK) kraft pulps have increased their share of the fiber furnish constantly, the share of wood pulps has increased from 54% in 2001 to 64% in 2021, despite fall in in sulfite and mechanical pulp uses.
- Recycled fiber (RCF) shows slower growth and its share has declined from 41% (2001) to 31% (2021).

Growth by fiber type in global tissue manufacture (2001-2021)

- Total global growth: 24.4 million tonnes (1.22 million tonnes per year)
- BHK has benefitted most of the global tissue market growth and in 2001-2021 accounted for 57% of the total increase in fibers needed in tissue manufacture worldwide.
- BSK is in the second position with a share of 23% of the increase, followed by RCF (21%).
- Sulfite and mechanical pulps have lost volume, while non-wood pulps have won almost the same volume.

Growth by fiber type in tissue manufacture by main region (2001-2021)

- In the past 20 years, Chinese tissue production has grown explosively and so did fiber needs of the domestic tissue industry. Today, about 83% of Chinese tissue is based on wood pulp and 15% on non-wood pulp with bamboo pulp showing growth recently. The use of RCF has radically declined.
- Europe (incl. Turkey) shows the second largest additional fiber needs for tissue, with BHK and RCF benefitted most, the expansion of the Turkish tissue industry has boosted wood pulp demand further.
- North and Latin America have also been important growth regions for both wood pulp and RCF.

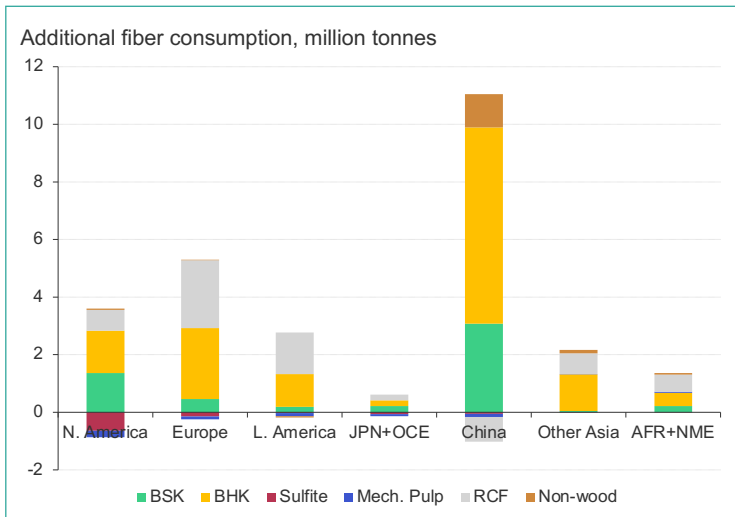


Figure 1: Growth by fiber type in tissue manufacture by main region (2001-2021)
Source: *Fastmarkets RISI*

Changing market pulp use patterns

- China is nowadays the main buyer of market pulp among all regions, taking the place from Western Europe which is currently in the second position. The US is today a much smaller buyer of market pulp than earlier, while emerging markets are of increasing importance.
- Tissue is back on normal growth trend and is the main end use with 41% share, the secular decline in graphic papers has reappeared, and cartonboard is supported by e-commerce and bans on single-use plastics.

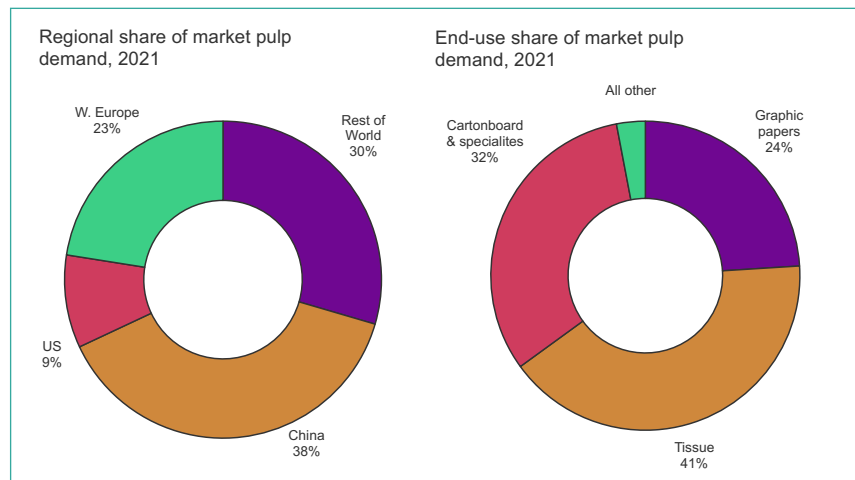


Figure 2: Market pulp use by main region and end use. Source: *Fastmarkets RISI*

GLOBAL TISSUE MARKET OUTLOOK

Western world is losing volume share

- In 2022, global tissue consumption approached the benchmark of 45 million tonnes, of which North America and Western Europe accounted for 38% (to compare, 45% in 2012 and 58% in 2002).
- China is now the largest consumer, but Latin America, Asia Far East and Near and Middle East have also shown positive developments.
- Africa's tissue consumption has recently exceeded the 1-million-tonne benchmark.

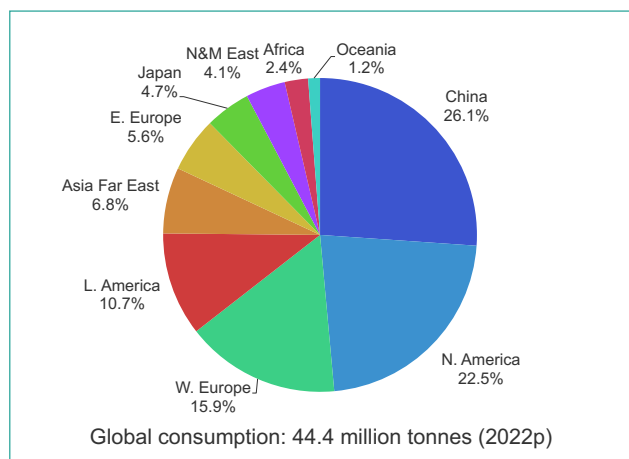


Figure 3: World tissue consumption by region (2022p)
Source: *Fastmarkets RISI*

Growth in the global tissue market

- Relatively stable growth in 2006-2014 with the exception of the Great Recession in 2009.
- Growth accelerated in 2015-2019 but 2018 was weaker due to slowdown in Chinese demand growth.
- The pandemic boosted global consumption growth to a new record of 5.8% in 2020, but 2021 was a hangover year with only 0,7% global growth.
- Our current figures for 2022 suggest return to the same growth level as before the pandemic – 2.5% is our preliminary growth rate for last year.

Volume growth of tissue consumption (2012-2022p)

- The global tissue market shows an average annual volume growth of 1.28 million tonnes in the past ten years, up from 900,000 tonnes in 2002-2012.
- China accounted for 46% of growth, followed by North America with 12%.
- In Europe, growth has substantially decelerated.

Tissue market growth by region (2019-2022p)

- Chinese consumption has recently shown very strong growth with 11% in 2021, but our preliminary figure for 2022 is only 1.9%, affected by the hard lockdown measures by Chinese authorities due to the pandemic.
- Markets in North America and Oceania reacted very positively to the pandemic, but setbacks were also substantial in 2021 while other markets experienced weaker though varying changes in 2020-2021.
- In 2022, most regions seem to have returned on the normal consumption patterns, however changes from 2021 vary depending on how deeply the hangover year had affected the regional market.

Anticipated growth in the global tissue market

- Tissue consumption was at an extraordinary high level in 2020 thanks to product hoarding by consumers, but 2021 showed that what goes up must come down, and 2022 growth was disappointing due to China.
- We expect that 2023 will be a year with below-the-average growth, as the global economy is struggling, and the war consequences have weakened the near-term prospects. But 2024-2025 are expected to be more positive, provided the war will not expand from Ukraine.

Expected growth in global tissue consumption and effective capacity* until 2025

- Tissue capacity has grown more than global consumption in recent years, and so global tissue capacity utilization has continued deteriorate. Only in the pandemic year 2020 capacity and demand increases were almost equal as global demand boomed.
- In 2021 the global demand/supply balance worsened substantially as consumption volume grew only moderately and new expansion investments continued.
- In 2022 capacity grew by almost 1.7 million tonnes more than demand, and outlook for 2023 suggest the 2021 situation will repeat. No new capacity announcements would be needed in the next few years.

*based on announced projects

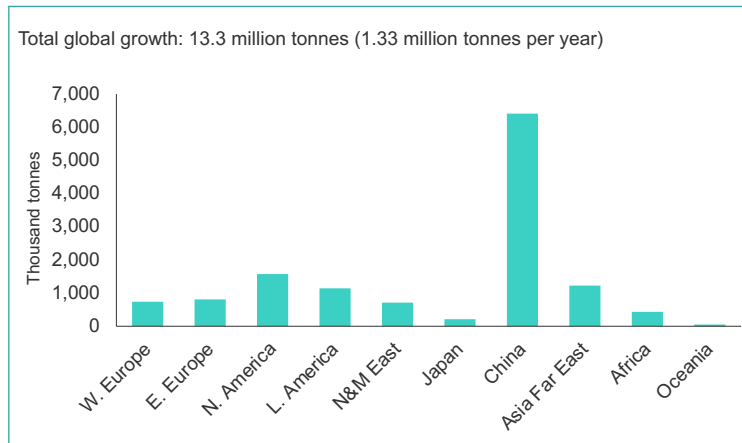


Figure 4: Volume growth of tissue consumption (2012-2022p)
Source: Fastmarkets RISI

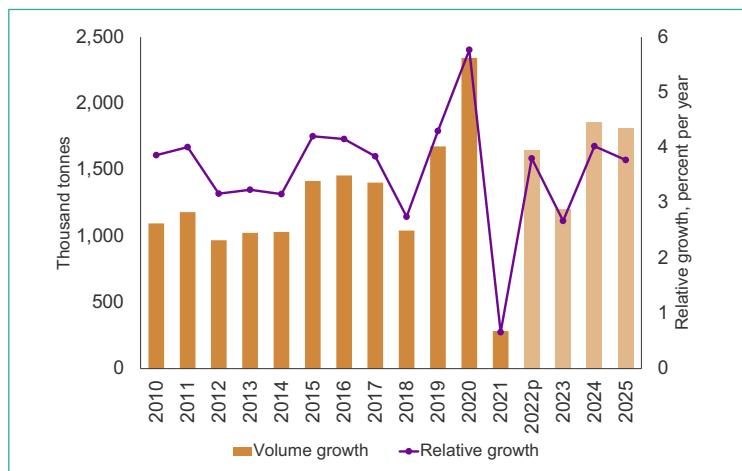


Figure 5: Anticipated growth in the global tissue market
Source: Fastmarkets RISI

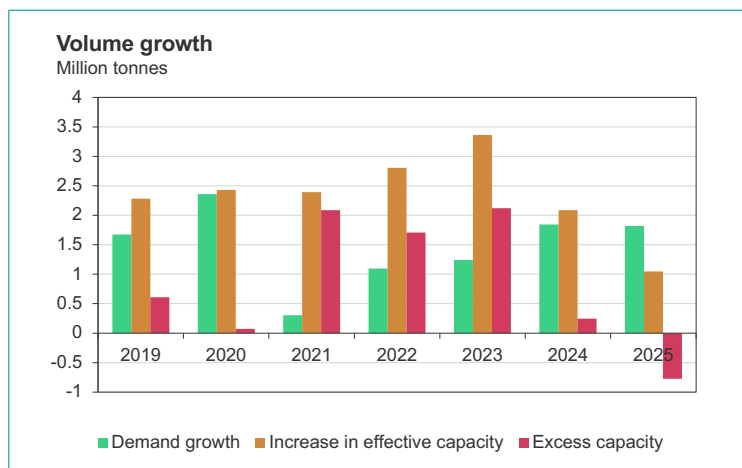


Figure 6: Expected growth in global tissue consumption and effective capacity until 2025
Source: Fastmarkets RISI

REGIONAL TISSUE DEMAND AND SUPPLY OUTLOOK

North American tissue demand forecast until 2026

- We expect that North American tissue consumption will grow by an average of 1.5% per year until 2026, slightly less than the average growth rate of 1.6% per year in 2016-2021. The markets are rather mature in both the United States and Canada, but population growth will account for about half of the expected volume growth of about 780,000 tonnes.
- North America is a net importer of tissue, with imports peaking at 800,000 in the pandemic panic year 2020, but slipped to about 500,000 tonnes in 2021, growth to 670,000 tonnes expected by 2026.

European tissue demand forecast until 2026

→ Average growth 1.9% per year

- European tissue consumption is expected to grow by 2.3% per year until 2026: Western European demand by only 1.4% per year, while Eastern Europe and Turkey will record higher annual growth rates of 2.7% and 4.5%, respectively.
- Volume growth of the region is expected to be 980,000 tonnes, of which Western Europe will account for about 490,000 tonnes, Eastern Europe for 350,000 tonnes and Turkey for 140,000 tonnes.
- Net exports will grow slightly thanks to Turkish expansion, while net imports of Western and Eastern Europe will continue to grow slightly.

Latin American tissue demand forecast until 2026

- Latin American tissue consumption is in good growth phase, and growth is expected to accelerate to 3.8% per year in 2021-2026, up from 2.6% per year in 2016-2021, which period was suffering from recession in Brazil and turbulences elsewhere (Argentina, Venezuela). This corresponds to a volume growth of about 960,000 tonnes.
- Foreign trade has played a small role in Latin American tissue business and with heavy investments in the region, particularly in Brazil, small net imports are expected to disappear wholly by 2026.

Tissue demand forecast for Japan and Oceania until 2026

→ Average growth 1.3% per year

- Tissue consumption is expected to grow very moderately with only 0.8% per year in Japan, while Oceania will see higher annual growth of 3.4%, but it should be noted that 2021 was a hangover year after demand peak due to the pandemic in 2020.
- Both regions have traditionally been net importers and this will continue, although recent and forthcoming investments in new capacity will slow down the growth in net imports.

Chinese tissue demand forecast until 2026

- Tissue consumption will continue to show good growth in China, despite slowing economy. Hygiene is highly respected in the country, and the pandemic has further emphasized its importance. Tissue companies are very confident about the future growth and investments continue. We expect tissue demand growth to remain around 6% in the coming years. Volume growth will be about 3.8 million tonnes.

- China is the world's largest tissue exporter and net exports are likely to grow, although not as fast as in the past due to global competition.

Tissue demand forecast for rest of Asia until 2026

- Tissue consumption in Asia Far East, other than China and Japan, is in an interesting sprouting phase and the population base offers good opportunities. However, in many countries the tissue business is still in the starting blocks, including highly populous countries such as India, Bangladesh and Pakistan. The relative growth of 4.0% per year corresponds to a volume growth of about 620,000 tonnes in 2021-2026.
- The region is a net exporter of tissue, mainly due to Indonesia, although also Malaysia and Vietnam are net exporter, but far behind Indonesia. Net exports are expected to grow.

Tissue demand forecast for Africa and the Middle East until 2026

- Tissue consumption is expected to grow by 4.9% per year in the Middle East region and by 4.4% per in Africa in 2021-2026. The growth rate is lowered by the fact that some countries already have very high per capita consumption (Bahrain, Kuwait).
- Both regions have traditionally been net importers and this will continue, although new investments in some GCC countries (KSA, Qatar) will replace part of imports. African net imports are expected to grow.

FORECAST OF PULP DEMAND IN TISSUE PRODUCTION

Expected production increase in tissue production by main region, 2021-2026

- Global tissue production is expected to increase by 7.8 million tonnes between 2021 and 2026, adding 18% to the production in 2021. This is a substantial volume increase among all paper grades.
- China continues to be the main driver for tissue globally (almost half of production increase), while Europe (Turkey major contributor) and Latin America will also record large production increases.
- Middle East will also see major production growth due to demand growth and import substitution.

Estimated fiber use in regional tissue manufacture (2026)

- About 56 million tonnes of fiber will be used in global tissue manufacture in 2026, almost nine million tonnes more than in 2021. Bleached chemical kraft pulp will be the main winner, accounting for an estimated 80% of the additional fiber use for tissue from 2021 to 2026.
- Alternative fibers, non-wood pulps and fiber from annual plants have become a major topic recently and their use will increase, but volume growth will not be dramatic for various reasons.
- RCF will be used for cost reasons where available, but as the availability of high grades for deinking will deteriorate, mills need to find technologies to be able to use lower grades.

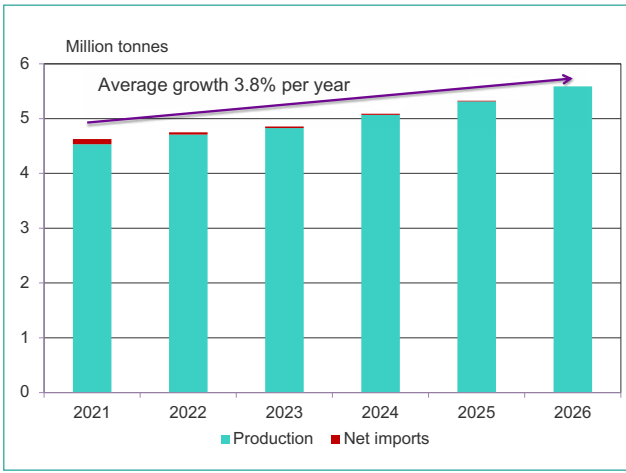


Figure 7: Latin American tissue demand forecast until 2026
Source: Fastmarkets RISI

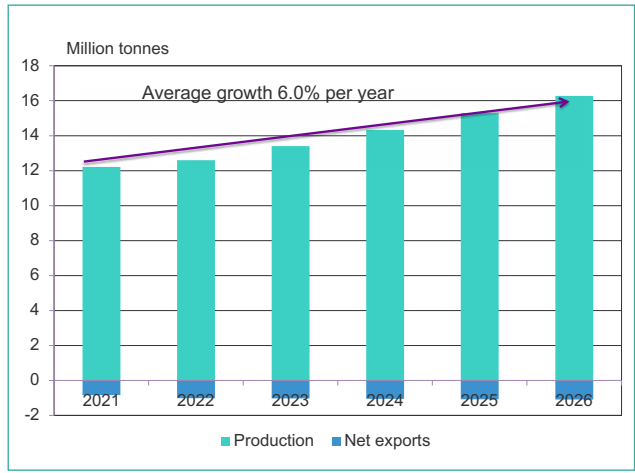


Figure 8: Chinese tissue demand forecast until 2026
Source: Fastmarkets RISI

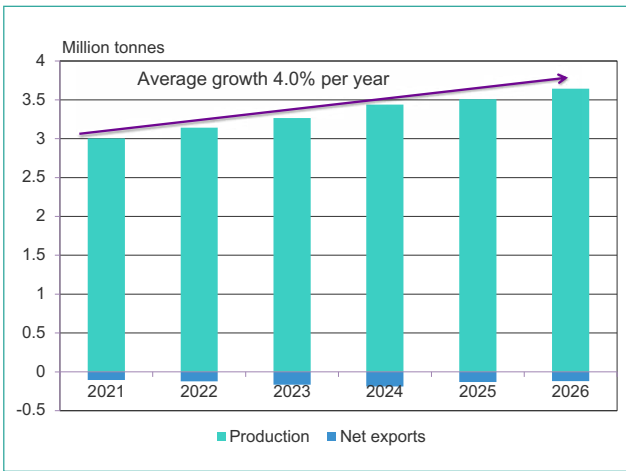


Figure 9: Tissue demand forecast for other Asia until 2026
Source: Fastmarkets RISI

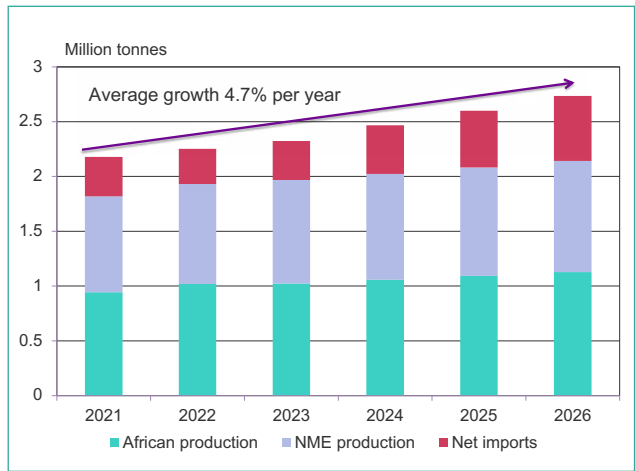


Figure 10: Tissue demand forecast for Africa and the Middle East until 2026
Source: Fastmarkets RISI

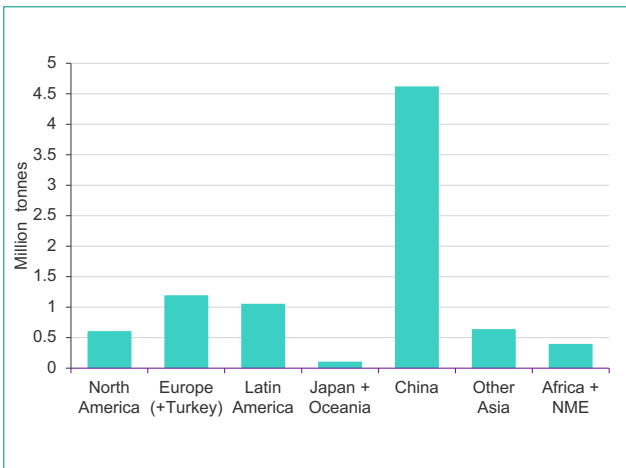


Figure 11: Expected production increase in tissue production by main region, 2021-2026
Source: Fastmarkets RISI

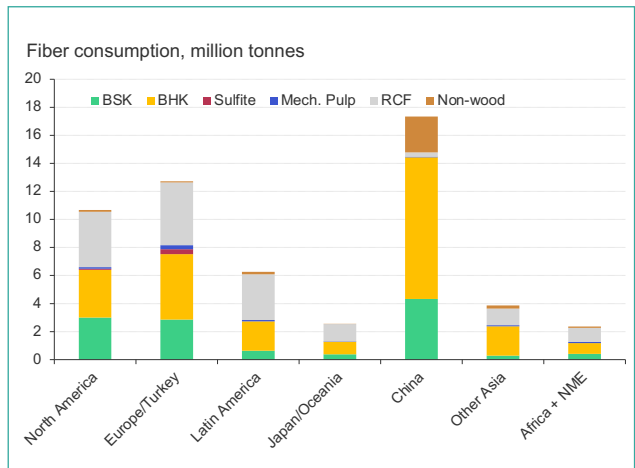


Figure 12: Estimated fiber use in regional tissue manufacture, 2026
Source: Fastmarkets RISI

Tissue producers showing growing interest in alternative fibers gaining interest

- Non-wood pulps, such as bamboo, bagasse, straw and reed pulps have traditionally been used in Chinese tissue production, as they have offered a local alternative to wood pulp which is mainly imported. In the past few years, the use of other non-wood pulps than bamboo has declined. Bamboo has good softness and strength characteristics and is suitable for tissue production. There are several plans to build new bamboo pulp mills in China inland, such as Sichuan Province where bamboo grows. Unbleached bamboo pulp has gained ground in recent years, also for sustainability reasons. Kimberly-Clark researched bamboo as an alternative several years ago, but the trials did not result in anything larger scale commercialization.
- Essity has built a smaller-scale straw pulp facility at its Mannheim mill Germany, using new production technology licensed by a North American company. Tissue products with about 30% straw pulp content (replacing softwood sulfite pulp) are now available in German supermarkets and drugstores.
- Also in Germany, WEPA has recently announced a project for the use of Miscanthus (silvergrass or Chinaschilf), a renewable natural raw material rich in cellulose. Hakle and Fripa have used green grass in small scale in their products based on processing developed by a German company. Trials with hemp have also been made in the US at least. There has also been interest in the use of residuals from instant coffee manufacture and white parts of orange peels originating from juice production.

Estimated increase in fiber use in tissue production in by fiber type and main region, 2021-2026

- Based on our tissue production and fiber furnish forecasts, the global tissue industry will need about 8.1 million tonnes more fiber in 2026 compared to our base year 2021. By grade, BHK will account for 58% of this, followed by BSK (20%), RCF (10%) and non-wood pulps (9%). The use of RCF is suffering from the lack of high deinking grades and lower grades need to be used.
- By region, China will be the main driver for BHK, BSK and non-wood pulps, accounting for roughly half of the global additional fiber needs for tissue. Europe (incl. Turkey) ranks second (13%), and Latin America third (12%). Tissue manufacture in Africa and Middle East will need about 350,000 tonnes more pulp in the forecast period.

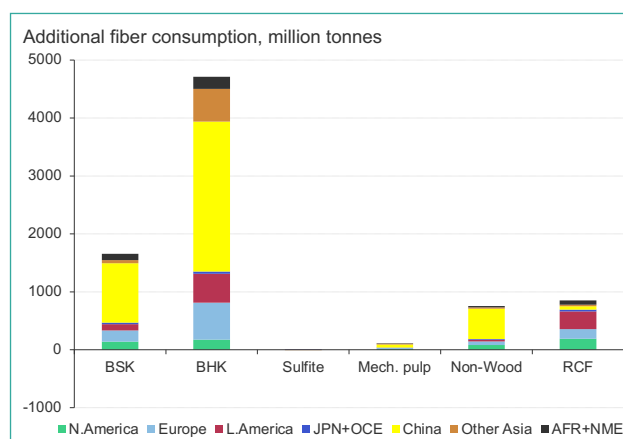


Figure 13: Estimated increase in fiber use in tissue production in by fiber type and main region, 2021-2026. Source: Fastmarkets RISI

CONCLUDING REMARKS

Tissue is today the main end use of market pulp with a 42% share and has taken the first position from graphic papers. It should be noted that not all the additional pulp demand shown in our forecast will be market pulp, as the forward integration of pulp mills with tissue manufacture will continue, particularly in Latin America and Asia by several companies (for example APP, Suzano and RGE/April/Bracell). At least 500,000 tonnes more integrated use can be counted based on current projects.

Global tissue demand and production will grow at an average annual rate of 3.6% until 2026, which corresponds to about 1.7 million tonnes volume growth per year, and more fiber is needed accordingly, of which 80% will be bleached kraft pulp, offering good prospects for additional pulp sales.

The outlook for RCF use is shadowed by the decline in graphic paper consumption globally, fine papers being the main and most suitable grade for deinked pulp for tissue. Tissue companies need to accept packaging and even mixed grades for their needs, and deinking plants need to be upgraded for using lower grades.

Alternative fibers have been a major discussion topic and a lot of trials with new fibers have been made there and where, but until now volumes used are still rather small. Bamboo pulp is expected to have good growth prospects in China.

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TISSUE PRODUCERS IN THE MIDDLE EAST AND NORTH AFRICA

Country	Company	Tissue Machine	Operating Speed (m/min)	Width (m)	Production Capacity (tons/year)	Supplier	Startup Year
Lebanon	Unipak Tissue Mill	PM1	1,500	2.7	22,000	Beloit	1995
	Sanitary Paper Co - Mimosa	PM4	700	2.3	7,000	Toscotec	1992
		PM5	850	2.1	8,000	Toscotec	1995
Jordan	Al Keena Hygienic Paper Mill	PM2	1,650	3.67	30,000	Voith	1995
	Al Snobar Hygienic Paper Mill	PM4	2,000	5.4	54,000	Valmet	
Syria	Oriental Paper Manufacturing	PM1	600	2.7	9,000	Recard	1995
	Lanatex	PM2	1,100	2.72	17,000	Over Meccanica	2000
	Dinatex Paper Manufacturing	PM3	1,800	2.72	28,000	Over Meccanica	2007
UAE	Abu Dhabi National Paper Mill	PM1	1,900	2.77	28,000	Over Meccanica	2002
		PM2	2,000	3.62	35,000	Over Meccanica	2007
		PM3	2,000	2.8	27,000	Valmet	2015
	Crown Paper Mill Ltd FZC	PM1	1,100	1.86	11,000	Beloit	2000
		PM2	1,700	2.75	24,000	PMT	2007
		PM3	2,000	5.6	60,000	Valmet	2019
	Emirates Fine Tissue Industry	PM1	700	2.7	8,000	Over Meccanica	2016
	Queenex Hygiene Paper Mfg.	PM1	1,800	2.85	28,000	Over Meccanica	2012
	Star Paper Mill	PM1	1,700	2.85	30,000	Recard	2019
	Al Nakheel Paper Mill	PM5	2,000	5.4	54,000	Valmet	2018
Kuwait	Gulf Paper Manufacturing Co.	PM2	1200	2.25	12,500	Carcano	1982

Country	Company	Tissue Machine	Operating Speed (m/min)	Width (m)	Production Capacity (tons/year)	Supplier	Startup Year
Bahrain	Olayan Kimberly Clark	PM1	1,250	2.6	14,000	Y.K.	1990
		PM2	2,000	2.8	28,000	Voith	2011
Iran	Pars Hayat Saglik Urunleri S.H	PM1	2,200	5.6	70,000	Valmet	2013
	Zarrin Barge Persia Paper Industry	PM1	2,000	5.6	60,000	Valmet	2014
		PM2	2,000	5.6	60,000	Valmet	2018
	Harir Khuzestan Co.	PM1	1,000	2.7	15,000	Voith	1995
	Latif Paper Co.	PM2	1,400	2.7	18,000	Andritz	2010
	Aryan Cellulose Sanat Co.	PM1	500	2.8	10,000	-	2014
Golpoune Pars Industrial Co.	PM1	1,400	2.75	18,000	Over Meccanica	2014	
Tunisia	Tunisie Ouate	PM2	1,100	2.7	16,500	PMT	2002
		PM3	1,600	2.76	26,000	GapCon	2014
	Azur Papier	PM1	1,500	2.75	22,000	Recard	2013
		PM2	1,800	2.75	28,000	Recard	2018
Morocco	SIPAT	PM1	600	1.8	5,000	Toscotec	1978
		PM2	1,300	2.75	16,000	Toscotec	1995
	Jeesr Industries	PM1	2,000	2.8	30,000	Valmet	2013
Algeria	Tonic Emballage Industrie	PM1	1,500	2.7	20,000	Valmet	2006
	Faderco SPA	PM1	2,000	2.8	30,000	Valmet	2007
		PM2	2,000	2.85	30,000	Valmet	2020
	Africaine Paper Mills	PM1	2,000	2.85	30,000	Andritz	2019
Egypt	Al-Sindian Paper Mill	PM1	1,600	2.25	17,000	Valmet	1991
		PM3	2,000	5.4	54,000	Valmet	2005
	Al Zeina Tissue Mill	PM1	2,000	2.75	30,000	PMT	2008
	Alex Converta Company	PM1	1,500	2.85	24,000	Recard	2018
	Carmen Tissues	PM1	800	1.7	6,000	ACelli	1995
	Interstate Paper Industries	PM1	1,800	2.86	25,500	ACelli	2008
		PM2	1,800	2.86	25,500	ACelli	2010
		PM3	1,000	2.7	12,500	Recard	2012
	Hayat Kimya Group	PM6	2,200	5.6	70,000	Valmet	2017
	Mediterranean Tissue Mill	PM1	1,500	1.8	15,000	Beloit	2011
PM2		1,400	2.75	25,000	Over Meccanica	2014	

Country	Company	Tissue Machine	Operating Speed (m/min)	Width (m)	Production Capacity (tons/year)	Supplier	Startup Year
Turkey	Aktül Kagit Uretim Pazarlama A.S.	PM1	2,200	5.6	60,000	Valmet	2011
		PM2	2,200	5.6	60,000	Valmet	2016
		PM3	2,200	5.6	70,000	Valmet	2022
	Hayat Kimya San ve Tic. A.S.	PM1	2,200	5.55	70,000	PMT & Valmet	2006
		PM2	2,200	5.6	70,000	Valmet	2010
		PM5	2,200	5.6	70,000	Valmet	2015
		PM8	2,200	5.6	70,000	Valmet	2021
	Lila Kagit San. ve Ti. A.S.	PM1	2,200	5.64	70,000	Valmet	2007
		PM2	2,200	5.64	70,000	Valmet	2012
		PM3	2,200	5.64	70,000	Valmet	2020
		PM4	2,200	5.64	70,000	Valmet	2021
	Ipek Kagit Tissue / Eczacibasi	PM1	900	2.2	15,000	ER-WE-PA	1970
		PM2	1,600	2.7	35,000	Beloit	1991
		PM3	2,000	5.4	60,000	Beloit	2000
		PM4	2,200	5.6	70,000	Valmet	2015
		PM5	2,200	5.6	70,000	Valmet	2022
	Levent Kagit San. ve Tic. A.S.	PM2	1,400	4.40	24,000	Voith	2002
	Parteks Kagit	PM2	900	2.75	6,000	Beloit	1996
		PM3	1,600	2.85	26,000	Toscotec	2014
	Europap Tezol Kagit San ve Tic	PM1	1,600	2.85	25,000	Recard	2016
		PM2	1,800	2.85	30,000	Recard	2009
		PM3	2,000	2.85	30,000	Valmet	2015
		PM4	2,100	2.92	40,000	Toscotec	2022
Viking Kagit ve Seluloz A.S.	PM1	550	4.5	15,000	ER-WE-PA	1971	
	PM2	1,500	2.76	27,000	Valmet	1999	
Essel Kagit	PM1	1,600	2.8	25,000	ACelli	2006	
	PM2	1,800	3.1	32,000	Recard	2015	
	PM3	2,000	5.7	90,000	Toscotec	2021	
Eka Kagit	PM2	1,500	2.85	25,000	Over/ABK	2014	
	PM3	2,000	2.85	30,000	Over	2016	
KSA	Saudi Paper Manufacturing	PM1	1,700	2.75	18,000	Recard	1992
		PM2	2,100	2.85	30,000	Recard	Closed
		PM3	1,600	3.6	22,000	Recard	2001
		PM4	2,000	5.5	60,000	Valmet	2008
		PM5	2,200	5.6	60,000	Toscotec	2024
	Al Faris Paper Mill	PM1	2,000	2.85	28,000	Papcel	2019
	MEPCO	PM1	2,200	5.6	60,000	Toscotec	2023

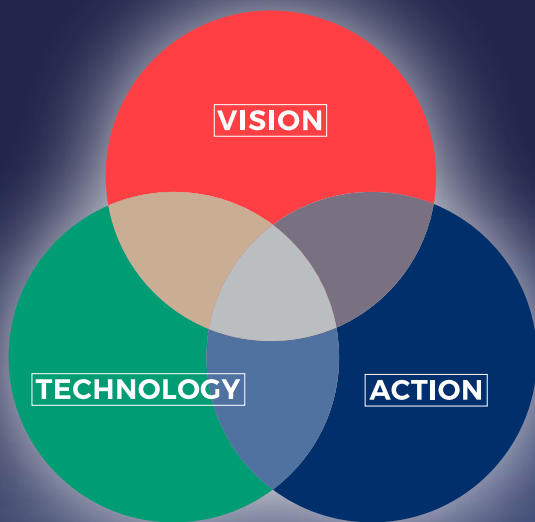
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UPHEAVAL OF THE BIOINDUSTRY SECTOR

Jenni Kärkkäinen
Senior Principal,
AFRY Management Consulting

It's a fascinating time to be part of the conversation about pulp and paper and the sector's transformation, with an ever-increasing focus on sustainability and the circular economy. New technologies and digital tools allow us to take a big step forward, which will help future society make the most of the limited resources that we have.

Sustainability is rightly one of the strongest trends both on an industry and a consumer level. However, daily choices of consumption are not only affected by sustainability but also by periodically contradicting trends – long-term, short-term and also shock impulses, such as COVID-19. Any potential impacts that COVID-19 has had on consumer behavior and whether those changes are here to stay are fascinating topics that we have decided to investigate.

Point of No Return

The world has moved past the COVID-19 pandemic by getting better at managing the disease and protecting the most vulnerable through vaccinations as well as other preventative measures. Even though our daily lives won't return exactly to the way they were in 2019, we could call the direction that we're now in an evolution. The pandemic changed the way we work, the way we shop and what we value. This shift continues to impact market demand and consumption patterns for all parts of our broader pulp, paper, and packaging sector. Before we dive deeper into the implications for the sector, the stage needs to be set and what has changed needs to be brought forward to the spotlight.

Recently in Germany, a mother and her young daughter entered a small shop. The mother was taking a sandwich out of the cooling shelf and asked her

daughter if she would also like to have one. The little girl replied: "No, mom, it's packed in plastic." Thinking about consumers, it's important to look at the next generations.

Listening to the conversations happening all around us, it's clear that we all agree the pandemic caused a particular shift in the way we work.

For many people, working at home has become the "new normal" – Based on a recent AFRY consumer survey conducted in Germany, the UK, and the US, more than half of the people in Western countries plan to continue to work from home, at least some days of the week, even now. Working at home, we obviously spend more time and consume more inside our residences, preparing meals or consuming packaged convenience or frozen foods as we jump from one conference call to the next. Thus, the pandemic gave a boost to various online services,

such as home food delivery and takeaway services, or online shopping in general. The food is usually ordered on our smartphones and still delivered covered in plastic, but increasingly in cartonboard or molded fibre containers.

The same applies to other products ordered online. Based on the same AFRY survey, one third of people continue to prefer online shopping. The brown corrugated shipping boxes and delivery envelopes continue to fill our front porches and our recycling containers afterward. Including recycled content in product packaging is a goal for many consumer products companies, while consumers themselves pay attention to reducing the use of single-use plastics. According to the consumer sentiment survey, 88% of consumers in Germany and 84% in the UK are committed to limiting single-use plastics, which creates demand upside and opportunities for our sector.



After experiencing a global health crisis, many of us have become more health-conscious, trying to eat healthily and exercise more. We also prefer locally produced food and products, at least when we have the time and money to do so. The instability caused by the war in Ukraine and concerns over the economy have shifted consumer purchasing attitudes more toward affordability rather than label or brand. In a survey conducted by Statista in 2022, over two thirds of consumers in the UK stated that they consider purchasing private-label packaged food as well as home and household care products. The fact that private labels are often cheaper than national brands has been beneficial, as financially strained consumers have tightened their purse strings.

Implications for the Pulp & Paper Industry

Recent changes in consumer behavior have had unequal impacts on our wider pulp and paper sector by segment, but one of the winners has definitely been the fiber-based packaging industry. The consumer packaging segment has risen to new heights, driven by strong sales of essential goods that need packaging, such as in the food and beverage segments. Time and money spent dining out were reduced, while home food delivery and takeaway services grew simultaneously, leading to increased profits for packaging suppliers in the food service sector. Other factors have been influencing the

market as well, such as sustainability. The trend that started before COVID-19 has become even stronger in the recent past, expedited by the regulation changes that promote the recyclability of packaging materials favoring fiber-based solutions in many segments. The packaging market was tight in 2022 but has since been softening with the rising inflation. Also, the availability of raw materials was tight which impacted the ability to push new innovations to the market. Brand owners and converters faced challenges in getting the necessary packaging material volumes. The uncertain regulatory environment and economic uncertainty in the short-term are likely to prevent a rapid transition to a larger offering of fiber-based packaging, delaying the plans to replace plastics which are still the prevailing packaging solution. The tight market has even forced some to regress back to plastic.




Luckily, there is light at the end of the tunnel for capacity limitations, as the project pipeline includes significant new machines and additions to capacity in China, Europe, and the Americas. Even so, e-commerce penetration reached the expected 5-year development in only one year during the pandemic. Just imagine what people all over the world have ordered in the last 24 months using channels such as Amazon.

Online shopping is now part of the new normal. Containerboard producers, corrugated box makers, and other

producers of protective shipping packaging are benefiting from the structural change in people's "click & deliver" purchasing habits. We can also expect to see new packaging designs as most of today's packaging has been optimized for traditional brick-and-mortar requirements. Nevertheless, e-commerce brings challenges to the industry as well: the traditional fiber loop is contested as packaging is delivered directly to consumers instead of retail outlets that have served as major sources for fiber collection. This impacts the quality of recycled fibers, as the already deteriorating fiber quality is not improved by mixed post-consumer waste.

The upcoming two to three years will play a significant role in defining the next period for the industry's green transition. The question is whether the sustainability trend will still be able to remain strong and whether the change that we have been witnessing in the European packaging markets will be a lasting structural change. The imminent EU Packaging and Packaging Waste (PPWR) regulation will play a key role in defining the direction.

PPWR impacts on packaging boards in a nutshell

 PACKAGING RECYCLABILITY	 REUSE AND REFILL	 PACKAGING FORMAT BANS	 PLASTIC RECYCLED CONTENT	 PACKAGING MINIMIZATION
<ul style="list-style-type: none"> - Based on Design for Recycling Guidelines and performance categories - Design for recycling compliance needed by 2030 - Packaging to be recycled at scale by 2035 	<ul style="list-style-type: none"> - Reuse targets for 2030 and 2040, depending on end segment - Hits especially e-commerce, food service, and liquid packaging 	<ul style="list-style-type: none"> - Single-use packaging, for less than 1.5 kg fresh fruit and vegetables - Food and beverages filled and consumed within the premises in the HORECA sector 	<ul style="list-style-type: none"> - Recycled content from post-consumer plastic waste, per unit of plastic packaging - Different targets for 2030 and 2040 - Different targets for contact sensitive packaging, other than contact sensitive packaging, and single-use plastic bottles 	<ul style="list-style-type: none"> - Packaging shall be designed so that its weight and volume is reduced to the minimum - The empty space ratio is maximum 40%
 	 	 	 	 

Bio-based products hastening the shift to sustainability

The bioindustry cluster has so much to offer on our path toward a more sustainable world, and when we take a broader view outside the limited scope of fiber-based packaging, there are large business opportunities in other bio-based sectors globally.

- Wood-based construction products that act as carbon sinks can be used to replace concrete and steel, both of which emit carbon in the production process, to support our efforts to mitigate climate change.
- Wood-based cellulose fibers used in textiles are 100% renewable, biodegradable, and recyclable and can provide an essential new vehicle to partially solve textile waste recyclability issues as well as the microplastic problem related to synthetic textiles.
- Bio-based chemicals are important tools for carbon emission reduction, and carbon-neutral biofuels can support the European efforts to become independent of Russian oil – two areas where the market is developing fast thanks to recent investment and legislation changes.

From an individual consumer’s perspective, it is naturally important that sustainable solutions are cost-competitive, particularly since there is increased economic uncertainty following the war in Ukraine and inflation. This is a challenge for many companies that are developing novel solutions to replace prevailing technologies and solutions and are investing significantly there.

The road to more sustainable solutions requires systemic changes that cannot be achieved without contributions from various stakeholders of bioindustry value chains. Consistent work to proactively influence the regulatory environment is a necessity to ensure the conditions for success.

The coherent voice of the forest-based industry should be made heard at the table with interest groups of other industries. Continuous identification of relevant partners with the most advanced competencies and initiatives supports game-changing innovativeness within our industry. In this context, conferences and other opportunities to get together are important so that

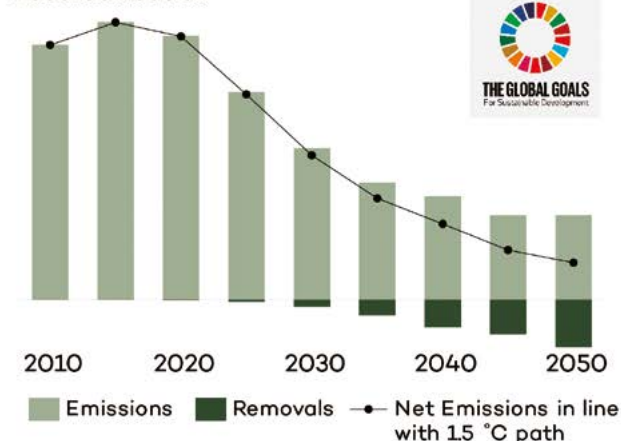
we can connect the dots across the industry and develop bio-based solutions for a circular economy, shedding fossil fuels on the way.

The Way Forward

Some changes in consumer behavior introduced by the pandemic have clearly become permanent. At the same time, if we take a step back and look at the big picture, we can also see COVID-19 as a short time period of two years which didn’t fundamentally change the megatrends that continue shaping the world, consumer behavior and the bioindustry sector – urbanization and digitalization will continue, as will the struggle against climate change and making efforts for sustainable solutions and the circular economy. We at AFRY want to actively contribute to new solutions – together with our partners and other industry experts.

Sustainability boosts global demand for bio-based products

Decarbonisation



Wood products
+75 bn EUR by 2035



Fibre-based packaging
+43 bn EUR by 2035



Wood-based textile fibres
+23 bn EUR by 2035



Bio-based chemicals & fuels
+7 bn EUR by 2035

The fiber-based packaging does not consider the PPWR impact on European packaging board markets

As we say at AFRY:
Making Future for generations to come.



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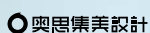
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7 BENEFITS OF REAL-TIME MONITORING IN NONWOVEN PRODUCTION

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In a period in which all industrial realities are subjected to increasing pressure to obtain better results using fewer resources and optimizing consumption, the technologies that are the basis of Industry 4.0 can be of great help in achieving the desired results. All this also applies to the nonwoven industry.

The term Industry 4.0 was born about ten years ago to indicate the last major change in industrial development: automation becomes increasingly digital and factories increasingly smart, thanks to solutions that use artificial intelligence (AI) and machine learning. The goal is to develop new and more efficient business models, increase productivity and product quality, reduce costs and machine downtime and make resource use more efficient.

Why use real-time monitoring

Current technology makes it possible to easily digitize all the machinery of a production line by equipping sensors and IoT devices capable of collecting, transmitting and sharing data related to their operation on the cloud.

These data, once historicized and analyzed, become usable in real time through interactive dashboards that allow unprecedented control over the industrial process, with the possibility of making corrective actions for its improvement.

Real-time monitoring of a production line makes it possible to promptly intervene in the event of anomalies that can reduce the yield of the line to the point of causing unexpected downtime, with consequent loss of time and degradation of production KPIs.

By monitoring the system, it is also possible to maximize the yield of energy consumption, intelligently allocating production according to the optimal energy profile and parceling out such consumption on the single product.

In the case of nonwoven production, the use of Industry 4.0 technologies acquires primary importance due to the extreme delicacy of the finished product and the process parameters that regulate its quality. The constant monitoring of these parameters allows the study of correlation phenomena imperceptible to the human eye and obtainable only through an accurate study of the product in the laboratory.

The possibility of having complete control of the process, on the other hand, makes it possible to statistically analyze all the variables involved, reducing non-conformities during production and improving time-to-market when launching new products.

The introduction in the company of an Industry 4.0 ecosystem, combined with the advantages of a cloud-based platform, allows us to easily integrate industrial data with data from the corporate infrastructure. This ensures a global vision of business processes and an improvement of both production ones, thanks to the data collected on the production line itself, and of those relating to the organization as a whole.

The scalability of the platform allows you to take advantage of the countless benefits guaranteed by the use of these technologies regardless of the size of the company, whether it is an SME or a multinational located on various continents, allowing a complete view of the production process without geographical limits.

7 BENEFITS OF REAL-TIME MONITORING

1 Production Optimization

If the behavior of the machinery should deviate from that expected (for performance, consumption or other) and therefore production was not proceeding optimally, the operator would observe the variation in the reference KPIs. These KPIs can be mainly summarized in three categories: plant availability, production speed and quality of the finished product. A control of these three factors has an impact on Overall Equipment Effectiveness (OEE), an indicator that measures the total efficiency of a plant and is also a standard in nonwoven production. In these cases, the monitoring of the OEE assumes particular importance as the yield of the single machine can have a significant impact on the whole plant: for this reason the management of KPIs and the implementation of corrective actions becomes a critical factor. Another Industry 4.0 solution offered by A.Celli specifically for optimizing the operation of the rewinders is the so-called Smart Ramp-up, thanks to which it is possible to increase production and rewinding speeds without risking the onset of vibrational instability phenomena. By keeping the vibration level under control through data obtained from IoT sensors, production can thus increase from 3% to 5% without damaging the machine.

Machine components are obviously subject to wear. Considering the economic damage resulting from a long period of machine downtime due to the sudden breakdown of a machine, it is essential to take action to ensure that the possibility of this happening is remote. Planned maintenance in relation to the nominal life cycle of each component is important, but only with IoT technologies is it possible to obtain more in-depth data to implement predictive maintenance activities and prevent even accidental failure. By analyzing the data obtained from the sensors on the machinery with machine learning applications, it is possible to obtain a precise indication of the residual useful life of the components, especially those considered critical. It will thus be possible to optimize the maintenance and replacement of components in the next scheduled machine downtime, guaranteeing optimal operation of the line and minimizing the risk of sudden breakages.

2 Planned and Predictive Maintenance

3 Remote Monitoring

A production plant adhering to the principles of Industry 4.0 and perfectly integrated into the corporate ecosystem allows remote monitoring of machinery without particular time and space constraints. Thanks to cloud computing services, the data on the machines can be collected and analyzed anywhere, regardless of the geographical location of the plant. A single dashboard can offer real-time information, 24 hours a day, on the conditions of multiple plants in various parts of the world, allowing you to compare different scenarios and conditions and adopt company-wide best practices in real time.

4 Real-Time Cost Allocation

The possibility of easily having data coming from the machines of a line allows to carry out analysis which were unimaginable until recently. By sharing production data in real time with company information systems, it will be possible to allocate production and management costs on the single meter of reel produced, allowing accurate and precise management control. The use of complex artificial intelligence algorithms also allows to improve the efficiency of the production flow, accurately evaluating the best case scenario and adjusting the production volumes on the different lines according to the desired optimum.

5 Reduction of the Environmental Impact

The optimization obtained through the analysis of the detected data from the sensors allows the machines to be used in the best possible way, limiting energy waste along the entire production line. It is also possible to take advantage of the automatic adjustment of certain parameters in order to keep consumption always within predetermined limits. Not only that: through specific applications, it is possible to manage the so-called Smart Carbon Footprint. This is an indication of the emissions produced during the processing of raw materials and the production of paper, two phases of the Life Cycle Assessment (LCA) that are critical for the calculation of CO2 equivalent, according to the GWP parameters expressed in the GHG protocol. Continuous monitoring of energy parameters and emission measurements allow for precise information on the process in order to be able to intervene appropriately to reduce the environmental impact.

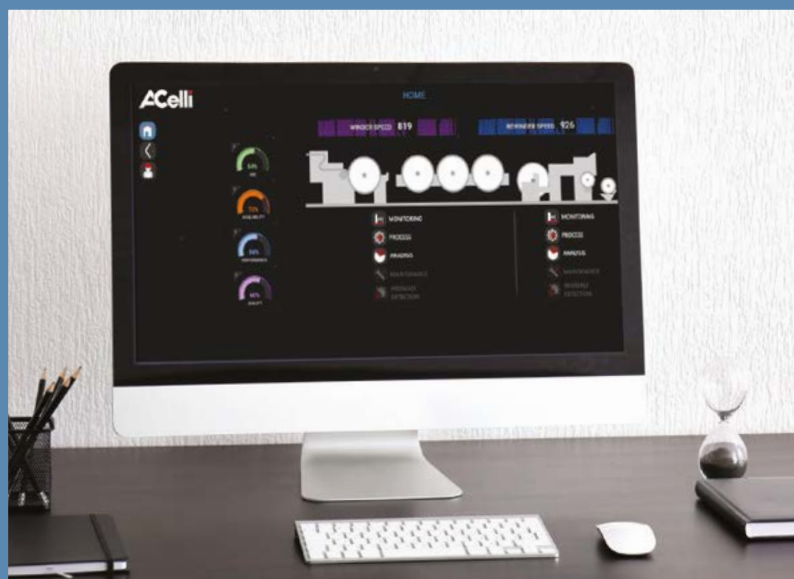
6 Quality Control

The ability to manage data from the plant, combined with the use of proprietary algorithms, allows you to calculate and track critical parameters for the nonwoven in real time, such as the density and elongation of the material. The real-time monitoring of these parameters, combined with the possibility of verifying historical trends, let you take immediate actions which, by changing the process settings, allow to preserve the quality of the material without wasting production hours.

7 Analysis of the Process Parameters

The data obtained from the sensors and IoT devices that are present on each machinery involved in the production can be suitably interpolated, allowing the creation of a “digital twin” of the product. This digital twin, suitably linked to the management software data, allows for the precise classification of all production and its intrinsic characteristics. The management of this huge amount of data through artificial intelligence algorithms makes it possible to detect ideal profiles and evaluate the deviations in the tuning phase of the work recipe, going to predictively define whether the product has a high probability of complying with the customer requests or not.

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Automate your factory with Business Made Easy for Industry 4.0



The Disposable Hygiene market in 2023 is much more challenging than it was just two years earlier[1]. Companies are now dealing with a **harsher environment**, ravaged by multi-decade high inflation, supply chain bottlenecks[2], fast-rising interest rates[3], a looming currency crisis[4][5], and, last but not least, war at the very border of Europe[6].

And yet, despite these difficulties, Disposable Hygiene players remain upbeat about the future, concentrating on **new product development, partnerships and line upgrades** while they wait for new capacity to be used and supply issues to ease. These manufacturers concur that **the rate of Disposable Hygiene growth** throughout the majority of application areas is **still strong**[1].

Now more than ever, **innovation is essential**. Companies are searching for a competitive edge that will set them apart from their rivals. That is why GDM has been developing **Business Made Easy for Industry 4.0**, a brand-new Disposable Hygiene solution designed to eliminate the complexity of this unpredictable landscape and help industry players meet — and even exceed — their business goals.

Today, with **Business Made Easy for Industry 4.0**, GDM doubles down on our vision with new and updated services for factory and business automation. Thanks to an integrated strategy for real-time monitoring and remote support, GDM is now able to guarantee the complete digitization of the production process by scaling the automation model from the machine to the factory level.

By leveraging the technologies made available by recent advancements in AI, IoT, AR/VR and smart supply chain technology, it is now possible to **automate your entire production plant and turn your factory into a Smart Factory**.

GDM has added more and more arrows to its quiver, transitioning from a company that is solely focused on **converting** and **packaging** up to one that, with Business Made Easy, is able to **optimize the customers' value chain** through a rich portfolio of digital services, such as remote support, assisted trouble-shooting, guided maintenance, digital documentation, connectivity, performance analysis and even end-of-line, on-demand automation via FlexLink.

No longer just a manufacturer and supplier, in the last few years GDM has morphed into a unique technological and consulting partner that provides 360-degree support along the entire customer journey, from order entry to shipment and afterwards.

And now, with **Business Made Easy for Industry 4.0**, GDM is reinventing its role once again: from a vertically integrated industrial manufacturer to a key player in the Industry 4.0 landscape.

Want to beat your competition?

Get in touch with info.it@gdm-spa.it and discover GDM portfolio for Industry 4.0 before anyone else. We will guide you through this complex manufacturing scenario and unlock the full potential of your factory.

After the huge success of OptiMate, GDM optimizes the Disposable Hygiene production process with a new and upgraded portfolio of digital Industry 4.0 solutions, such as **PerforMate** and **HyperMate**.

PerforMate is a brand-new IIoT platform for full-scale, real-time machine monitoring. By leveraging machine learning algorithms running on Coesia's proprietary cloud infrastructure, PerforMate provides a **bird's-eye view of the production line** through a **personalized, easy-to-use dashboard**, combined with asset monitoring, loss tree analysis, trends and alarm notifications.

HyperMate, on the other hand, is a **cutting-edge factory automation solution that runs your production plant on autopilot.** Through wireless sensor networks and AI, HyperMate raises your productivity to a whole new level, turning your factory into a full-fledged, 21st century Smart Factory.

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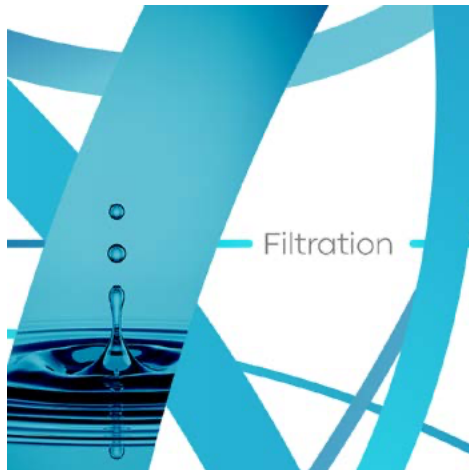
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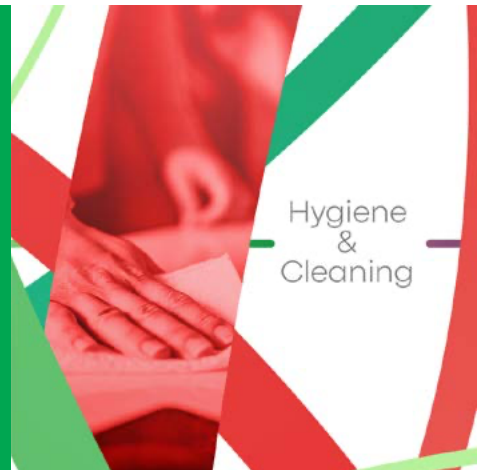
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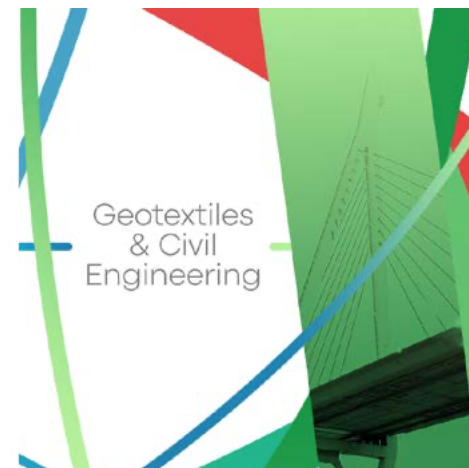
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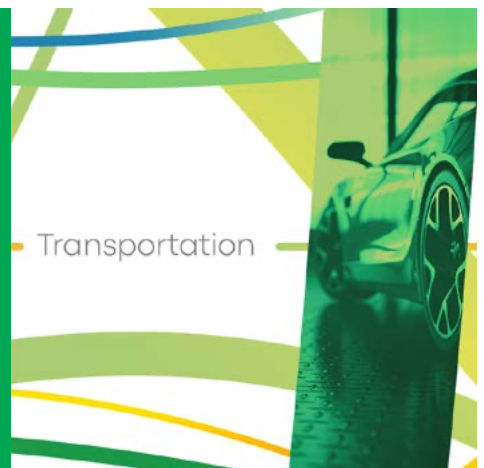


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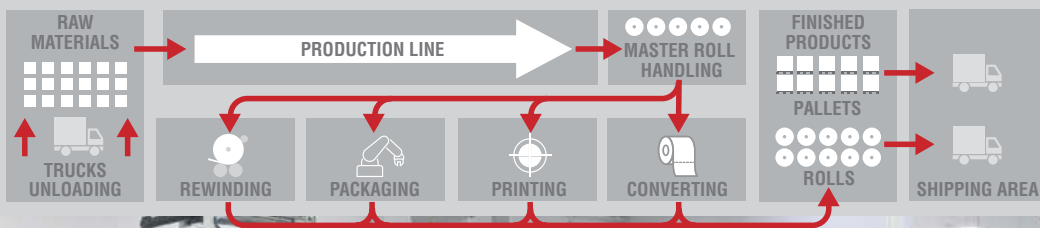
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