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IMPS 2024


Prof. Dr. Stephan Kleemann opens the 32nd IMPS

# IMPS 2024 – International Munich Paper Symposium

View into the hall

Session 3 – left to right: Tjerk Boersma, Mark Erkelenz, Jens Haessner, Jan Sedlacek

Session 1 – left to right: Enzo Sadra, Klaus Eibl, Erich Kollmar, Dirk Schwarze, Jürgen Lemke, Prof. Dr. Stephan Kleemann


Session 4 – left to right: Dr. Tobias Kleemann, Matteo Notini, Stepahn Wenzel, Angelika Hofer-Orgonyi, Florian Latzelsberger, Günter Röhrich, Lucas Ortego, Lena Hofmann


Session 2 – left to right: Prof. Dr. Jürgen Belle, Verena Speckle, Kevin Klassen, Rudolf Gräfenstein, Thomas Böhme

# Progress in paper and board technology – Part 1

**Under the direction of Prof. Dr. Stephan Kleemann, Institute for Paper Technology (IVP) e.V., Munich / Germany, the 32nd IMPS — International Munich Paper Symposium — took place from March 19–21, 2024 in Munich, in the Westin Grand Munich conference hotel. Prof. Kleemann opened the symposium and gave an overview. With > 350 participants representing 180 companies from 25 countries, the symposium was well booked. Paper manufacturers were once again very well represented with a share of 39%. All lectures were translated simultaneously into German and English.**

The 32nd IMPS — International Munich Paper Symposium — dealt with developments that improve the processes of paper and board production as well as product quality. In addition, lectures and an exceptionally large number of reports directly from paper mills and cardboard manufacturers were presented.

Both well-known and new companies were represented with their products and services in the exhibition that accompanied the conference.

The conference was framed by two joint multi-course lunches, a gala dinner and the chance to take part in a cultural evening and an excursion (paper machine and coating units of Munich University of Applied Sciences in Munich; UPM mill Schongau in Schongau; MAI Carbon - Composites United e.V. (CU) in the technology center in Augsburg).

**The 33rd IMPS will take place from March 25-27, 2025 in Munich.** The organizer is happy to receive suggestions for interesting presentations about technical innovations (symposium@paper-online.de).

## Overview of the lectures

### Planning and commissioning of Model Papier Eilenburg

Dirk Schwarze, Model Papier Eilenburg GmbH, Eilenburg / Germany; Jürgen Lemke: Model Holding AG, Weinfelden / Switzerland

Sachsenpapier Eilenburg paper mill, formerly owned by Stora Enso, was completely shut down in June 2023 and is scheduled to start-up production in the second quarter of 2024.

First, the presentation explained why Eilenburg is so interesting as a location for the Model Group and its corrugated board sites. It was then shown why and how the Eilenburg site is being consistently converted to lightweight (corrugated board, $CO_2$ footprint, development of corrugated board qualities in the USA and China) The first results of the approach: Rethink corrugated cardboard... have been described. What are the key components to be able to produce lightweight products efficiently and quickly? In the second half of the lecture, practical experiences and impressions from the conversation period were presented. The audience were not only presented with specific details relating to this conversion, but reference was also made to organizational experiences that may be of interest for other projects/conversions. Topics concerning the organization are safety issues, employee training - use of a "virtual image of the new PM", project logistics and a reference to costs. The presentation described the actual construction process at Model Sachsen Papier GmbH with photos and a short film.

### Rebuild of a paper machine for packaging papers

Enzo Zadra, Norske Skog Bruck GmbH, Bruck / Austria; Klaus Eibl, Norske Skog Bruck GmbH, Bruck / Austria: Erich Kollmar, Bellmer GmbH, Niefern / Germany

Two paper machines are operated at the Norske Skog site in Bruck an der Mur. PM3 has been producing up to 125,000 tons of newsprint paper for around 70 years and has been converted to produce 210,000 tons of corrugated base paper. PM4 has been producing up to 265,000 tons of LWC paper annually since 1989. The site is part of Norske Skog ASA, one of the world's leading producers of publication papers with sites in Europe and Australia. Following the rebuild of a second newsprint machine at the sister company in Golbey, France, Norske Skog will become one of the leading independent packaging base paper manufacturers.

At the plant in Austria, the decarbonization of the site was consistently driven forward in a multi-stage process. Investments in a new energy plant and the expansion of the existing wastewater treatment plant with an anaerobic pre-treatment stage ensure significant reductions in fossil $CO_2$ emissions while at the same time expanding production capacities.

The production of corrugated base paper is Norske Skog's entry into a new business segment.

The core of the investment is the construction of an OCC

pulp preparation plant for the preparation of brown waste paper grades and the conversion of paper machine 3 for the production of corrugated base paper.
The new systems were fully integrated into the existing plant, making the best possible use of the existing infrastructure. The technical challenges and the corresponding implementation of the demanding brownfield project are shown. Thanks to a highly motivated and qualified team, the project goals were achieved in record time, both in terms of quantity and quality. The investments initiated efficiency and environmental improvements that will have a lasting positive impact on the future of the site and the number of jobs.
In addition to paper, Bruck also supplies district heating to the surrounding communities, supports the stability of the electricity grid by actively balancing the demand for electricity and produces ash for use in road and dam construction.

### Conversion of the circulation water purification system and commissioning of a drum filter system

Verena Speckle, Landqart AG, Landquart / Switzerland; Andreas Paech, Landqart AG, Landquart / Switzerland; Kevin Klassen, Cellwood GmbH, Düren / Germany

Landqart AG has been producing banknotes and high-security paper for the speciality paper sector since 1978. The company is a supplier to more than 50 countries worldwide. Paper production is followed by further finishing steps on various systems.
The presentation described the current situation and challenges with micro flotation. The reasons for the conversion of the recirculating water treatment system were explained. The focus was on the problems that arose during the conversion and commissioning. K. Klassen went into more detail on the technical part and the functioning of the ALGAS AMF45.

- The objectives of the rebuild are primarily:
- Increase fibre / filler and M-feature recovery.
- Reduction of rejects due to less contamination and slime.
- Significant reduction in the surface area available for microorganism activity and biofilm formation by reducing the total volume in the constant part.
- Cost reduction for biocides.
- Improvement in paper machine efficiency and increased availability of the system.
- The drum filter system has now been commissioned.

### Ultrafiltration for the post-treatment of biowater from process water treatment

Thomas Böhme, Progroup Paper PM3 GmbH, Sandersdorf-Brehna / Germany; Rudolf Gräfenstein, Progroup Paper PM3 GmbH, Sandersdorf-Brehna / Germany

Since 2020, Progroup Paper PM3 has been producing corrugated base paper at its Sandersdorf-Brehna site in a closed water circuit with an internal recirculating water treatment system – ProAquaPlus – and uses BAT to keep the overall process as stable as possible. In fact, Progroup fully implements the BAT and does more than it recommends – e.g. complete extraction of the stripping tanks. At the ProAquaPlus, the highly contaminated process water is cleaned anaerobically and then decalcified and freed of solids by means of short-term aeration and flotation. The efficiency of the recirculating water treatment plant is approx. 75 %.
With a view to further technological optimization of process water treatment, an ultrafiltration technology established in open water circuits was tested for biowater treatment. The main objective of the project was to reduce the organic and inorganic load of the recycled biowater using a test plant and to determine the capacity of this technology. The constituents and the fibre content of the water to be filtered are decisive for the success, in order to be able to assess the effect, a filtrate containing fibres was temporarily added to the biowater. The test showed that ultrafiltration technology can also be used for biowater. The system coped well with the water. The membranes had to be rinsed alkaline and acidic twice a week. In the open circuits, once a week is usual. The filterable substances in the permeate could be reduced by approx. 75%. The COD content and the content of organic acids could be reduced by 20-30%. The experiment was less successful in the area of inorganic pollution, the conductivity (sum parameter for the salts) remained unchanged, only the sulphate concentration could be reduced by 5-10%. The yield from the inlet was > 70 %, with a capacity of approx. 80-100 litres/h/m² membrane.
From a technological point of view, ultrafiltration is suitable for the post-treatment of the biowater in a partial flow. The point in the process at which the purified permeate can be used must be considered on an individual commercial basis.

### New cleaning concept and digital contamination determination for suction rolls

Tjerk Boersma, Sappi Maastricht B.V., Maastricht / Netherlands; Marc Erkelenz, J.M. Voith SE & Co. KG, Heidenheim / Germany

The suction roll is a central and complex subsystem in the paper manufacturing process. Often, it is not the first point of focus when runability and profiling problems arise. Nevertheless, a large number of influencing factors can have a considerable effect on production. In particular, there is a tendency to underestimate the influence of suction hole contamination on production. Here again, a number of factors play a role. On the

one hand, the clogging of the suction holes is a gradual process whose negative influence builds up over time. Secondly, there is no reliable and reproducible method for determining clogging and, above all, its intensity.

Many paper manufacturers use cleaning systems to counteract the problem of contamination. Conventional systems available today, such as the Voith InsiderJet or similar, are designed to clean the suction holes from the inside to the outside. However, these systems are very expensive to purchase and unfortunately prone to failure due to their complex design and many moving parts. Furthermore, such a system is available to a limited number of customers, as the installation space required in the suction rolls is often not sufficient for these conventional systems.

Voith has taken on the challenge to develop a cost-effective, robust and reliable solution. This could only be achieved by breaking new ground and thinking in a fundamentally new way. This involved not only the development of a new type of cleaning system that eliminates the weak points described but also the development of an objective measuring method that can clearly, reproducibly and reliably determine the degree of contamination of a suction roll. These two complementary products are now being used for the first time at Sappi Maastricht, helping the professional production and maintenance teams to develop new approaches to optimizing runability and downtime planning.

### Experience and success with installing a vacuum blower

Jens Haeßner, Munksjö Unterkochen GmbH, Unterkochen / Germany; Jan Sedlacek, Munksjö Unterkochen GmbH, Unterkochen / Germany

In times of growing sustainability awareness, resource conservation and simultaneously rising energy costs, the “PM1 vacuum system conversion” project was created. To date, five water ring pumps have been used for the various suction points in the wire and press sections. These have proven over the years to be a reliable and easy-care means of generating vacuum. Rising operating costs combined with improvements in efficiency and high resource consumption have prompted the company to rethink the drainage strategy on the PM1 and replace the previous complex installation with a vacuum blower.

As a basis for the conversion, a detailed vacuum audit was carried out by Runtech at the beginning of the project. As a result, this confirmed the project’s great potential for improvement with significant energy savings. In addition, a positive side effect was shown in terms of water consumption and waste heat transfer into the operational wastewater. The decision to implement the

project was made quickly due to the expected benefits and a positive economic assessment.
During the project phase, Munksjö and Runtech worked hand-in-hand from kick-off to commissioning. The very limited space on site presented the project team with major challenges. The final installation location was therefore defined with the help of 3D scans of the existing building structure and the fan model was integrated into the 3D scan. This was necessary because the limited space made it very difficult to insert the individual components and required a change in the design of the separator. The separator was redesigned into several individual pieces so that it could be transported to the later operating location and reassembled there.
In addition to increased installation effort, the project was fraught with a certain amount of risk and was "doomed to success" because redundant installation was not possible due to the space available. All five existing water ring pumps were completely dismantled before installing the blower. There was therefore no convenient fall-back option. However, the positive experiences during a recent installation at a sister factory allayed any concerns in this regard.
Careful detailed engineering in advance and a successful conversion phase ultimately guaranteed smooth commissioning of the turbo blower – similar to a plug-and-play installation. After just a few hours of operation, the papermakers were able to see for themselves the advantages of the unit, which led to a number of improvements; Above all, the extremely efficient operation of the vacuum system, which has not yet been consistently pursued with the large range of decorative papers.
Significant improvements were achieved shortly after the blower was put into operation. In further optimization steps, the vacuum levels were successively adapted to the requirements of the production spectrum, which resulted in savings of around 60% compared to operating with water ring pumps.

### Optimization of stability in the production process

Matteo Notini, Sofidel S.p.A., Porcari / Italy; Stephan Wenzel, Valmet GmbH, Tampere / Finland

Valmet Industrial Internet solutions are developed to optimize tissue production and reduce quality losses and operational costs. Sofidel has innovated by adopting a digital transformation project with Valmet. The project uses real-time prediction of quality parameters, such as tensile strength, to reduce raw material usage and improve process insight for operators.
Valmet and Sofidel collaborated to create a predictive real-time model based on process analysis, testing, and verification. The model provides real-time information on tensile strength to operators through the Valmet interface. This solution reduces the variability of quality parameters, which could result in downgrading or higher production costs.
Additionally, the project incorporates a predictive monitoring service as a development stream to optimize the performance and reliability of the production assets. The predictive monitoring service uses software, asset management best practices, and Artificial Intelligence to reduce costs, increase availability and lifespan of assets. Sofidel, during this collaboration, tested the service to understand better its potential: a new way to monitor and assess the health and condition of their assets, prevent failures, and enhance efficiency and productivity.

### AI-Powered computer vision reshaping processes at Mondi

Angelika Hofer-Orgonyi, Mondi AG, Vienna / Austria; Florian Latzelsperger, Mondi Frantschach GmbH, St. Gertraud / Austria; Günter Röhrich, Mondi AG, Vienna / Austria

In the paper industry, similar to numerous other industrial sectors, process automation is increasingly gaining importance. This development results from the necessity to adapt to changes in the labor market as well as to meet increased demands for quality and efficiency. The integration of software solutions in the field of Computer Vision (CV) plays a central role by serving as an essential tool for automation and support.
Research in CV has made significant progress in the last years especially through the democratization and enhancement of the underlying technologies. This development opens a plethora of applications along the chain of production from incoming goods to final quality checks. The broad tool kit of CV poses enormous potential for a wide range of applications in the industrial field from process control to workers' safety.
Particularly, functionalities such as classification, object recognition, and image segmentation are often considered highly promising, but also less popular use cases like classic anomaly detection are increasingly coming into focus. The use of CV can take pressure off operators and support them in their tasks. Especially monotonous, repetitive tasks, that are therefore prone to human error can be supported very well with CV. With new technologies conventional tasks around product or process inspections are becoming easier to tune to specific problems, which leads to more precise results in problem detection, less errors and in return to higher tolerances for users.
Another crucial aspect lies in the flexible adaptability of CV algorithms to specific work processes as well as the utilization of existing infrastructure. This last point, in practice, allows for the adaptation and utilization of existing camera systems, often avoiding the need for new equipment acquisitions.

### Successes at SAICA with predictive and AI based monitoring

Lucas Ortego, SAICA S.A., El Burgo de Ebro, Zaragoza / Spain; Lena Hofmann, J.M. Voith SE & Co. KG, Heidenheim / Germany

A reliable predictive monitoring system is key when it comes to machine availability and maintenance planning. Voith's predictive monitoring solution OnCare.Health Paper is an online monitoring, analysis and diagnostic solution, combining Voith's expert know-how in papermaking, analytics and artificial intelligence.

In 2022, SAICA decided to upgrade its existing condition monitoring systems of three machines in Spain with the Voith OnCare.Health predictive machine and technology monitoring solution, following with two more machines in 2023. By continuously collecting and analyzing data on the machine condition, SAICA can now automatically detect deviations and anomalies. Timely response to malfunctions can be triggered to prevent unplanned machine downtimes.

Nevertheless, at diverse positions within the paper mill, it is not possible or costly to install sensors. In addition, experts must still investigate and analyze the root causes of issues at physically monitored components. Therefore, SAICA and Voith began a joint development project to enable overall machine monitoring and analytics based on existing machine data. This approach can facilitate both condition and behavior monitoring of different component and processes.

- Self-trained AI models for mechanical and electrical components were set up based on SAICA's historical process data.
- The running of AI models is designed to identify anomalous behaviors across diverse mechanical components.
- SAICA, with consulting from Voith, is independently executing incremental learning of the AI models and fine-tuning its models to different machine modes and grades.
- Automatically generated insights about the most common causes of the anomalies are enabling SAICA to take immediate actions.
- In 2024, the joint development project will be enhanced with the new intelligent pattern recognition function, allowing SAICA to generate automatic recommendations for action on errors identified by the AI.

The presentation showed Voith's data-driven monitoring approach and provided insights into the AI and associated technical solution. In addition, the results achieved at SAICA were shown and the possibilities and limitations of AI-based predictive monitoring in paper production were discussed.

# IMPS 2024 – International Munich Paper Symposium **Progress in paper and board technology – Part 2**

## Overview of the lectures

### Production of paper with bactericidal and improved surface properties

George Barnovi, "Paper+" LLC, Tbilisi / Georgia; Vladimer Tsitsishvili, Georgian National Academy of Sciences, Tbilisi / Georgia; George Khutsishvili, Petre Melikishvili Institute of Physical and Organic Chemistry, Ivane Javakhishvili Tbilisi State University, Tbilisi / Georgia

In the context of the coronavirus pandemic, not only the demand for various disinfectants has increased, but also the interest in obtaining new antibacterial and antiviral materials, especially paper packaging for food and agricultural products. Changing the properties of paper and cardboard, including giving them antibacterial properties, is possible with the help of special fillers, among which zeolites containing biologically active metals (silver, copper, zinc, etc.) are recognized as very promising.

The essence of the project supported by the Shota Rustaveli National Science Foundation of Georgia is the production of paper with bactericidal and improved surface properties using zeolite fillers containing bioactive silver, copper and zinc ions. For the preparation of bactericidal fillers, natural zeolites of Georgia have been used, in particular, heulandite-clinoptilolite of the Dzegvi-Tedzami deposit.

A simple and cost-effective technology for producing bactericidal wrapping paper with improved surface properties is offered. The technology is based on introduction of zeolite material enriched with biologically active metals (silver, copper, zinc) into the paper web.

It is believed that only silver has high bacteriostatic activity, but its use increases the cost of the product, so this technology is not widely used. It is therefore suggested to use cheaper metals, copper and zinc.

The introduction of these bactericidal metals has been found to prevent the formation of mold as well as the growth of fungi and other microbial contaminants on the surface of paper and cardboard. In addition, the introduction of copper-containing compositions makes the paper waterproof; on the other hand, the use of such paper/cardboard meets modern environmental requirements to reduce the share of synthetic polymers in the assortment of packaging materials and to return to "paper bags" and "cardboard boxes".

The most important expected result of the project was the preparation of packaging paper with bactericidal properties, not only in laboratory conditions but also in production. Paper with activity against E. coli, as well as waterproof paper active against staphylococcus, have been produced on the production line of the paper mill of the Limited Liability Company, "Georgia Paper Production Ltd" (126, Beri G.Salosi str., Tbilisi, Georgia, identification code: 206165424, director Ramaz Gvalia), both technologies will be used by the company in the future. It should be noted that the raw material for producing paper is secondary raw materials – recycled paper. The team of scientists, together with the paper manufacturing factory, is successfully working on this project.

The chemical and mechanical properties of the obtained paper samples were studied. Chemical composition of paper samples was determined using the X-ray energy-dispersive spectra. The basis weight (grammage) of the paper was determined on electronic analytical balance; the tensile strength and stretch of the paper strips (25 mm × 150 mm) was measured using Universal Testing Machine in machine and in cross directions. The surface topology of paper was analyzed using optical microscope; to obtain representative images, imaging was carried out at five different places of the material (homogeneity test). Characterization of sample morphology was based on the scanning electron microscope images.

Evaluation of the bactericidal activity of metal-zeolite-containing paper was carried out by the disk diffusion (Kirby-Bauer) method and colony-forming unit (CFU) assay using the cultures of gram-negative bacterium Escherichia coli, gram-positive bacteria Staphylococcus aureus and Bacillus subtilis, fungal pathogenic yeast Candida albicans and a fungus Aspergilus niger (or A. brasiliensi).

Working on a project is a group of scientists from the Petre Melikishvili Institute of Physical and Organic Chemistry, I. Javakhishvili Tbilisi State University, under the leadership of the Member of Georgian National Academy of Sciences Vladimer Tsitsishvili. The team includes Prof. N. Dolaberidze, PhD N. Mirdzveli, PhD M. Nijaradze, PhD Z. Amiridze, PhD B. Khutsishvili, G. Khutsishvili, O. Chudakova.

In 2020-2021, with the support of the International Bank of Reconstruction and Development (IBRD), the team worked on the project of the CARYS 19-442 "Bactericidal zeolite fillers for paper production". Successful implementation of the project may become a factor in

reviving the paper industry in Georgia and creating new jobs. (This work was supported by Shota Rustaveli National Science Foundation of Georgia (SRNSFG) [grant number AR-22-610, Project Title "Production of paper with bactericidal and improved surface properties")

### Real-time microbial monitoring in a paper mill

Christian Lübke, Kabel Premium Pulp & Paper GmbH, Hagen / Germany; Marisa Silva, onCyt Microbiology AG, Zürich / Switzerland; Samuel Wüthrich, onCyt Microbiology AG, Zürich / Switzerland

A fully automated in situ sampling and measurement device offers process analytical data for microbes in process water streams. Sensor data that is available 24/7 and in real-time makes trends in bacterial concentrations and the effect of biocides on bacterial viability directly accessible and fully quantitative.

With such information at hand, it becomes much more feasible to anticipate microbially induced quality and operational problems (e.g., odour, paper brakes, slime formation). Hence, countermeasures and preventive maintenance can be refined and optimised. More targeted and reduced biocide consumption is economically and environmentally beneficial. Importantly, financial losses due to downtime and faulty products can be minimised. Preventive maintenance rather than emergency shutdowns reduces strain on infrastructure and personnel. Efforts and cost for inefficient sampling and external analysis of infrequent microbial analyses of very little information content can be avoided.

By closing the "microbial gap" in process analytics and adding these crucial parameters to the process management system, the highly complex art of making paper becomes a touch less challenging and more controllable.

### Probiotic water treatment

Moritz Fessenmayr, Maxauer Papierfabrik GmbH, Karlsruhe / Germany; Thomas Achtermann, Maxauer Papierfabrik GmbH, Karlsruhe / Germany; Dominik Stumm, Wöllner GmbH, Ludwigshafen / Germany; Jörg Alles, Wöllner GmbH, Ludwigshafen / Germany

Biocides and biodispersants are the classical approach to solve microbiologically induced problems in the paper industry, mostly caused by biofilms and their effects such as bad odours and acidification.

In recent years, the approach of biological cleaning with probiotic bacteria has become a promising alternative to the chemical, antimicrobial treatment of industrial water circuits in the paper industry, including the peripheral water circuits of cooling equipment, air scrubbers and wastewater treatment plants. The focus is on environmental considerations, sustainability, user-friendly functionality and work safety.

In past few years, Wöllner has succeeded in establishing and successfully operating applications with its Waropure® products in all areas of paper production, from hygiene paper and packaging paper to speciality and printing paper, as well as in other industries.

In addition to improving hygiene in production processes, the probiotic microorganisms in Waropure® showed surprising metabolic properties with regard to catalase formation in laboratory tests.

During the same period, the biocide glutaral, which has been used for decades to control catalase, was classified first as SVHC candidate and finally as SVHC substance.

Together with the partner from graphic paper production, Maxauer Papierfabrik GmbH, an SVHC-free alternative was sought in order to operate the deinking systems economically successfully. For more than 4 years now, the stock preparation has been able to supply biocide-free deinking stock to both paper machines.

The next step was to work together on the biological treatment of the paper machines in order to transfer the good process hygiene achieved in stock preparation to the paper machine. Of particular interest here is the way in which the probiotics spread on the machine.

### Significant dry content increase in the press section

Bas Noldus, Smurfit Kappa Roermond Papier B.V., Roermond / Netherlands; Caio Penteado, J.M. Voith SE & Co. KG, Heidenheim / Germany

The process of pressing paper significantly contributes to the overall energy efficiency of paper manufacturing. In order to further improve the ecological footprint of this process, there are ongoing activities to optimize the efficiency of the mechanical dewatering process, which would provide increased dryness content of the web after the press section.

Within a modern press section, a shoe press applies a pressure gradient in the z-direction, which is the driving mechanism of the mechanical dewatering. Theoretical considerations show that the dewatering efficiency can be improved with a tailor-made pressure gradient that takes the specific paper grade and boundary conditions into account. To obtain the desired pressure gradient, an optimized adjustment of the mechanical components and press fabrics is crucial, as the dynamic properties of the fabrics will considerably affect the resulting system compression behavior.

Using advanced simulation tools, laboratory experiments and pilot machine trials, it was developed a novel dewatering system consisting of both mechanical components and fabrics to provide the desired pressure gradient for optimized dewatering with respect to the operating conditions of a paper machine. This was achieved through an integrated approach of mechanical and fabric development. After testing it on a small-scale pilot shoe press, the system was installed at the Smurfit Kappa Roermond mill, focusing on testliner and corrugated medium. After a successful preparation and

start-up, and because of great cooperation between Voith and Smurfit Kappa, the initial results show an increase in dryness content after the press section of >1% immediately after starting the new pressing system.
In addition to the economic and ecologic benefits, implementing the novel pressing system can increase production when the dryer section is the limiting factor of the paper machine. Furthermore, the higher dryness content after the press section further increases the runability of the paper machine. These benefits can be achieved without time- and cost-intensive rebuilds, as the novel pressing system requires only minor adaptations to the shoe press roll and press fabrics, making it a very economical solution for paper manufacturers.

### Innovation to reduce energy consumption and $CO_2$ emissions during paper drying

Timo Pisbach, Moritz J. Weig GmbH & Co. KG, Mayen / Germany; Roman Klug, AutomationX GmbH, Graz / Austria

The simulation-supported optimization technology for drying a paper machine enables a significant increase in energy efficiency with a sustainable reduction in $CO_2$ emissions. A modern paper/cardboard machine consumes almost 80% of the total energy requirement of a paper mill and causes almost half of all $CO_2$ emissions. The main reasons for avoidable energy losses are, on the one hand, insufficient measurement data quality or unavailable measurement sensors for relevant process variables and, on the other hand, control loops that operate independently of each other but are linked in terms of process technology.
Current systems use process values from field instrumentation to control production. However, many important process variables are difficult or impossible to measure (e.g. dry content of the paper web after the press section, temperature of the drying cylinders, evaporation rates, air humidity, efficiency of heat exchangers and much more). This is state of the art, a limiting factor of current control technologies.
AutomationX combines measured values with physical process dependencies and device functions and maps the real drying process as a virtual system. The digital representation of the real sub-processes is carried out with the help of rigorous models from the field of thermodynamics. This results in a remarkable improvement in the quality and quantity of process information.
Using "What If" scenarios, i.e. virtual validation of modified process operating modes that cannot be carried out on the real machine for safety or production-related reasons, significant potential savings in terms of energy (steam, electrical) are identified in an offline simulation. AutomationX ePM DryEnd integrates the virtual representation of the real drying process into the model-based optimization solution and enables online closed-loop control of the system.
Thanks to the high quality of the calculated optimum process operation, the system can be operated close to the physical and process-related limitations and enables the existing energy-saving potential to be maximized. The solutions already implemented, including at Moritz J. Weig GmbH & Co. KG in Mayen, show savings of more than 4.5% live steam over the entire drying process.

### First results with a new refiner type at Klabin

Ênio Reis, Klabin S.A., Harmonia / Brazil; Philipp Schimmelpfennig, J.M. Voith SE & Co. KG, Ravensburg / Germany

Philipp Schimmelpfennig, Global Product Manager Refining and Deflaking, presented the new Voith refiner, while Ênio Antônio Dos Reis, Process and Engineering Consultant at Klabin, reported on his experiences with the first InfibraFiner DG that has been started up.
The InfibraFiner DG (Digital Generation) is a combination of solid mechanical design based on decades of experience with double-disc refiner, smart features and the latest sensor and control technology on the market. Its SmartLight combines industrial design with innovative functionality.
With the new InfibraFiner, throughput and usable performance are increased. At the same time, load power consumption, maintenance effort and the machine's space requirement are reduced. Ease of operation and work safety also played a major role in the development, which is why the InfibraFiner is equipped with a new rotor changing device.
This completely new refiner concept differs significantly compared to other refiners available on the market today in terms of both design and performance values.

### Challenges in the development of a soft sensor

Hanna Schwandt, LEIPA Group · Schwedt / Germany; Paulina Hahn, Hochschule München, Munich / Germany; Jürgen Belle, Hochschule München, Munich / Germany; Felix Hake, Consultingtalents AG, Walldorf / Germany

As part of the "KIBAPap" project, a soft sensor is being developed to determine the dry content after the press in order to identify possible potential for increasing the dry content. The development of the soft sensor is being carried out by project partners from Munich University of Applied Sciences, Leipa Group GmbH and Consultingtalents AG at PM 5 in Schwedt and will be utilized together with the Institute of Textile Technology at RWTH Aachen University. The "KIBAPap – AI-based operator assistance system in the paper recycling loop" project

aims to significantly reduce resource consumption in the production process by adapting process parameters to the quality of the raw material. The basis for this is data collected along the value chain, which is used for process optimization with the help of comprehensive analysis methods and artificial intelligence. Leipa Group is providing the industrial equipment for the paper production side of the project. Leipa is focussing on the production of packaging paper from 100% waste paper. Uncoated corrugated base paper has been produced at PM 5 in Schwedt, which is being used for trials, since 2018.

Saving raw materials and energy is currently more important than ever and is therefore one of the main objectives of the project. In order to achieve this, measurements and sensors to visualize the current status play an important role. However, as measurement technology reaches its limits in some places, cannot be procured for cost reasons or cannot be safely installed in the paper machine for space reasons, soft sensors offer a good alternative.

In this presentation, the methodology for developing a soft sensor to determine the dry content after the press was examined and possible challenges in the development process were highlighted. A system analysis of the equipment serves as the basis for the soft sensor. In a further step, parameters are determined based on theoretical approaches and experience from everyday production, which have an influence on the desired target value. With the help of correlation analyses and evaluations, dependencies can be determined based on historical data. The number of influencing parameters that serve as input for the soft sensor can thus be limited to the relevant parameters. Machine tests are carried out to confirm individual parameters that have been determined by process engineering knowledge in order to determine their influence. Identified and validated influencing factors can then be used as input for the selected modelling approach. The equation and AI-based models are optimized and validated using historical data. The selected model can be continuously checked using comparative values from laboratory and retrofitted online measurements, ensuring constant optimization and further development. A soft sensor is implemented as soon as it can be ensured that the model reliably represents the real-life conditions. In future, this can be used to simulate theoretical conditions without having to intervene in production. This will make it possible to find optimum operating windows, for example. Using the example of the dry content after the press, it will be possible to draw conclusions about optimization options for steam consumption and thus about potential for reducing energy costs.

### Cost reduction with new reject pelletizer

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The German paper industry produces around 2.5 million tons of rejects and sludge every year, which must be disposed of. Some factories can burn it in their own power plant if this is suitable for RDF. However, depending on the water content, this requires additional firing, which makes thermal utilization more expensive. On average, however, they are transported 170 kilometers for disposal. The costs are typically between €80 and €140 per ton. Two companies in Europe and Asia have independently developed presses for mixed plastic waste and have been operating them successfully for many years. The plastic waste can be sent for thermal recycling, achieving calorific values that far exceed the amount of electricity used. Both have independently developed the equipment to dewater the typical waste from paper mills and form granulate or pellets from the plastics.

During dehydration, the rejects reach a temperature between 70°C and 95°C, so that most microorganisms are killed – similar to pasteurization of the rejects. Due to the low moisture content, the rejects are no longer colonized by microorganisms. Unpleasant odors are thus eliminated.

The results of the scientific monitoring of the market launch were presented. Many samples have already been processed at the pilot plants in Asia and Europe. The samples were analyzed before and after processing. The increase in calorific value and other important characteristics were presented for a cross-section of different rejects and sludges, and the feasibility of the process was demonstrated. In particular, the increase in calorific value to the level of lignite and hard coal shows that paper mills can not only elegantly solve a major waste problem, but also significantly reduce the need for fossil fuels.

### Reduced $CO_2$ Footprint without Loss of Quality

Thomas Staehrfeldt, Omya International AG, Oftringen / Switzerland

During recent years, the consideration of carbon dioxide emissions became the focus of global initiatives and national regulations. As the paper and board producing industry is among the main six emitters of greenhouse gases of the industrial sector, greenhouse gas reduction regulations triggered many initiatives among which the replacement of raw materials with high carbon footprint is seriously considered. Mill trial results on a commercial scale paper machine show that the careful choice of functional pigments can support the carbon footprint reduction of paper and board. This article demonstrated that improvements of the environmental footprint of paper (board) can be done without compro-

mising on quality – and that carbon footprint reductions and quality considerations are not contradicting each other.

### Fuels from flue gas – biogenic advantage for pulp and paper mills

Engelbert Schrapp, Siemens Energy AB, Stockholm / Schweden

Green methanol is a driving force for industrial decarbonization, and as a major emitter of biogenic $CO_2$, the pulp and paper industry has an opportunity to reuse biomass-based (biogenic) $CO_2$ for methanol synthesis. This methanol synthesis is based on green hydrogen and $CO_2$ from biomass-based flue gas and is an enabler to increase the prospect of a carbon-neutral industrial system in pulp and paper mills or combined heat and power plants.

Methanol synthesis based on green hydrogen and $CO_2$ from biomass flue gas offers the prospect of a carbon-neutral industrial system. As a fuel for mobility applications and a feedstock for the chemical industry, green methanol can make a significant contribution to the decarbonization of shipping and other industries. At the same time, the integration of green methanol production into existing industrial facilities, such as pulp mills or combined heat and power plants, creates an opportunity to reuse a valuable resource such as biomass-based (biogenic) $CO_2$, where the pulp and paper industry, as a major emitter of biogenic $CO_2$, can play an even more important role in the transformation of the transport industry.

**Production from water, green electricity and biogenic waste gases** — The potential of this method lies in the fact that the biogenic $CO_2$ emitted from, for example, biomass boilers or a lime kiln, can be recovered via a carbon capture process. This process avoids the emission of further climate-damaging carbon dioxide and uses it as a valuable resource and raw material for a new green energy carrier, such as eMethanol, a sustainable energy and, most importantly, generates the use of a biogenic $CO_2$ sustainability loop, unlike if we were to use fossil-based $CO_2$ emissions.

In addition, methanol synthesis produces water, oxygen (from the electrolysers) and waste heat, which can be used in a closed-loop system in the pulp mills. Oxygen is a valuable raw material in the pulp and paper industry, e.g. for the bleaching process, wastewater treatment or to increase the efficiency of other processes. Oxygen must either be produced on site at a high energy cost or purchased as a raw material from the market. Demineralized water from the pulp and paper process can be used in the electrolysis process as a feedstock for further hydrogen production.

Finally, due to highly efficient processes and state-of-the-art technology, modern pulp mills produce much more electrical energy than is needed for pulp production. Today, the surplus is either used in integrated pulp and paper mills or sold on the energy market for sometimes more, but usually less, profit.

**Global roll-out of a model project** — Liquid Wind, a Swedish power-to-fuel development company, together with Ørsted as investor, is currently building the world's first large-scale industrial roll-out of an e-methanol production plant, FlagshipONE. In addition, 100,000 t/a plants such as FlagshipTWO in Sundsvall, FlagshipTHREE in Umeå and FlagshipFOUR (2x 100,000 t/a) in Haapavesi/Finland are in the process of implementation and will be joined by 10 more Flagship plants in Europe by 2028, in partnership with CHP plants, waste incineration plants, bioethanol plants and hopefully soon also pulp and paper mills. The eMethanol produced will be used to power all types of vessels, replacing marine fuel oil.

The scale-up of the flagship projects will be supported by the Design & Performance Centre (DPC), which was inaugurated on 22 February in Hørsholm, Denmark. Liquid Wind and all OEM partners such as Siemens Energy. In the DPC, the Flagship "product" will be further modularised, standardised and enhanced with the latest technologies from the OEM partners, thus contributing to rapid scale-up, with the aim of developing and deploying 500 plants worldwide by 2050, helping to meet the much larger global demand for eMethanol.


Session 5 – left to right: Prof. Dr. Emanuele Martorana, George Khutsishvili, Christian Lübke, Samuel Wüthrich, Dr. Dominik Stumm, Moritz Fessenmayr

Session 6 – left to right: Prof. Dr. Helga Zollner-Croll, Roman Klug, Timo Pisbach, Bas Noldus, Caio Penteado

Session 7 – left to right: Prof. Dr. Stephan Kleemann, Philipp Schimmelpfennig, Hanna Schwandt, Paulina Hahn, Wolf Heilmann

Session 8 – left to rigth: Dr. Thomas Staehrfeldt; Prof. Dr. Stephan Kleemann, Engelbert Schrapp

View towards the stage of the lecture hall