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### The Special Issue of the 66<sup>th</sup>—2023 JAPAN TAPPI Annual Meeting at Arcrea HIMEJI, Hyogo

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### **Application to improve productivity and reduce CO<sub>2</sub> emissions in dryer process -Kurita Dropwise Technology-**

Shogo Ujiie, Shintaro Mori  
Kurita Water Industries Ltd,

Kurita Dropwise Condensation Technology has been applied with over 150 paper machines in the world. Based on the achievements so far, the improvement of steam consumption by 3~10 % and other new values were also revealed, such as the improvement of the paper machine speed, the decrease of electric power, the cut of maintenance operation, the decrease of loss products, the time saving of pre-heating and so on.

In recent years, this technology has been applied not only with paper machines, such as a black liquor evaporator, condenser of power boilers, pulp sheet machines, and corrugators in cardboard factories.

Kurita believes that we can contribute to creating new value for society and companies, by introducing this technology and maximizing heat transfer efficiencies of more factories.

### **Next Generation Technology for Continuous Pulper Detrash "S-PAL SYSTEM"**

Yoichiro Iwatani  
AIKAWA Iron Works Co.,Ltd.

There have recently been substantial changes on the domestic recycle paper supplies in Japan, following the import restrictions of the used materials in world. It is expected to continue the tendency of such difficult procurement of the good quality recycle papers, which would lead to increase the use of un-sorted recycle papers.

To adapt these changes, we need to recommend the upgrade of the stock preparation processes for proper handling. On this paper we would like to introduce the latest technology of the recycle paper pulping system (continuous detrash system) based on an actual case study.

### **Operating Experience with Chelating Agents in Kraft pulp process at Ishinomaki mill 1KP plant**

Hiroshi Kimura, Takuya Yamauchi, Kazuhiko Makabe and Masahiro Shimizu  
Ishinomaki Mill, Nippon Paper Industries Co., Ltd.

In the 1KP process at Nippon Paper Industries' Ishinomaki Mill which produce NBKP the usage of the domestic softwood species, which contain higher calcium(Ca) constituents than the conventional softwood, has increased in recent year. According to the increase usage of the domestic softwood, the adhesion and accumulation of the stains including the Ca scale for the digester and the other 1KP process has been actualized with the in recent years. As a result, it has become difficult to maintain continuous operation (for six months) or led to decline in digestion efficiency, such as deterioration in steam consumption per unit.

Previously, the digester of 1KP process have been cleaned with sulfamic acid at each shutdown (SD) to remove the stains including Ca scale. However, Cleaning with sulfamic acid had some issues and risks, which is the corrosion of the base material of the digester, highly workload with manual sulfamic acid dissolution etc.

To solve these issues and risks, we applied the chelating agents to the digester cleaning as an alternative to the conventional sulfamic acid cleaning. In this paper, the operational experience of the chelating agents cleaning for the digester is reported.

We tried the digester cleaning test with the chelating agents in the SD period, based on our past operational experience and the suggestion from Kurita Water Industries Ltd. As a result, Ca elution in the cleaning liquid from the digester was equivalent to that of the conventional sulfamic acid cleaning. Also, from the visual inspection of the top separator basket, the drastic removal of the stains including Ca scale was confirmed. Furthermore, there was little adhesion and accumulation of the stains including Ca scale to the A6 heater tube and the inline drainer basket. And the conventional high-pressure jet cleaning could be avoided.

The above results indicated that the application of the chelating agents to the digester cleaning is significantly effective, compared with the conventional sulfamic acid cleaning.

The chelating agents are expected to play a role on maintaining the stable operations, reducing the workloads, and ensuring the safety, and also contribute to the cost reductions and the improved profitability.

## **Energy Demand and Carbon Footprint of Bleaching Chemicals**

Alexis Metais , Tao Su, Saori Sakamoto and Kyomitsu Hikida  
Xylem Inc.

Energy prices strongly increased in 2022 and remain unstable. It leads to additional challenges in meeting all at once competitive pulp bleaching costs and global targets on reduction of GHG emissions. The present paper intends reviewing energy demand for production of the main chemicals involved in bleaching of chemical pulp such as oxygen, ozone, chlorine dioxide and hydrogen peroxide as well the chemical precursors needed. Once done in a first part, carbon footprint will be assessed considering the influence of different national grids to help pulp producers and the local regulation authorities.

## **Evolution of on-demand printing machines and media development**

Ryuichi Kisaka  
Mitsubishi Paper Mills Limited.

Printing, which was developed by Gutenberg in Germany in 1450, has developed as a means of transmitting information using paper as a medium, but with the spread of the Internet, the shift from printed media to display has accelerated, and the decline in commercial printing such as catalogs and posters is accelerating. On the other hand, with the advent of computers, from around 1990, many on-demand printing presses (electrophotographic method, inkjet method, etc.) appeared, which obtained "output quality close to offset printing" and met the demand for "small lot, variety of products, short delivery time" in commercial printing. In the 2000s, against the backdrop of dramatic improvement in elemental technologies for digitization and colorization, the fields of use expanded to commercial printing and photographic printing, and it is expected that they will continue to penetrate the market.

This paper reports on the technological innovation of on-demand printers and media used for them, divided into electrophotographic paper and inkjet paper. Based on existing reports and the investigations that the author has been involved, how the media responded to market performance requirements (high image quality, high functionality, low cost, etc.) were summarized.

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### **Food Applications of Cellulose Nano Fiber "Cellenpia®"**

Takashi Matsuoka  
Biomass Material Business Div. Nippon Paper Industries Co.,Ltd.

Cellenpia®, which is Cellulose Nano Fiber(CNF) of NIPPON PAPER INDUSTRIES CO.,LTD, (NPI) and has the same chemical structure as that of carboxymethyl cellulose (CMC), is sole CNF as using for food additives. cellenpia® shows same characteristics of traditional food additives, such as moisture retention, shape retention, foam stability, suspension stability, and emulsion stability. Furthermore, cellenpia® is able to stabilize quality of wide-ranging food with very small amount. The raw material of cellenpia® is derived from woody biomass material and is procured from sustainably managed forest of NPI. Therefore, using cellenpia® is related to promoting carbon cycle at entire society and can be said to a food additive, which contribute to achieve SDGs(Sustainable Development Goals).

### **Features and Developments of Phosphorylated Cellulose Nanofibers**

Miho Sato  
CNF R&D Center, Innovation Promotion Division, Oji Holdings Corporation

Recently, woody biomass is expected to be used in multiple ways as a carbon-neutral and renewable resource. Among them, cellulose nanofibers (CNFs) are attracting attention as a new nanomaterial derived from cellulose, one of the major components of trees. We have established a unique CNFs production method by introducing phosphate groups to the hydroxyl groups in wood pulp and mechanically processing the resulting phosphorylated pulp. The obtained phosphorylated CNFs were completely nanofibrillated (about 3 nm in width) with high yield, and their aqueous dispersion was highly transparent, viscous, and stable at pH 3-11. The aqueous dispersion of phosphorylated CNFs can be dehydrated and dried to form transparent CNFs sheet with densely-packed CNFs. This sheet has high transparency, strength, and thermal dimensional stability, and at the same time, it has paper-like flexibility. To promote the practical use of this technology, we have currently been developing the new composite of CNFs and polymer materials. Natural rubber, polycarbonate, and polypropylene have been successfully composited with CNFs. These composites showed the specific mechanical and thermal properties and have the potential to replace commercialized products. We will continue to develop the use of cellulosic materials in composites while taking advantage of the features of phosphorylated CNFs.

### **Development status of CNF reinforced plastics (cellenpia® PLAS)**

Yujiroh Fukuda  
Fuji Innovative Materials Research Laboratory, Research & Development Division,  
Nippon Paper Industries Co.,LTD.

In recent years, heightened global environmental awareness has led to calls for the realization of a low-carbon, sustainable, recycling society. Nippon paper industries (NPI) have been studying cellulose nano fiber (CNF) as a new destination for cellulose resources derived from pulps used in paper. To date, NPI has been one of the first to introduce mass production facilities and put them into practical use in a TEMPO-oxidized CNF and a carboxymethyl CNF. As a further use of cellulose resources, NPI is expanding into the reinforced plastic's business, where cellulose fibers are used as reinforcement material in plastics, and NPI is considering using them in structural material applications such as automotive components and construction materials. CNF-reinforced plastic is a material that can be utilized as a reinforcement, in which cellulose is finely fibrized to nano-levels and uniformly dispersed in the plastic. And it is actively being developed as a reinforcement material to reduce carbon dioxide emissions by reducing the weight of structural materials such as automotive components. Cellulose resources are also a renewable material and the use of this material can contribute to reducing the use of plastics and the amount of waste.

NPI have developed such CNF reinforced plastic using the pulp direct kneading method called Kyoto Process® developed by Prof. Yano and his colleagues at Kyoto University, where the pulp is nano-fibrillated and dispersed the same when kneaded with resin. NPI installed demonstration equipment in 2017 to offer CNF reinforced plastic to companies that wanted them. In this report, I present some of the findings from our feasibility studies and report on the prospects for our projects.

## **Novel Agricultural Materials Utilizing Cellulose Nanofibers Produced by Aqueous Counter Collision**

Yui Hayashi

Research & Development Dept., Chuetsu Pulp & Paper Co., Ltd.

To achieve both stable food supply and sustainability, it is necessary to develop novel agricultural materials that can control crop losses due to plant diseases and are environment-friendly. We have developed a novel agricultural material, which called nanoforest-S [Agri], utilizing cellulose nanofibers produced by aqueous counter collision (ACC-CNF).

This material physically prevents plant pathogens from being infectious by covering hydrophobic leaves with ACC-CNF, having amphiphilic surface properties. The physical prevent, which corresponds to physical preventing in Integrated Pest Management (IPM), is due to two effects: "masking effect" and "camouflage effect." It has been verified effective against both plant pathogenic fungi and bacteria, which cause most plant disease. Furthermore, it has advantage of not developing drug-resistant strain and being friendly to both workers and environment.

In addition to laboratory-level testing, we are also conducting field trials and have obtained positive results in tests conducted with the producers in the Kyushu region. We will continue to conduct field trials and research, aiming to contribute to agriculture utilizing this material.

### **Development of CNF reinforced plastics manufacturing process.**

Takaaki Imai

Advanced Materials R&D Center, Daio Paper Corporation

In domestic, the development of CNF production process and CNF application are advanced, but there are still not a lot of commercial productions with CNF. In order to expand commercialization of CNF, it is important to reduce the production cost of CNF and to promote the development of technologies for expanding product applications. And reducing CO<sub>2</sub> emissions will realize social implementation and market expansion at early stage because of motivation for decarbonized society.

The integrated manufacturing process from CNF raw material to CNF reinforced plastics was developed through the technology of the continuous process and the high productivity method of CNF reinforced plastics with a twin-screw extruder (CNF contents 67%, 250 kg/h by φ 48mm equipment). These development results were conducted as a NEDO's project from 2020 to 2022 with Shibaura Machine Co., Ltd. and National Institute of Advanced Industrial Science and Technology.

### **Introduction of eco-friendly chemicals for household paper**

TaKatomo Tsuda, and Hitoshi Tsuchida

Technical Group, Yokkaichi Research Institute, Technology and Production Division,  
Chemical Solution Company Hakuto Co., Ltd.

Under the PRTR Law, a number of chemical substances have been added to the list of substances subject to PRTR since 2023. In order to be environmentally friendly, it is preferable to avoid the use of PRTR substances as much as possible, and we have succeeded in developing coating and release agents that contain no PRTR substances as environmentally friendly household paper chemicals.

In addition, with the revision of the Safety and Health Law, businesses are increasingly required to pay attention to the health of their employees, for example by strengthening risk assessments.

The paper manufacturing process is a key source of paper dust. The household paper manufacturing process is characterised by its tendency to generate paper dust, which, if inhaled, could have a negative impact on employee health. Furthermore, paper dust is also a potential source of fire.

Therefore, in order to reduce the risk of health hazards and fires, we have developed paper dust inhibitors, which are agents that reduce the amount of paper dust.

In this report, we introduce these three chemicals: a PRTR-free coating and release agent and a new paper dust inhibitor.

## **Latest Press Technology for Energy-Saving and High-Quality Products Installation of 『Advantage™ ViscoNip® press』 on Existing Machines**

Shungo Yokouchi  
Sales Dept, KAWANOE ZOKI Co., Ltd.

In recent years, household paper machine manufacturers have been demanding highly energy-efficient equipment due to soaring material and fuel costs. It is also important to have high operating efficiency throughout the production line and to be able to respond to various operation conditions, from low basis weight product for long winding products to high bulk premium products.

Kawanoe/Valmet's press equipment, "Advantage™ ViscoNip® press (ViscoNip)", enables higher press dryness, improved nip profiles, and operation under various operation conditions. The ViscoNip presses by feeding oil into an internal pressurizing element made by polyurethane. The material used is flexible and abrasion resistant, enabling the element to follow the dryer surface. The element is designed to minimize water return from the felt during pressing, reducing the amount of moisture in paper by 2 to 7% compared to suction press rolls. This reduction in moisture can reduce drying energy by up to 25%. ViscoNip does not require roll crown adjustment and can follow the deformation of the dryer surface at any nip pressure, allowing operation under a wide range of conditions. The uniform nip profile provides a good moisture profile and many other advantages, such as a significant reduction in the number of paper breaks, stability of the dryer coating, extending felt and belt life, and increased operating efficiency of converting machine. ViscoNip can be installed not only on new machines but also on existing machines, and by replacing suction press rolls with ViscoNip, energy savings and a wide range of operating conditions can be achieved.

Kawanoe/Valmet will respond flexibly to the drastically changing environment and contribute to the development of the industry "together with our customers" as a trusted partner.

## **Wire and Felt cleaner for Tissue Machines - CleanLine Excell -**

Kazuhiro Funai  
Technical Sales Department, Voith IHI Paper Technology Co., Ltd.

Because of increasing raw material cost and energy price, electricity, hard to decide big investment at paper industry. Main focus is reducing operating cost and keep making profit. Also life extension of existing machine and product same quality as before is very important.

In this, we would like to introduce CleanLine Excell which continuously cleans a running fabric to maintain fabric performance and optimize productivity. This product can be installed with relatively small investment cost and customer can expect lower water and chemical usage. High pressure needle jets water removes stickie and contaminants from fabric.

## **Example of energy saving and improvement of operation with wire**

Ichiro Yamada  
Domestic Sales Dept Tokyo Office. PMC · EF In-House Company Nippon Filcon Co., Ltd

Forming Fabrics are a necessary and integral component for modern papermaking machines, which serve three main functions: 1) Draining pulp slurry 2) Forming the sheet 3) Transporting the sheet to the press section.

Adequate sheet formation is one of the greatest concerns of paper makers, because it directly impacts the sheet qualities as a finished product. There are also various requirements of draining and conveying capabilities as the basis weight ranges vary greatly. While recent demand for certain paper types has been sluggish, sales of paper for home use have shown steady growth. In Japan, the demand for towel paper at hotels and restaurants has increased due to the heightened awareness of hygiene due to the corona virus outbreak (COVID-19). Demand for home use paper is also increasing overseas due to population growth and increases awareness and needs for hygiene and sanitary conditions. Global growth is expected to continue in the future. In the paper industry, there are various types of machines use for making home use paper. NIPPON FILCON has been developing wires that meet the needs of each type of machine. Wires for home paper are required to have specific fiber supportability, dehydration, washability, and running stability. Given these wire performance priorities, it is important to select a suitable wire design for each machine type. Due to the increasing need for industry and manufacturing to have a lighter impact on the environment, wires are required to have energy-saving performance. We will continue to develop and select the most suitable wire for each machine, which has further added value while responding to many requirements. We will introduce the features and examples of energy saving and operation with wire.

## **Visualization of Yankee Coating and Crepe -Realtime Monitoring by Image Analysis-**

Ryo Inamatsu  
Maintech Co., Ltd. Fuji Office

Recently, in the Japanese manufacturing industry, the labor shortage is becoming serious year by year. The labor shortage is an unavoidable problem in the paper industry as well. Many kinds of Crepe As a counterplan against labor shortage, it is effective to improve operational efficiency using technology and DX. The key to this is understanding the current situation.

Yankee dryer coatings and crepes are the most difficult to grasp. This is because multiple factors are involved. Therefore, only a limited number of people can make judgments, and judgments change as person change. We are developing a real-time monitoring system by image analysis for coating of Yankee dryer and crepe. As a result, if anyone can easily grasp the current state of Yankee dryer coating and crepe from the same point of view, it will not only improve operational efficiency, but also improve productivity, avoid dangerous work, and solve the problem of passing on technology. We think it is possible to contribute to the solution.

## **Saving Fiber Cost for Tissue**

Ryohei Watanabe, Mamoru Ochi, and Hirohiko Kato  
Voith Turbo Co., Ltd. BTG Japan

Household paper, such as facial tissue, toilet paper, and paper towels, is an indispensable necessity in our daily lives, in today's paperless society and in the future when IT will be even more advanced. In a world where the SDGs are becoming more and more important, the household paper industry is recognized as an excellent resource-recycling industry that successfully circulates and utilizes "forests", "recycle paper", "energy", "carbon dioxide", and "products (household paper)".

On the other hand, the impact of the Covid-19 and Russia-Ukraine war has caused raw material and energy costs to rise sharply, putting pressure on the profitability of household paper manufacturers.

In particular, the rise in fiber costs, which account for more than 80% of the cost of raw materials for household paper, has more than doubled compared to three years ago and is the most headache topic for household paper manufacturers.

What approaches are needed to reduce fiber costs without compromising the functionality and productivity required of household paper? In this paper, we will introduce the following three approaches we offer under the theme of "fiber cost reduction in the household paper industry.

- A) Reduction of basis weight by "ReelTime", a variability minimization solution
- B) Reduction of basis weight by "Textura," a special high-performance creping blade that improves bulk and water absorbency
- C) Reduction of NBKP ratio by improving paper strength through headbox sheet energy optimization

## **Evaluating to functional paper by Imaging software and LIBS technology**

Mariko Ikezaki, Toshiki Nakae  
Hakuto Co., Ltd. System Products Company Div.

It has various way to industrial paper analysis depending various demanding like production, development of new or better functions, and others.

Even focusing impurities analysis, it has also several different needs like the size, distribution, source of contamination, material of impurities.

In this report, explaining several latest methods of functional paper analysis that new generation imaging analysis software and elements distribution imaging using laser irradiation (LIBS) with actual examples.

From these methods, we propose to reach more valuable information for R&D and more reasonable QC possibility.



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**Digitization Made Innovative Operation Management  
-The need to digitize time-series information-**

Yusuke Nishida  
Honeywell Cyber and Connected Industrial, Honeywell Japan Ltd.

Plant operations require management of operational constraints, reference values, detection and correction of deviations from those constraints and reference values. To solve the management challenges faced by companies, more advanced and proactive condition awareness is required. Our operations management software, Operations Monitoring, is an application that systematically monitors plant operations data and summarizes deviations from standards, helping to ensure that plant operations are always within the "best" operating envelope. The software conforms to the "Integrity Operating Window" defined in industry standard guidelines established to ensure that process equipment critical to plant operations is better and safer managed, and is used for worker safety, prevention of environmental contamination due to chemical releases, and management of equipment critical damages. The "Integrity Operating Window" is also applied for worker safety, prevention of environmental pollution from chemical emissions, and management of equipment malfunctions. The "integrity operating window" translates directly to "integrity of the operating area," and refers to the control of the integrity of the operating conditions within a defined boundary value. Boundary values in a manufacturing site may include, first, environmental safety boundaries that affect the public, and second, design limits of equipment assets that may lead to equipment damage. The Operations Monitoring software allows managers to define these boundaries centrally for the process data under consideration. The Operations Monitoring software allows managers to define these boundary values centrally on the process data to visually evaluate the operation status, detect events that deviate from the boundaries, and make improvements. In addition, the software enables the workers and management to examine the data using a common index.

**Recent Generator Online Insulation Diagnosis**

Makoto Takanezawa  
Toshiba Energy Systems & Solutions Corporation

Generators installed in power plants and factories are important power supply equipment. To ensure stable operation over a long period of time, it is necessary to monitor the operating conditions and perform maintenance on a regular basis. With the introduction of renewable energy in recent years, thermal power plants have come to play the role of a regulating power source, which is different from conventional operations, requiring enhanced monitoring of the entire power plant. To meet this need, Toshiba has developed a new power plant monitoring and diagnosis system that incorporates an IoT application for power generation equipment diagnosis into the CPS(Cyber Physical System)-based IoT platform "TOSHIBA SPINEX for Energy". This system monitors equipment operation in real time to detect signs of failures that may lead to outages and formulates optimal maintenance plans to improve equipment operation rates. In the event of a breakdown, the system provides information on the cause of the breakdown and countermeasures to support early restoration. This monitoring and diagnosis system can also be applied to power generation equipment in factories.

The insulation of stator coils in generators deteriorates over long periods of operation, which can lead to ground fault accidents. The accident results in an unplanned shutdown of the generator, and a long period of time is required to repair the ground-faulted stator coils. To avoid long-term unplanned shutdowns of generators, it is important to conduct insulation diagnosis and ascertain the state of insulation deterioration. Conventionally, insulation diagnosis of stator coils has been conducted with the generator stopped, and off-line insulation diagnosis, which comprehensively diagnoses the insulation condition based on multiple test results, has been used. In the future, online insulation diagnosis, which enables monitoring of insulation condition trends during operation, is expected to become the mainstream.

Toshiba has developed an on-line insulation diagnosis system that can be installed in "TOSHIBA SPINEX for Energy" as an IoT application for diagnosis and that uses a non-contact sensor installed outside the generator. This paper introduces its features.

## **Automated plant operation using AI that imitates manual operation**

Kazuto Asamura  
Yokogawa Digital Corporation

"AI plant operation support solution" realizes automatic operation using AI model that learns human operations from plant data and manual operation history. The AI model automatically relearns frequently based on the accumulated manual operation history. By the automatic relearning, the AI was able to output appropriate operations depending on the situation, such as production volume and equipment deterioration over time. By introducing this solution to a chemical plant, we succeeded in automating manual operations that are difficult to automate with existing control technology, reducing the workload of plant operators.

## **Realization of smart factory in Tissue processing equipment**

Shinya Takai  
Kani Mill, Daio Engineering Corporation

Daio Engineering Co., Ltd. is an engineering company of the Daio Paper Group. The Kani Maintenance Department, to which I belong, is responsible for maintaining the processing equipment at Daio Paper Co., Ltd.'s Kani Mill.

Daio Paper Co., Ltd.'s Kani Mill is located in Kani City, Gifu Prefecture, and is the Daio Paper Group's second-largest production base after the Mishima Mill, producing the largest amount of Elleair brand tissue and toilet paper in the group. It's a factory.

This paper introduces the transformation of equipment into smart factories to process household paper products such as tissues and toilet paper into final products. We hope that you will find this case study useful as a reference.

## **A Small Scale Advanced Control Solution to Utilize Sensors and Analyzers**

Nozomu Wada  
Voith Turbo Co., Ltd. BTG Japan, Process Solutions

The current state of automation in Japanese paper mills assumes that today's automation technologies have already implemented IoT infrastructures such as DCS and OPC.

On the other hand, there are still many factories, especially in small and medium-sized enterprises, where the operator changes the SP (SV) for each loop while operating it by PID controller-based control. Even if one decides to consider advanced automation technology, the huge cost and manpower required to design and implement a small-scale DCS, PLC control, or OPC system from scratch can be a major hurdle.

Therefore, the author believes that a new solution is needed to improve and spread automation technology throughout the paper industry, one that provides predictive model control such as APC, but also has the low cost and manpower requirements of a conventional PID controller.

In this paper, a novel standalone control system package currently on going as a new project which provides prediction model-based control, however more simplified and easier to implement is introduced.

## **Case study : Digitalization of raw material yard -Digital data utilization and visualization by BI × IoT Technology-**

Taichi Kitamura  
MITANI SANGYO Co., Ltd.

The cost of recovered paper continues to rise due to recent fuel price hikes, which have increased collection and transportation costs. Whereas the rapid increase in demand for recovered paper in Southeast Asia, making it necessary to manage recovered paper inventories to avoid wastage.

Against the backdrop of the above, in this initiative, we together Rengo Co., Ltd. Fukui Division Kanazuru Mill (hereinafter "Kanazuru Mill") collect data through the Internet of Things (IoT), and use the collected data and Business Intelligence (BI) to digitalize the recovered paper yard (hereinafter "yard"). The goal was to achieve first-in, first-out (FIFO), which further enhances the recyclability of recovered paper through the digitalization of the yard.

To solve the problem, there were challenges in integrating two types of data with different structures, sensor data (unstructured data) and recovered paper inventory data (structured data), but we were able to solve them with the cooperation of the Kanazuru Mill.

The introduction of BI increased the visibility of the structured data, clarified the traceability of raw materials, and made it possible to instantly trace which lot of recovered paper was at risk in the event of an emergency. In addition, the ability to visually grasp the condition of recovered paper has prevented the retention of deteriorated recovered paper, and the appropriate delivery of raw materials has improved the yield rate of products, leading to an improvement in product quality.

## **DX brought by Control AI -Winner of the Prime Minister's Award-**

Makoto Shimizu  
Executive Officer, DX Consulting Division, Yokogawa Digital Corporation.

The Japanese manufacturing industry has long led the world with its high-quality products and advanced technological capabilities. However, in recent years it has been forced to respond to rapid changes in the external environment and intensifying international competitiveness. At the same time, with the development of digitalization and AI technology, a wide variety of AI exists, and under the banner of DX, a wide variety of AI is being applied to manufacturing sites. Nevertheless, it is rare to hear of any major success stories in the manufacturing industry.

In this paper, we describe the most promising AI that can create a differentiating factor for Japanese manufacturers to become internationally competitive, and describe a successful case of autonomous control of a chemical plant using control AI, which won the Prime Minister's Award, the highest award of the 52nd Japan Industrial Technology Awards sponsored by the Nikkan-Kogyo-

## **Characteristics of CNF-reinforced PA6 for PBF 3D printers**

Ryota Inoue, Takashi Date  
Nippon Paper Industries Co., Ltd

Cellulose is the most abundant, renewable, and environmentally friendly bio-based polymer, which is available from non-edible biomass sources such as wood, grass, and agricultural residues. Cellulose is attracting much attention as a reinforcing material for resin that can replace glass fibers and glass beads. Composites of resin and cellulose nanofibers (CNFs) have been prepared for many attempts in the injection molding field, but only few tries in the 3D printing industry. Therefore, we have produced CNF-reinforced composites in demonstration facility, and verified the application of CNF-reinforced composites to powder bed fusion (PBF) 3D printers. In this research, we prepared a 5wt% CNF compounded PA6 (CNF5%/PA6) powder by compounding of modified pulp fibers and PA6 pellets and followed by cryogenic powdering. The obtained CNF5%/PA6 powder was then molded to prepared test pieces by a PBF 3D printer, and the mechanical properties of the pieces were evaluated. As a result, the tensile strength and modulus of the CNF5%/PA6 test pieces were 60MPa and 2.6GPa, and the bending strength and modulus were 95MPa and 2.7GPa, respectively. These values of the CNF5%/PA6 test pieces were similar to or better than mechanical properties of 20% glass bead-reinforced PA6 composites composite (GB20%/PA6). Moreover, the CNF5%/PA6 3D model samples were almost 10% lighter than GB20%/PA6 because of characteristics of the lower density of CNFs than that of GB. Therefore, the CNF5%/PA6 powder is expected to be an important candidate as the raw material for the PBF type 3D printers.

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**『Impression Smart Motor Sensor』 Lecture on predictive maintenance solution services for Low-voltage three-phase cage induction motors**

Shiro Ebara  
Product Marketing Div. ALTIMA Company MACNICA

Predictive maintenance is the concept of predicting the failure or abnormality of equipment or equipment and performing efficient maintenance.

By introducing predictive maintenance, it is possible to detect the abnormality in advance and take maintenance measures, thereby preventing sudden troubles.

In conventional preventive maintenance, which cannot detect sudden abnormalities.

Therefore, "condition based maintenance (CbM)" is attracting attention as a new method. By the evolution of sensors and analysis, it is possible to detect the condition of facilities and equipment and predict failures and abnormalities.

"Smart Motor Sensor (SMS)" is a solution for predicting the failure of a three-phase induction cage motor.

It collects data such as vibration and temperature and analyzes it in the cloud to determine the condition of the motor.

SMS makes it easy to attach the sensor to the device, easy to set up, and uses a learning model for automatic determination.

By eliminating the barriers of conventional CbM, it can accurately determine the abnormality or deterioration of the motor.

In addition, SMS has the ability to determine the abnormality for each function of the motor and to grasp the trend of the state transition and deterioration.

It provides the result to the user through a dashboard or smartphone application.

The API can also be used to link with other systems, enabling efficient management of multiple equipment decisions on a single screen.

SMS is attracting attention as a new predictive maintenance method that replaces conventional preventive maintenance.

**NDT assessment of boiler pipe's wall thinning using 3D scanner: current technology and future trajectory**

Osamu Higashi  
Anritsu Corporation

Boiler thinning is required by the Electricity Business Act to inspect the wall thickness by ultrasonic flaw detection. It is a very labor-intensive task to illuminate each of the countless water tubes in a dark boiler to observe the subtle undulations of the thinning parts, and then apply an ultrasonic probe to each of them one by one. The shape, arrangement, and thinning pattern of the water tube are not uniform, and the numerical values by ultrasonic flaw detection vary depending on the operator. There is an increasing demand for inspection technology that does not rely on craftsmanship and does not overlook thinning areas due to fatigue.

**Paralign revolutionary roll parallelism measurement technology.  
Enables measurement with higher accuracy than previously possible.  
Introduction of roll parallelism measurement technology using a laser ring gyro.**

Yuta Namiki, Keisuke Fujimoto  
TTS Ltd.

The facility inspection specialist TTS has started services for the paper, foil, film, printing and steel industries, introducing ring laser gyroscopes to perform roll parallelism measurements in Japan.

Three high precision ring laser gyroscopes measure the parallelism of rolls compared to a single reference, regardless of distances, installation layout and obstruction. Accuracy is as high as  $\pm 0.05\text{mm}$  per 1m, ensuring high product quality, while measurements require only 1 to 5 minutes per roll.

Comprehensive graphic measurement results and a correction list are compiled immediately and facilitated on-site adjustment work shortens downtime. Thanks to measurement accuracy and speed, the new service contributes to improvement of quality and productivity.

**Age of Renovation Somay-Q will be responsible for**

Yohei Watanabe  
Somay-Q Technology

Dye Q Technology is a technology development laboratory that solves the world's problems. By using our proprietary technologies of "nano-bonding technology" and "reinforcement technology using new materials," it is possible to reinforce and extend the life of deteriorated concrete and steel parts. By applying new materials and reinforcing them without replacing deteriorated ones, wasteful industrial waste can be generated and significant cost reductions can be realized. In addition, it is widely used in both the interior and exterior of the factory and the type of structure, such as application to low-temperature and wet surfaces, and anti-corrosion paint that does not require kerens. It already has a lot of achievements, and it has been expanded not only to the private sector but also to public works.

**Traditional and State of the art cost reduction approach in abroad  
– 5th generation automated paper testing machine**

Hikomichi Yoda  
Process Industry Division, ABB K.K.

Currently, industry got strong pressure from the market because Japan government announced carbon neutral industry by 2050. In Japanese industry, especially material industry, there are several serious potential issues like lack of human resource due to less attractiveness for young people, retirement of baby boomer and the technical transfer. On the other hand, there are bright future in paper industry because paper is excellent material for plastic reduction and new functional material, Cellulose Nano Fiber.

ABB started following four approaches to cooperate with customer to solve facing issues.

- 1) Reliable and high performance online measurement for Refiner, Wet end control
- 2) Cutting-edge fiber analyzer for new material development
- 3) Speedy, Safety and high precise paper testing machine
- 4) High speed, high precise and reliable automated paper testing machine

In the paper; 4) High speed, high precise and reliable automated paper testing machine is described. You can understand how to utilize ABB 5<sup>th</sup> generation automated paper testing machine for mill operation optimization.

## **The latest information of softness measurement by acoustic and stress**

Kazumi Tanikawa  
Sanyo Trading Co., Ltd

In many cases, touch feeling evaluation is often performed by a panel test method in which the product staff and inspectors evaluate and quantify the feeling when they actually touch the product. However, what one person finds to be nicer and softer may not feel the same to another. Texture is subjective and tends to vary by individual, gender, and nationality. In order to increase the objectivity of the evaluation, it is desirable to use the equipment rather than the panelists.

Germany's emtec electronic company's TSA softness measurement device is a device that evaluates the softness and texture of paper products such as tissue products. A measurement method that simulates the vibration and stress felt by human fingertips, and measures the three parameters that affect the feel of the hand: true "softness", "smoothness/roughness", and "rigidity/flexibility". In addition, the overall texture is evaluated as an HF value.

## **Performance evaluation of low attracting insects between sunlight type LEDs, high CRI LEDs, and white LEDs.**

Goro Kimura  
Technical Research Laboratory, Ikari Shodoku Co.,Ltd.  
Toshihiro Kusama  
Product Development Division, Ikari Shodoku Co.,Ltd.  
Hiroyuki Watanabe  
Business Development Division, Ikari Shodoku Co.,Ltd.

The study was conducted to evaluate the insect control performance of sunlight type LEDs, high color rendering index (CRI) LEDs, white LEDs and prototype of LEDs in a comparative laboratory test. *Musca domestica* (house flies) and *Megaselia scalaris* (scuttle flies) were used in the study. The number of houseflies captured by high CRI LEDs was significantly higher than that of white LEDs. The number of house flies and scuttle flies captured by sunlight type LEDs was significantly higher than those captured by white LEDs. The number of scuttle flies captured by sunlight type LEDs was significantly higher than that of high CRI LEDs. The number of house flies captured by white LEDs was significantly higher than that of prototype of LEDs. The results of this study show that high CRI LEDs and sunlight type LEDs have higher insect attracting power than white LEDs. On the other hand, prototype of LEDs have lower attractiveness than white LEDs. These results suggest that insect attractiveness is not only influenced by UV light but also by visible light.

## **Key Points for Manipulation of Several Data and Effective Measures Concerning with Pest Management**

Takeo Ishizaki  
Earth Environmental Service Co., Ltd

For the appropriate pest management, we have to consider both the effectiveness and the efficiency because many factories have limited staff and time to spare for pest management. In this paper, some key points for manipulation of several data and effective measures concerning with pest management were mentioned.

At first we have to connect the monitoring data (investigation using trapping tools such as light trap) with other data, for example the insect contamination data gained from the defect detector, which is very important because these information indicates the direct contamination into the products. Also it is useful to utilize the data for the cause of insect (e.g. wind direction and speed), which leads to the preventive actions. In addition, in order to manipulate these data effectively, I recommend 'analysis of correlation', which can verify the hypothesis for the insects' invasion.

As for the effective measures, we have to consider the characteristics of insects. Then it is useful for us to think of pest management strategy that we construct the measures based on the insects' invasion routes, which consists of the approach from the outside to the factories, the border of inside and outside, the approach to the productive area in the factories, and the habitation of insects near the productive area.

Finally, I introduce some specific measures such as traps, extermination, partitions, and so-called '5S'. The important thing is that we need to select measures considering not only the merit, but also the demerit or risk.



## **Report on the Results of the Fiscal 2023 Follow-up Survey on” JPA’s Carbon Neutrality Action Plan” and Related Information on Measures against Global Warming in the Japanese Paper Industry**

Yasuharu Sakina  
Japan Paper Association

The Japan Paper Association (JPA) established its “Voluntary Action Plan on Environment” in 1997, in response to The Japan Business Federation’s call to the Japanese business community to organize “The Voluntary Action Plan on Environment”. Since then, JPA has carried out a follow-up survey and published the results every year.

As the Voluntary Action Plan finished in fiscal year (FY)2012, JPA newly started “the Action Plan towards a Low Carbon Society” which is renamed “Carbon Neutrality Action Plan (Phase II)” this year and has been actively addressing global warming prevention in order to achieve the following targets set in the plan:

- Reduce energy derived CO<sub>2</sub> emissions by 38% by FY2030 from the FY2013 level .
- As a source of CO<sub>2</sub> absorption, increase total forest plantation area at home and abroad by 375,000 ha to 650,000 ha by FY2030 from the FY1990 level .

According to the results of FY 2023 follow-up survey (actual results for FY 2022), fossil-energy derived CO<sub>2</sub> emissions in FY 2022 was 14.33 million tons, which is 1.5 million tons lower than those in FY 2021(15. million tons) and is 4.5 million tons lower compared to those in FY 2013(18.83 million tons). This is attributed to each manufacturer’s active efforts including energy saving and energy conversion from fossil energy to non-fossil energy such as biomass energy.

In addition to the results of the follow-up survey, this report introduces the current energy situation in the Japanese paper industry.

### **Creation of polycaprolactone–wood pulp composites and the evaluation of degradability in soil**

Kotchaporn Thangunpai and Mir Ihara Paola Maria  
Degree Programs in Life and Earth Sciences, University of Tsukuba  
Toshiharu Enomae  
Institute of Life and Environmental Sciences, University of Tsukuba

Plastic waste has become a reality as a major global risk to the environment due to a lack of disposal facilities. Furthermore, CO<sub>2</sub> continues to be generated throughout plastic production and plastic waste processes, damaging the environment as a greenhouse gas. To address these environmental problems from a standpoint of environmentally friendly materials, the concept of a biodegradable polymer composite is proposed in this research. Cellulosic pulp fibers and polycaprolactone (PCL) are both biodegradable and can be applied to create a biodegradable plastic-pulp fiber composite. In addition, it possesses excellent mechanical and structural properties depending on the design and manufacturing technology. In this study, we applied traditional papermaking techniques and heat pressurization to produce a PCL-cellulose composite with a high rate of degradation in soil and specific mechanical properties. Fourier transform infrared spectroscopy and scanning electron micrographs exhibited PCL was retained among pulp fibers. The soil degradation test clarified the PCL-cellulose composite degraded faster than plain pulp sheet since PCL is more biodegradable than cellulose.

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### **Pine-based resin use in paper for sustainability**

Asuka Okumura

Paper Chemicals Development, R&D Center, R&D Company, Harima Chemicals, Inc.

Currently, from the viewpoint of marine plastic pollution, resource disposal regulations, and global warming countermeasures, there is a demand for 3R and for the conversion from petroleum-derived plastics to renewable resources. In Japan, the Plastic Resource Recycling Strategy which was formed in May 2019, and the Osaka Blue Ocean Vision which was announced at the G20 Osaka Summit in 2019, are addressing these important topics. The Plastic Resource Recycling Strategy is also attracting attention for the use of sustainable resources.

Pine trees are a sustainable and natural resource that are especially abundant in North America and Europe. Wood fiber is the main component of a tree, and it is recovered during the “pulping process”. Paper is produced from wood fiber, and it is an excellent material for consideration as a renewable resource.

Harima Chemicals Group continues to work towards a more sustainable environment. Naturally occurring resins such as rosins and fatty acids are recovered from crude tall oil which is obtained from the pulping process, and these biproducts have many valuable end uses. In this article, we will introduce Harima Chemicals Group’s pine chemical business that is expanding its utilization of sustainable natural resins for paper “sizing agents” and for “water-based barrier coatings”.

### **Valmet’s Biorefinery Technologies for Products from Wood-resources towards Decarbonization**

Masaharu Menjo and Tomonori Miyako

Valmet K. K.

In this paper, Valmet’s biorefinery technologies will be briefly described. Towards decarbonization, utilization of wood-resources is essential. There are some potential products based on wood-resources and it is possible to produce bioethanol (2nd generation) and black pellets as mass production by using Valmet’s steam explosion technology. For the production of bioethanol, raw materials are pulverized during exhausting from a pressure vessel. Then, the exhausted materials from the pressure vessel are fed to hydrolysis, fermentation and distillation processes. On the other hand, pulverized raw materials are simply fed to pelletizers for the production of black pellets. There are already some commercial plants where Valmet’s steam explosion technology is installed for bioethanol-production and there are some on-going projects about commercial black pellet plants. Valmet has a pilot plant in Sweden, thus, the test-runs with potential raw materials by changing process conditions can be conducted for investigation of future projects.

After the introduction of Valmet’s steam explosion technology, the high-performance valves from Neles will be briefly described. After the merger of Neles, wide variety of products portfolio is now available from Valmet. Neles’s products are highly reliable and suitable for commercial plants.

### **Effective treatment of organic liquid waste such as shochu liquid waste -Introduction of Miyazaki model-**

Yutaka Isu

Nichinan Mill, Oji Paper Co., Ltd

Nichinan mill accepts organic waste, especially shochu waste, as industrial waste and treats sustainably with efficient sludge recovery, heat utilization, and effective use of incinerated ash. This sustainable waste management approach is certified by the Ministry of Economy, Trade, and Industry.

Since 2017, We have expanded the acceptance of shochu waste from Nichinan City to outside Miyazaki Prefecture, and in fiscal 2022 more than 11,000 tons of shochu waste was accepted annually. We will effort to increase acceptance capacity and also continuously effort to achieve Goal 7 of SDGs: ” Ensure access to affordable, reliable, sustainable and modern energy for all” through the environmentally-friendly treatment.

## **Development of the Bio-Asphalt Mixture Utilizing Kraft Lignin**

Takuto Shakuno  
Nippon Paper Industries Co., Ltd

In Japan, it was declared in October 2020 that emissions of greenhouse gases that cause global warming will be reduced to zero by 2050. In response, ministries and agencies announced various policies to realize a carbon neutral and decarbonized society.

Against this background, Nippon Paper Industries is developing a bio-asphalt mixture that partially replaces petroleum asphalt with lignin as a technology to realize a decarbonized society in the pavement sector. This technology is implemented jointly with Taisei Rotec Corporation under the NEDO project “Strategic Innovation Program for Energy Conservation Technologies”.

This work summarizes the properties, energy-saving effect, laboratory test result, and test construction results of the bio-asphalt mixture.

## **Development of Cellophane Recycling Technology**

Shumpei Ishikawa and Noriaki Tsukida  
Central Laboratory, Rengo Co., Ltd.

Cellophane is a transparent cellulose film produced by coagulating and regenerating viscose, a solution obtained by dissolving pulp in an alkaline solution. Cellophane is a natural cellulose material that biodegrades not only in soil but also in seawater, making it an environmentally friendly material. However, cellophane is classified as a non-recyclable material and does not have a recycling system like plastic film. Therefore, as a result of examining the effective use of cellophane, it was found that scraps generated in the manufacturing process can be reused as part of the raw material.

When cellophane is used as a packaging material, it is usually laminated with a sealing material such as polyethylene. Therefore, in order to reuse the cellophane collected on the market, it is necessary to separate the cellophane from the sealing material, which is not realistic in terms of cost. On the other hand, most of the offcuts generated in the slitting process in cellophane manufacturing are discarded as scrap. Therefore, we considered reusing this offcut material as a raw material. First, the cellophane manufacturing process produces viscose from wood pulp through a two-step reaction of alkalization and sulfurization. This viscose is regenerated into cellulose to produce wide rolls of film. The slitting process in converting these rolls into final products produces cellophane scrap. In this study, we attempted to produce viscose from these scraps using the same procedure as wood pulp. However, despite having the same chemical structure, it could not be dissolved as easily as wood pulp. On the other hand, it was found that a low-concentration cellophane solution can be obtained by simultaneously carrying out the alkalization reaction and the sulfurization reaction. This cellophane solution was then used to dissolve the wood pulp to prepare recycled viscose that was no different from conventional viscose. Cellophane samples made from this recycled viscose had similar properties to regular products. This study shows the possibility of the recycle system for cellophane.

## **Paper packaging materials to substitute for film**

Keisuke Takemoto  
Marketing&Development Dept. Sales Div, Oji F-Tex Co., Ltd

The SDGs adopted by the United Nations General Assembly in September 2015 have accelerated environmental awareness around the world. Among them, many people are interested in measures to combat environmental pollution caused by the outflow of plastic products.

In Japan as well, the 3Rs + Renewable of plastic products are an important issue, as seen in the government's goal of reducing one-way plastic emissions. In such a social situation, paper and cellulose materials made from carbon-neutral woody biomass are attracting attention as alternative materials to plastics.

The performance of plastic products is excellent in "water resistance, oil resistance, transparency, heat-sealing, and gas barrier properties", and it is essential to provide these properties as an issue for replacement with paper materials. We produce paper with the above performance by combining papermaking and coating technologies based on various pulp materials. In particular, the developed product "SILBIO Series" can meet various needs by selecting the necessary characteristics from among the characteristics such as transparency and concealment, based on the gas barrier properties and heat-sealing properties required for many packaging materials.

"SILBIO EZ SEAL" is a heat-sealing paper developed for secondary packaging, and uses water-based coating technology to give the paper heat sealability. "SILBIO BARRIER" has gas barrier properties by coating the barrier coat layer that fills the gap between the pulp. "SILBIO CLEAR" combines highly transparent paper with heat seal OPP to achieve all transparency, gas barrier properties, and heat-sealing properties. "SILBIO ALBA" achieves high gas barrier performance by combining aluminum vapor deposition technology with a barrier coat layer.

By providing paper materials that meet the needs of society, we aim to contribute to a carbon-neutral society.

## **Valmet's New Recovery Boiler and Effective utilization of existing boilers after new recovery boiler construction**

Kazuya Hirakawa  
Energy Group PES, Service business line, Valmet K.K.

On February 10, 2023, the "Basic Policy For Realizing GX" was approved by the Cabinet. GX = Green Transformation Investment further accelerates decarbonization efforts, and the nation supports investments that lead to decarbonization in the power generation, industrial, transportation, and household sectors, etc., and is preparing for an early transition to a decarbonized society. Renewal of recovery boiler is listed as an investment destination for GX in the paper and pulp industry. For this reason, it is expected that the replacement of the recovery boiler will be considered in the future.

We will introduce Valmet's recovery boiler, which has maximized efficiency, high availability, safe work environmental and low emissions. In addition, the existing boilers are often left behind after the recovery boiler is renewed and are hardly used effectively. This time, we will focus on this idle boiler. We will introduce the modification of an existing recovery boiler to a bubbling fluidized bed (BFB), which has many achievements overseas, has advantages over new boiler construction costs, and has almost the same performance as the latest boiler.

## **Our efforts to the Energy Plants in the Pulp and Paper Industry**

Yuji Fujiwara  
TAKUMA CO., LTD.

Takuma Co., Ltd. was established in 1938 by Tsunekichi Takuma, one of the top ten inventors of the Meiji and Taisho eras, who invented Japan's first purely domestic water tube boiler, the "Takuma Kikan." Based on our original boiler technology, in 1963 we delivered Japan's first continuous waste incineration plant (with a processing capacity of 450 tons/day) to Osaka City, and in 1998 we built the largest scale waste incineration plant in Japan (with a processing capacity of 1,800 tons/day). Japan to the Tokyo Metropolitan Government, and currently holds the top share in terms of processing scale and number of deliveries in the field of waste incineration.

On the other hand, in the field of energy plants, in 1949 we became the first in the industry to export bagasse (sugar cane residue)-fired boilers. We have delivered a large number of steam supply and power generation plants that use a wide variety of fuels as heat sources for various industries.

We have delivered energy plants to the paper and pulp industries without exception, and in this article, we will introduce our recent efforts for the paper industry.

## **Operating experience of Biomass boiler**

Shuhei Yomo  
Tonegawa Division Paper Mills Rengo Co.,Ltd.

Environmental initiatives are becoming increasingly important for all companies. Rengo formulated “Eco Challenge 2030” that targets reduction of CO<sub>2</sub> emissions derived from fossil energy by 46% by FY 2030 compared to FY 2013.

To achieve this target, Tonegawa Division commenced operation a new biomass boiler for power generation that utilizes fuel source such as waste woodchips, RPF, and scrap tires in October 2022.

The steam conditions of new boiler were planned to be equivalent to the existing gas boiler, and the existing boiler is currently utilized as a backup.

This report shows overall of the new biomass boiler, operational experiences and trouble cases since commissioning.

## **Anti-scaling technique of black liquor evaporator using high power ultrasonic technology**

Masato Tatematsu  
Mitsubishi Paper Mills Limited Kitakami mill

Black liquor, a byproduct from the pulp manufacturing process, needs to be concentrated to a solids content of about 75 wt% in order to be supplied as fuel for the recovery boiler. The Kitakami Mill has an eight-can, six-effect black liquor evaporator, and fouling due to calcium carbonate was noticeable especially in the second-effect. Injection of scale inhibitor had been used as a countermeasure, but no fundamental solution was yet to be reached. In this report, we describe a new fouling prevention solution, applied by high-power ultrasound. It is known that ultrasound can induce nucleation in black liquor, which resulting to suppress trigger of new nucleation induced on the surface of the heat-transfer elements. For this demonstration, a high-power ultrasonic device owned by Nippon Steel Engineering Co., Ltd. was used for proof of concept. The ultrasonic device was installed at the black liquor supply line running to the second-effect, and its demonstration was performed from December 2020 until March 2022. Comparison of operational data on the transition of effective temperature difference with and without ultrasound showed a clear improvement for the case of having continuous sonication, and it was also confirmed by the evident reduction of fouling formation on the heating elements at the occasion of open inspection. The efficacy of ultrasound for the application to fouling prevention was confirmed.

## **Confront the surge in energy prices!**

### **An organizational approach to maximize the value of factory energy management systems**

Yasuyuki Horiuchi  
Industry HQ Industry Solution Center Dept.3 Group1, Yokogawa Solution Service Corporation.

Energy prices are skyrocketing today, and energy conservation is becoming more and more important in factories. Organizational management and data insight are essential to achieving factory energy efficiency. This paper introduces the essence of improvement cases connected by insights while involving the manufacturing site.

## **Application of Superheated Steam Drying to Pulp and Paper Industries**

PT Tanjungenim Lestari Pulp and Paper, Director (technology and engineering)  
Akira Nakasuka

It is very popular to utilize pressurized superheated steam (SHS) in boiler & turbine area. However, SHS can also exist under atmospheric pressure and as dry as pressurized SHS. I will show a model to simulate a continuous drying process with SHS under atmospheric condition. Then, this model is developed into an industry-oriented model like Tissue Machine dryer hood. With this model, I will explain that it is not advantageous to introduce fresh air into SHS drying system.

Finally, some hints were provided to implement SHS drying technology in pulp and paper industries.

## **Safety Assessment of Bamboo-derived Cellulose Nanofibers in Food for Healthy Adults : A Long-term, Open-label Ingestion Trial**

Tomoko Shimokawa, Noriko Hayashi

Department of Forest Resource Chemistry, Forestry and Forest Products Research Institute

Tetsuya Takao

Graduate School of Life Sciences, Showa Woman's University

This study was conducted as part of a proposal to add cellulose nanofibers (CNFs) to food. Given the nanoscale nature of CNFs, comprehensive safety assessments are essential. In this study, a long-term, open-label safety assessment involving human consumption of CNF-enriched test food derived from bamboo (*Phyllostachys edulis*) CNFs was conducted. The CNF slurry was prepared via bead milling after enzymatic pretreatment of bamboo pulp. In total, 22 adult Japanese men and women who were not receiving treatment for their disease consumed CNF-containing test food equivalent to 1 g of dry weight per day for 12 weeks. The test food was packaged in 45 g pouches, with a CNF concentration of 0.556%, and each pouch contained CNFs equivalent to 0.25 g of dry weight. Therefore, the participants ingested two pouches of sample food in the morning and two pouches in the evening. Notably, no participants withdrew from the study during the evaluation period. Although significant variations in anthropometric, physical, blood chemical, and urinalysis parameters were observed, these were either within the bounds of normal physiology or minor fluctuations. Additionally, there was an increase in both the frequency of bowel movements and the volume of feces, although these findings did not raise any clinical concerns. Overall, the safety assessment undertaken in this study did not reveal any major issues associated with the consumption of bamboo CNFs, and the observed variations were not of medical concern.

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## Green Ammonia Value Chain

Yoshihiro Menju  
IHI Corporation

Fuel ammonia is in the spotlight as one of the next-generation energies for achieving carbon neutrality as it does not emit CO<sub>2</sub> during combustion. In the IHI Group, the renewable energy - derived green ammonia production business is positioned as the core of future decarbonization business.

In addition, considering the future mass consumption of fuel ammonia, IHI is engaged in a wide range of activities to build a value chain that extends not only to the production of green ammonia, but also to the transportation, storage, and utilization technology development.

For ammonia production, in other words the upstream part of our value chain, IHI is conducting surveys and studies for cost-effective green ammonia production in countries such as India and Australia, as both have abundant renewable energy resources. For transportation and storage, or the midstream part of the value chain, IHI is developing ammonia fuel ships that do not emit CO<sub>2</sub> during transportation, and the conversion of LPG tanks and large storage tanks for the construction of large ammonia receiving terminal. Finally, in the downstream part of the value chain, IHI is developing technologies to utilize ammonia, such as boilers, gas turbines, and gas engines.

IHI Group is determined to contribute to the realization of a sustainable society by establishing a green ammonia value chain and promoting decarbonization globally.

## Operation experience of No.5 Recycling Boiler

Tatsuhiko Ohira  
Iwaki Daio Paper Corporation

Iwaki Daio Paper started commercial operation of No.5 recycling boiler (Mitsubishi Heavy Industries Power IDS Co., Ltd.) on February, 2023.

A feature of the No.5 recycle boiler is that by setting the steam temperature to around 300°C, the temperature of metal is kept away from the corrosive range, reducing high-temperature corrosion of the boiler tubes caused by chlorine. Its greatest strength is that this allows the use of a wide variety of waste materials, such as fuel derived from waste that would be difficult to use with conventional equipment and would otherwise be landfilled or simply incinerated.

During the commissioning run, a big clinker was generated. This is because the co-firing of RPF and heavy fuel oil A locally raised the temperature of the fluidized sand too high around the burner, and the molten fluidized sand mixed with "combustion ash" and "agglomeration generated in the bed." This problem was resolved by reviewing the fuel combination and has not recurred. Furthermore, thinning of the thermal spray coating that protects the in-bed evaporator tubes has been showing signs of wear since the beginning of the test run, and we are working with the manufacturer to take measures to extend the life of the tubes, with the goal of expected continuous operation.

This article provides an overview of the recycling boiler's equipment, operational experience, and trouble cases.

**Go green with pumps!**  
**-Realize energy saving and carbon dioxide reduction!-**

Yota Fujimoto  
Torishima Pump Mfg. Co., Ltd.

Due to soaring fuel prices and the promotion of carbon neutrality, interest in energy saving within factories is increasing. Particularly in the paper industry a large amount of water is consumed such as raw water in the pulping process, boiler water, and various types of cooling water, and therefore the pumps that transport the water consume a large amount of electricity. This shows that it is important to achieve energy savings with pumps in factories. However, pumps are not often considered as means for energy saving, because it is difficult for user to select optimum pumps which are not standard products and lifespan of pumps is so long that they are rarely replaced.

Our company has greatly contributed to energy saving with developing high-efficiency pump and giving advice for energy saving with pumps. Based on our experience, we will introduce in this article our activities of proposal for energy-saving and methods for energy saving with pumps used in the paper industry for three systems: the white water system, the boiler area and the cooling water system, such as adopting high-efficiency pumps and optimizing pump specifications.

**Energy saving by converting factory raw water pumps to inverters**

Yoshimasa Ikeda and Mitsuhiro Murata  
Iwakuni Mill Nippon Paper Industries Co., Ltd\*<sup>1</sup>

Nippon Paper Group operates under the slogan “Shaping the future with trees” as a comprehensive biomass company with the goal of creating new value never seen before and contributing to better living and cultural progress. As part of our activities, we are working to reduce greenhouse gas emissions by 54% compared to FY2013 in FY2030, with the aim of achieving carbon neutrality in FY2050.

This paper reports on the significant energy savings achieved by converting two raw water pumps (wire-wound high voltage motor) used at a water source from commercial power supply drive to inverter drive. It also introduces the troubleshooting measures taken for vibration, noise, and instantaneous voltage drops during lightning strikes that occurred when the two pumps were upgraded one by one.

**Steam Driven screw-type air Compressor system for Energy-saving**

Masaru Sakakida  
Industrial Machinery Dept.3 Gr. Iatsubo Corporation

The recent rise in electricity costs due to the high cost of electricity and fuel has placed a heavy burden on industry.

This paper introduces a technology for operating compressors using waste steam.

This technology was developed more than 10 years ago and has many installations.

Due to the recent high energy prices, the cost benefits are now even greater than before, so a faster return on investment can be expected.

## **Operating experience of Biomass boiler**

Shuhei Yomo

Tonegawa Division Paper Mills Rengo Co.,Ltd.

Environmental initiatives are becoming increasingly important for all companies. Rengo formulated “Eco Challenge 2030” that targets reduction of CO<sub>2</sub> emissions derived from fossil energy by 46% by FY 2030 compared to FY 2013.

To achieve this target, Tonegawa Division commenced operation a new biomass boiler for power generation that utilizes fuel source such as waste woodchips, RPF, and scrap tires in October 2022.

The steam conditions of new boiler were planned to be equivalent to the existing gas boiler, and the existing boiler is currently utilized as a backup.

This report shows overall of the new biomass boiler, operational experiences and trouble cases since commissioning.

## **A report on technical exchange meeting with IPPTA (Indian Pulp and Paper Technical Association)**

Terunobu Fukui<sup>\*2</sup>  
JAPAN TAPPI<sup>\*1</sup>

39 people from the Indian Pulp and Paper Technical Association (IPPTA) came to Japan and technical exchange events that included mill tours, theme presentations, and a social gathering were held. For the mill tours, from March 4th to 6th, they visited Rengo Co., Ltd. Yashio Mill, Ichikawa Co., Ltd. Kashiwa Mill, Oji Materia Co., Ltd. Fuji Mill, Nippon Paper Creca Co., Ltd. Koyo Mill and Hokuetsu Corporation Niigata Mill. The theme presentation and social gathering were held on March 7th at the Kmiparupukaikan in Ginza, Tokyo.

In the theme presentation, IPPTA made a presentation regarding the status of India's pulp and paper industry, with the following main points:

- There are 569 paper mills in India.
- Production capacity in 2022-23 is 32 million tons, and both production and demand are approximately 26.5 million tons.
- By raw material used, recycled fiber accounts for approximately 80%.
- Paper demand will grow significantly in line with future growth in GDP.

The Japanese side made presentations on the following seven themes.

- (1) Issues in the Japanese paper industry and initiatives towards net zero CO<sub>2</sub>
- (2) Measures to secure fiber (wood and recovered paper) for future
- (3) Measures to improve the industry image
- (4) Water management strategies, Water saving initiatives
- (5) Equipment reliability measures and initiatives towards predictive maintenance
- (6) Initiatives to improve automation using AI and operator skills
- (7) Collaboration with Government, Industry, Institutions and Society

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## Activities of energy-conservation at Kumagaya Mill

Tatsuya Miyazaki  
Kumagaya Plant, LINTEC Corporation

It is supposed that greenhouse gas causes various kind of climate change such as increasing global average temperature. Currently, reducing the amount of greenhouse gas emission is one of the significant issues around the world since greenhouse gas causes sea level rise, acidification, drought and flood.

New international framework "Paris Agreement" was adopted in the 21st Session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (COP 21). Japan set a goal of greenhouse gas reduction 46% by FY 2030 compared to FY 2013, and companies are taking actions to achieve the goal.

As Energy Saving Act calls for an effort to decrease annual average energy consumption intensity more than 1%, companies must struggle with energy conservation and CO<sub>2</sub> reduction activities.

In above circumstances, this paper introduces a case of contributing to energy saving and CO<sub>2</sub> reduction by the CO<sub>2</sub> Hot Air Supply Heat Pump Unit, effect of gas turbine CGS installation with energy service contract and optimized boiler operation.

## Introduction of Linear Turbine Vacuum Pumps in Jiangmen Xinghui Paper Mill (China)

Noriyuki Fujita  
Kanto Mill (Katsuta), Hokuetsu Corporation

Jiangmen Xinghui Paper Mill Co., Ltd. was launched in June 2011 in Jiangmen City, Guangdong Province, China, as the first greenfield project among the overseas investments made by Hokuetsu Corporation. Figure 1 shows the location of the mill. It is a whiteboard paper mill using recycled paper with annual production capacity of 300,000 tons, that started commercial operation in January 2015. In the construction of the mill, we adopted the latest equipment with automatic control technology at the time, and since then we have continuously improved the equipment and production technology to stabilize the operation and improve the product quality and reduce the costs.

China is promoting energy conservation as a national policy, and the government sets energy reduction targets in every five years and each company is required to achieve them, so that we tried various energy-saving projects in the mill.

In this report, we introduce an example of the introduction of linear turbine vacuum pumps that have achieved great results among them.

## Energy saving of compressor equipment

Hiroaki Fujita  
IHI Rotating Machinery Engineering Co.,Ltd.\*2

In the industrial field, compressed air is widely used as a convenient power source. Compressor equipment is what produces the compressed air, but the users who operate it have a wide range of needs and concerns, such as reducing CO<sub>2</sub> emissions and rising electricity costs.

Compressed air trends are constantly changing, and there are many cases where there are times when the basic unit (power consumption per unit amount of air) deteriorates due to the inability to operate with the appropriate model or number of units. For this reason, it is ideal for compressor equipment to be one that does not deteriorate (or change) its basic unit no matter what the trend situation is, as it is the ultimate energy-saving equipment.

However, given the ever-changing trends in compressed air trends, it is realistically impossible to operate at the same basic unit throughout the day or throughout the year, but it is possible to approach the "ultimate energy-saving equipment." be.

First, it is important to know the operating status of the compressor through trend analysis and to confirm whether the compressor's characteristics are being utilized. In addition, we recommend planning from a broad perspective, including investigating the Control device, piping equipment, air leaks, maintenance status, etc. There are always hidden hints for improvement.

## **Energy Saving by Adopting High-Efficiency Motor**

Hiroomi Ohtajima  
Tokai Mill, Oji F-Text Co. Ltd.

In September 2020, the Oji Group formulated an Environmental Action Program 2030 with fiscal year 2030 being the target achievement year and Environmental Vision 2050, a 30-year long-term vision from now. In Tokai Mill as well, to achieve the target, we are working to improve our energy efficiency with a target reduction in energy consumption intensity of at least 1% per year, averaged over five years. In this paper, we focus on the fact that many motors on operating in plant are standard-efficiency induction motors and introduce an example of replacing them with high-efficiency motors.

## **Introduction of energy saving cases for paper production part at Sendai mill**

Yuki Iwao  
Sendai Mill, Chuetsu Pulp & Paper Co.Ltd

Carbon neutrality trials are currently being actively carried out around the world, and our mill has been engaged in energy-saving activities for long term. The present trends are also reflected to quality demands, and many variations are also required to the operations of the papermaking process.

Changes in operations are bringing companies the opportunity to achieve improvements to previously common operating patterns and get energy-saving without affecting the quality.

This paper introduces trials of energy-saving case implemented in the papermaking process at our mill.

## **Demand-side optimization and cost reduction utilizing the wholesale electricity market**

Kenjiro Yagi  
Tokushu Tokai Paper Co., Ltd.

TOKUSHU TOKAI PAPER CO., LTD.'s Mishima Plant participated in the wholesale electricity market and began adjusting the operation of its own power generation facilities according to market prices and power supply and demand conditions. In addition to achieving cost reductions by purchasing electricity at low prices and selling electricity at high prices, it has also achieved "optimization of electricity demand" through upward and low DR. It is considered to be an initiative that will contribute to the elimination of the duck curve phenomenon, which has become a global issue due to the expansion of renewable energy.

## **Development of Gas combustion technology for Lime Kiln toward realization of a Carbon-neutral society**

Hitoshi Inoue

Business Development Department, Daigas Energy Co., Ltd.

Efforts to reduce CO<sub>2</sub> emissions are accelerating toward the realization of a carbon-neutral society by 2050, but fuel oil C and other fuel oils are mainly used for Lime Kiln in the paper industry in Japan. These emit more CO<sub>2</sub> per calorific value than Natural gas, but they are generally cheaper. Therefore, simple fuel conversion to Natural gas has been a challenging situation. In this problem, we've been working to improve our customers' specific energy consumption and reduce CO<sub>2</sub> emissions by advancing our existing technologies including energy-saving and others.

Gas atomizing combustion is one of the mixed combustion technologies of fuel oil and Natural gas without changing the existing burner. By designing the nozzle and optimizing the flame shape according to the customer's facility, we have succeeded in improving the Lime firing rate, lowering NO<sub>x</sub> emissions and so on. Our gas atomizing combustion technologies are already adopted in four Kilns at two customers, and that contributes to approximately 20% CO<sub>2</sub> emission reduction compared to fuel oil combustion.

Regarding the gas firing burner technology, we have developed a new gas burner with a high-brightness flame for Lime Kiln. We can optimize the flame shape and temperature distribution by introducing main gas burner and auxiliary burners around the main burner and adjusting each input balance and gas jet velocity. We plan to conduct combustion tests of gas firing burners in our customer's furnace during 2023 and to promote their introduction.

It is important to steadily promote low carbon emissions by converting fuels to Natural gas through the introduction of gas atomizing and gas combustion technologies. In addition, carbon neutrality can be achieved in the future by methanation to customers that already use natural gas. With these technologies, we'd like to contribute to the realization of a carbon-neutral society in 2050.

## **Energy saving and operational improvement for kraft pulp process - processes involving black liquor-**

Satoshi Wada

Pulp & Paper Technology Section, Kurita Water Industries Ltd.

At pulp and paper mills, the demand for improved production efficiency and energy conservation continues to increase due to various factors such as fluctuations in raw material prices and soaring fuel prices in recent years.

Here, the cooking process and the evaporator are processes that use a lot of energy in the KP process, and stable operation and productivity maintenance are very important processes.

In these processes, the adhesion of deposits causes a decrease in productivity and energy loss.

As a countermeasure against deposits, as a countermeasure using water treatment chemicals, it is ideal to wash with a cleaning agent and maintain a clean state with a preventive agent.

Since deposits have different components depending on where they are generated, it is necessary to use appropriate chemicals according to the components and where they are generated.

This report introduces the theory and application of detergents and scale inhibitors to improve scale and organic matter adhering to digesters and evaporators as methods of improving operations and reducing energy loss related to deposits.

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### **Separation of lignin and its utilization Technology**

Makoto Iwasaki  
MIP Consultant Office

Currently, from the viewpoint of preventing global warming, carbon neutral energy and chemicals are highly attracting attention, and many companies want to use them as a substitute of fossil energy and chemicals. Under these circumstances, pulp and paper companies have become more oriented toward biorefinery in which lignin utilization is included. In this article I will introduce the world trend of separation and utilization technology of lignin. I will also outline the method of separating lignin from KP black liquor, which was developed by Sweden and the efforts of North America and Japan centering on lignin derived products.

### **Development of energy saving and CO<sub>2</sub> saving burner for Lime Kilns and evaluation of on-site kilns**

Takayuki Kitamura  
Daigas Energy Co., Ltd.

Efforts to reduce CO<sub>2</sub> emissions are accelerating toward the realization of a carbon-neutral society by 2050, but fuel oil C and other fuel oils are mainly used for Lime Kiln in the paper industry in Japan. These emit more CO<sub>2</sub> per calorific value than Natural gas, but they are generally cheaper. Therefore, simple fuel conversion to Natural gas has been a challenging situation. In this problem, we've been working to improve our customers' specific energy consumption and reduce CO<sub>2</sub> emissions by advancing our existing technologies including energy-saving and others.

Gas atomizing combustion is one of the mixed combustion technologies of fuel oil and Natural gas without changing the existing burner. By designing the nozzle and optimizing the flame shape according to the customer's facility, we have succeeded in improving the Lime firing rate, lowering NO<sub>x</sub> emissions and so on. Our gas atomizing combustion technologies are already adopted in four Kilns at two customers, and that contributes to approximately 20% CO<sub>2</sub> emission reduction compared to fuel oil combustion.

Regarding gas combustion technology, we have developed a new gas burner that forms a luminous flame by modifying ways to blow out gas. We have pursued gas combustion by either retrofitting the existing burners with our gas burner or combining them with gas burners manufactured by Taiheiyo Engineering Co., Ltd. With these two approaches, we have already achieved approximately 7% energy savings in Lime Kilns.

It is important to steadily promote low carbon emissions by switching fuels to Natural gas through the introduction of gas atomizing and gas combustion technologies. In addition, carbon neutrality can be achieved in the future by methanation to customers that already use natural gas. With these technologies, we'd like to contribute to the realization of a carbon-neutral society in 2050.

### **Biodegradable Bio plastic resin using Hemicellulose -One stop development & production from Resin to Products-**

Jin Nasukawa  
Hemicellulose Ltd.

Hemicellulose is an insoluble polysaccharide, 20-30% present in almost all terrestrial plant cell walls. It is the largest underutilized side-stream of pulping. To make use of it, bioplastic resin called "HEMIX™" was developed and manufactured. Our goal is to utilize hemicellulose in functional materials in large quantities, paving the way for the effective use of this underutilized resources by combining natural resources and chemical technology, thus contributing to creation of a sustainable society.

In this paper, various features of HEMIX™ such as biodegradability, good melt flow, and transparency are introduced as well as some examples of mass-produced products made from HEMIX™.

## **The production technology and its features for world first alcohol beverages made from wood - Aiming to create new industries that will lead to regional development-**

Yuichiro Otsuka

Department of Forest Resource Chemistry, Forestry and Forest Products Research Institute

We have developed a wet-type bead milling technology that allows exposing cellulose and hemicellulose packed in the cell walls of wood by physical defibrillation in water without chemical or thermal treatment. It was found that the exposed cellulose was decomposed into glucose by food-grade cellulase enzymes without component separation, and the resulting glucose could be directly fermented into alcohol by brewer's yeast. In other words, by adding water, food enzymes, and brewer's yeast to wood, wood itself can be directly fermented into alcohol, making it possible to produce drinkable alcohol from wood for the first time in the world. This paper will outline the technology for producing drinkable alcohol, "kino-sake," from wood, the characteristics of the produced "kino-sake," safety tests, and efforts to implement the technology in society.

## **New Materials reassembled from wood cell walls using organic acids**

Takashi Watanabe

Division of Biomass Product Tree Industry-Academia Collaborative Research, Kyoto University

Center for Future Pioneering Research on the Humanosphere, Research Institute for Sustainable Humanosphere, Kyoto University

Woody biomass is the most abundant renewable resource. Plant secondary cell walls comprise a heterogeneous aromatic polymer, lignin, and structural polysaccharides, cellulose and hemicelluloses. Hemicelluloses are associated with cellulose microfibrils mainly by hydrogen bonding and cross-linked with lignin by covalent linkages to form lignin-carbohydrate complexes (LCCs). These components form rigid matrices *via* noncovalent bonds, such as hydrogen bonds, van der Waals forces, and hydrophobic interactions. Despite wood's potential as a resource for mitigating environmental impacts, current plasticized wood products depend on petroleum-derived chemicals. Additionally, paper and pulp are manufactured from wood through environmentally high-load processes involving the sulfur reactions at high temperatures to depolymerize the recalcitrant lignin in wood components and subsequent paper making processes using huge amounts of water. We found the dissolution of wood sawdust and chips in formic acid under ultra-mild conditions without any catalysts, and the subsequent production of the plastic-like film comparable to those of acryl resin from the total dissolved solution of *Eucalyptus globulus*, and of paper-like sheet from Japanese cedar. These two types of films were also produced from agriculture wastes. Furthermore, multi-dimensional NMR analyses revealed formylation of lignin, hemicelluloses and cellulose. Substituents of formyl groups broke the hydrogen bond networks among cell wall components, resulted in disintegration and solubilization of wood. Subsequently, the highly affinity molecules were bonded and reconstructed to form film by casting.

## **Refiner Energy Reduction and Pulp Fiber Modification by Cellulase**

Masanobu Hatano

Research Laboratory Technical Dept., Specialty Chemical Div. RIKENGREEN CO.,LTD.

Enzymatic paper strength agents employing cellulase excel in enhancing paper strength. They achieve this by efficiently decomposing cellulose into fibrils.

Using cellulase agents first improves paper strength through fibrillation by the agent. It reduces fibrillation by the machine, which means the refiner load can be reduced, leading to energy savings. In addition, reducing fibrillation by the machine improves pulp quality, and the increase in fineness can be expected to improve water filtration, which saves dryer steam. These effects will lead to a reduction in energy consumption, which in turn will lead to a decrease in CO<sub>2</sub> emissions. Cellulase agents not only improve paper strength but also improve water filtration and reduce energy costs, thus contributing to environmental measures.

It has become clear that improving the strength of the paper with this cellulase can produce other effects. When the beating test is performed with a beater, the tensile strength is enhanced, and the opacity is lowered. In addition, a similar decrease in opacity was observed in the refining test using a refiner tester.

## **Possibility of applying digester additive in the kraft pulping process**

FUJII, Takayuki and FUMIHARA Masakazu  
KATAYAMA CHEMICAL, Inc. and KATAYAMA NALCO, Inc.

Virgin pulp production in Japan is dominated by chemical pulping, of which the kraft pulping accounts for the majority. Kraft pulping is a production method in which cellulose fibers are produced with cooking chemical, called white liquor, and heat. While kraft pulp has high fiber strength, it is characterized by lower pulp yield than mechanical pulp. Anthraquinone has been widely used as an excellent digester additive to increase the pulp yield and to accelerate delignification. However it was removed from the chemical list of BfR Recommendations on Food Contact Materials in 2013.

Although virgin pulp production in Japan is on the decline, demand for paper products made from virgin pulp is expected to increase as an alternative to plastic for SDGs and carbon neutrality. Under these situations, we believe there is a need to develop alternatives, such as anthraquinones, that can improve pulp yield and accelerate delignification in kraft pulping. We have developed a product that compensates for the pulp yield improvement that is one of the effects of anthraquinones. In this article, we will report the results of laboratory test under several cooking conditions.

## **High Consistency Operation for Screening**

Takashi Kanda  
Andritz K.K. Service Business Department

Screens are used to remove impurities from pulp, and relatively small impurities such as bark and shive are removed during the fine screening stage in the kraft pulp process. Due to the recent increasing energy cost, the industry demands for not only screening efficiency with a focus on high quality but also sufficient capacity securing with lower power consumption. In the history of screening, technical improvements have been made not only in the screen itself, but also in the baskets and rotors that the screen equipment consists of. These improvements enable a large amount of pulp to pass through the screen while maintaining a high-quality standard.

In Japan, especially in the production of kraft pulp, there are many mills which secure sufficient capacity with high consistency while maintaining high screening efficiency for both softwood and hardwood, using the latest screening technology. Being able to operate a screen which could deal with a higher consistency without losing quality means that it would be possible to downsize the screen or to decrease the number of screen units used, thus reducing energy consumption.

This document introduces ANDRITZ's latest technology for screens, rotors, and baskets which enable high consistency operation in screening.

## **Improvement of steam consumption by suitable washing -TwinRoll Press & Pressure diffuser -**

Yoshiro Nishihara  
Pulp & Energy, Services business Line, Valmet K.K.

In the pulp and paper industry and other industrial sectors, energy saving, including the reduction of greenhouse gases, is the most important issue for sustainable development in the future. In the Japanese pulp and paper industry, energy conservation at pulp and paper mills is being considered in order to meet the 2030 GHG emission reduction target, and Valmet has a comprehensive global sustainability business that helps mills save energy using Valmet's technology.

Good examples of energy saving in the washing stage is the introduction of DiConn™ with a pressure diffuser (PDW) at digester blow line and Valmet TwinRoll Press at brown washing stage. The former results in washing at higher temperatures in the digester washing zone and the PDW, which increases the temperature of the C8 extraction liquor as well as washing efficiency, leading to increase of steam generation in the flash cyclones. The latter is installed in the final stage of the unbleached washing stage to reduce the amount of washing liquor used while improving or maintaining washing efficiency, and to reduce the amount of black liquor sent to the evaporator, which results in a reduction in steam consumption at evaporation process. The improvement of washing efficiency of the BSW and POW line also has the effect of reducing the chemical consumption of the bleaching plant in the subsequent stage.

## **Overview of Containers and Packaging Recycling System in Japan -Regarding paper containers and packaging-**

Masayuki Nagatsuka  
Director, Manager of Planning and Public Relations Division  
The Japan Containers and Packaging Recycling Association

The Containers and Packaging Recycling Law (Officially called the “Law for Promotion of Sorted Collection and Recycling of Containers and Packaging”, hereinafter called “CPRL”) prescribes the recycling of Paper containers and wrapping, Plastic containers and wrapping, Glass bottles, PET bottles for "containers" and "packaging" purposes discharged from households. It was enacted in 1995, as the first recycling law according to the characteristics of individual goods in Japan.

The background of the enactment of the CPRL is the increasing amount of waste generated and the shortage of final disposal site. After a period of high economic growth, waste increased due to mass consumption, and treatment plants were also strained. The CPRL, by transforming “waste” into “resources” once again through recycling system, to achieved reduction of the volume of domestic waste and effective use of resources.

The features of the recycling system based on the CPRL are as follows:

-Consumers, municipalities, business entities, and each of these and every person all have a role in the recycling system.

Consumers separate and dispose of container and packaging waste, municipalities separate and collect the waste, and businesses entities fulfill the obligation of recycling.

- Implement of EPR: Extended Producer Responsibility

EPR is the concept that business entities’ responsibility shall be extended not only to the production and usage of products, but also to the disposal and recycling. Business entities are obligated to recycle the amount of containers and packaging of above 4 materials used, manufactured, or imported in their business by themselves or by outsourcing the recycling to the designated association (Containers and Packaging Recycling Association) and paying the prescribed commission. In fact, outsourcing method is used in most cases.

In this seminar, I will explain the background to the enactment of the CPRL , the scheme, and an overview of its results.

## **The latest pulper & detraging technology**

Satoshi Orido  
Voith IHI Paper Technology Co., Ltd.

For the detraging system of pulping stage, more effective machine is required because the contaminants ratio of raw material is getting increase recently. The IntensaMaXX and IntensaScreenDrum is the detraging machine which fulfills the request for better detraging operation. The IntensaMaxx is rotor and screen plate are located at the top of the tank, and this layout prevents wearing and jamming by heavy contaminants. The rotor axis is located as eccentric against the center axis of the vat. This layout prevents strong centrifugal flow and also growth of long contaminants. The piping layout is also considered for the better reject removal. The IntensaScreenDrum is equipped with powerful cleaning power and rotation speed control by INV. By controlling the INV, it is possible to set the cleaning and dehydration performance as desired. The introduction of the latest detrag enables more efficient and stable operation, and it is possible to aim for optimal power consumption and wear rate.

## **Maintenance Digital Transformations for Stable Operations -Improving Efficiency and Quality of Maintenance Work-**

Takuto Sumiya  
Yokogawa Solution Service Corporation

We have developed compact wireless sensors, the Sushi Sensor series, for maintenance. The XS770A integrated wireless vibration sensor, which is robustly designed to be used for digital transformations. This battery-driven sensor can monitor the vibration and surface temperature of manufacturing facilities for a long period, significantly reduces the cost of monitoring. This paper describes the feasibility of condition-based maintenance (CBM) in plants. We believe Sushi Sensor achieves high standard of monitoring and data analysis for maintenance work in pulp and paper plants.

## **Using Data to Drive Future Initiatives in the Pulping Process -Mill Digitization-**

Hisanori Bando  
Valmet K.K. Automation Systems Business Line

Valmet offers products for the optimization of entire mills, processes, and pulp to facilitate the digitalization of pulp mills and take them to the next level for the future. Making Data Valid and Meaningful, the unification of the control room is also a key factor. As factories are built in the future, it will be important to make them easy for everyone to understand and to communicate intentions quickly and easily.

## **Profit improvement program by utilizing pulp digester additive**

Yukinori Enomoto  
KATAYAMA CHEMICAL, Inc.  
Masakazu Fumihira  
KATAYAMA NALCO, Inc.

Virgin pulp production in Japan is dominated by chemical pulping, of which the kraft pulping accounts for the majority. Kraft pulping is a production method in which cellulose fibers are produced with cooking chemical, called white liquor, and heat. While kraft pulp has high fiber strength, it is characterized by lower pulp yield than mechanical pulp. Anthraquinone has been widely used as an excellent digester additive to increase pulp yield and to accelerate delignification. However, it was removed from the chemical list of BfR Recommendations on Food Contact Materials in 2013.

Kraft pulp production has become less profitable due to recent increase in energy costs, including electric power, and raw material chip costs. Under these situations, we believe there is a need to develop products that can be alternative to chemical like anthraquinone, which can improve pulp yield and accelerate delignification in kraft pulping. We have developed a product that compensates for the pulp yield improvement that is one of the effects of anthraquinone. In this article, we will report the results of various tests, including lab tests, field trials, and profit improvement programs.

## **EcoBright™ - The latest Pulp Bleaching Technology, improving Cost, Quality and Environment**

Yusuke Aikawa  
Imerys Minerals Japan K.K. / Imerys Specialities Japan Co., Ltd.

Pulp bleaching technology showed a significant improvement in terms of environment, safety and health, after the introduction of "TCF/ECF". On the other hand, bleaching chemicals were replaced with higher value substances, and the reaction mechanism became complicated, which brought quite a high load to the pulp operations. The pulp bleaching technology is not necessarily beyond the partial improvement of conventional methods, since the introduction of TCF/ECF around 20 years ago in Japan.

EcoBright is a Magnesium Hydroxide slurry produced in the proprietary stabilizing process, which is made from severely selected high purity crude material, and will deliver  $Mg^{++}$  and  $OH^-$  ions.  $Na(OH)$  will be partially replaced with  $OH^-$  from EcoBright, and it was successful for EcoBright to derive the maximum performance of  $H_2O_2$  and  $ClO_2$  with controlling pH at the optimum level. Concerning  $Mg^{++}$  ions, it is well published that it will protect cellulose and increase the pulp yields which is quantified as a pulp viscosity, and this effect enables the significant reduction of "COD" and "hard Limescales by the presence of  $Ca / Si$ ". Thus,  $Mg^{++}$  and  $OH^-$  ions are very important in the pulp process, and EcoBright as a single substance will provide both ions.

The effect of EcoBright is remarkable in Chemical and Mechanical pulp process, and Anionic charge in the process water is reduced under the controlled pH by EcoBright, thus there are a lot of success cases where Cationic Polymer in the paper machine section was significantly reduced.

The references for DIP is still limited, however, it was reported that foaming conditions in the deinking "Flotator" are optimized by  $Mg +$  fatty acid(metal soap), and that the pulp yields were improved by reducing rejects of fibers and mineral fillers.

Lastly, Ecobright enjoys good success in EMEA according to the expansion of the references, and it is expected to be broadly implemented in Japan, as the supply position is being established in Asia at the end 2022.

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### **The introduction of latest technology and process control for Stock Preparation**

Rei Nagaoka  
Voith IHI Paper Technology Co., Ltd.

Traditionally, timer control has been mainly used in the stock preparation process for processing reject and adjusting the amount of feed.

This is because, until now, it has been difficult to obtain information on fibers within the system and reject to be discharged as metadata, and it has not been possible to directly feed back information within the system to the control.

Recent improvements in sensing technology have already made it possible to treat this information as metadata.

The Voith paper focuses on traditional control methods for stock preparation and proposes the concept of 'Autonomous Stock Preparation', which automates as much as possible of these adjustments.

This paper introduces some component products to realize 'Autonomous Stock Preparation'.

### **Recent Technical Development of Internal Sizing Agent**

Shunsuke Irie  
Research & Development H.Q. Forestry Chemicals Development Dept.  
ARAKAWA CHEMICAL INDUSTRIES, LTD.

This paper focuses on the internal sizing agents such as rosin, alkyl ketene dimer (AKD), and alkenyl succinic anhydride (ASA), which are added for paper sizing, and outlines the basics, mechanisms, and effective usages. In the recent operation of environmentally friendly papermaking, it has become difficult to express the original function of the internal sizing agent. Therefore, we have developed and sold a new product, SPCA-956, with the aim of addressing issues such as performance degradation and machine staining caused by resin hydrolysis, as well as the risk of soaring prices of rosin. In the end, we believe that we were able to share information on the positioning of various sizing agents in various papermaking conditions and the best choice.

## **Functionality of HYMO Wet End System and Latest Technology**

### **-Reducing the Environmental Impact of Paper Making by coagulants, retention and drainage aids-**

Natsuhiko Sato

Shonan Research Center, Performance Chemicals Development Group, HYMO Corporation

In recent years, induced by the SDGs, reduced impact on the environment as well as cost reduction became more and more important. Therefore, paper mills are promoting the use of low-grade wastepaper, efficient chemicals, and a reduction in energy consumption for paper manufacturing. Among these, the use of low-grade wastepaper lead to an increase in short fibers and fillers and lead as well in increased amounts of pitch components. As a result, increasing amount of short fibers tend to decrease the retention rate on the wire and impede drainage. In addition, an increase in the amount of pitch components causes increase web breaking and other trouble in the papermaking process. In this situation, coagulants, retention and drainage aids are getting more and more important. The role of retention aids is to efficiently retain fines and fillers on the wire. Drainage aids shall improve drainage and to reduce steam consumption. Along with their roles, coagulants, retention and drainage aids provide various functions that contribute to the SDGs and result in a considerable reduction of the environmental impact. As for the specific functions of these chemicals, they shall enhance an effective use of fibers and fillers, as well as other paper chemicals, improvement of wastewater treatment, reduction of energy consumption, and improvement of the paper quality. Furthermore, we recently propose that it is important to optimize how to use the chemical products, such as the addition point, the addition method, and the combination of chemicals to maximize their effectivity by making use of the chemical characteristics of coagulants, retention and drainage aids. We call this system the HYMO Wet End System. For example, if we focus not only on the retention and drainage effect at the wire part, but also on the retention of other wet end chemicals, such as sizing agents, strengthening agents, and dyes, it is necessary to consider the addition point. In this case, the recommended addition points are mixing chests, machine chests, and stuff boxes located close to the addition points of sizing agents, strengthening agents, and dyes. In addition, we have recently developed a new drainage system, which system is a combination of high-molecular-weight anionic chemicals and special cationic chemicals added in that sequence. We are aiming at contributing to the SDGs and the reduction of environmental impact and cost by applying coagulants, retention and drainage aids and by making effective use of the functionality of the HYMO Wet End System.

## **Basic Technology and Latest Trends for Solution to Pitch Problems**

Yuken Ishikawa

Research & Development Dept., Nissin Kagaku Kenkyusho Co., Ltd

In recent years, the paper industry has been faced with the problems of increased pitch sticky problems due to an increase in the amount of pitch in recovered paper caused by a decline in the quality of it and an increase pitch in pulp.

One of the methods used to prevent pitch problems is the use of pitch sticky control agents. We are working to solve pitch problems throughout the entire process by using the appropriate agent for each process, and we call NISSIN Pitch Control Method (NISSIN-PCM).

Conventional pitch evaluation methods could measure the total amount of pitch or evaluate coarse pitch, but could not evaluate fine colloidal pitch. Because white water and pulp slurry contain many components other than pitch, flow cytometry has low measurement accuracy.

We visualized the pitch by image analysis using a fluorescence microscope, which enabled us to evaluate fine colloidal pitch. Using this method, when a pitch sticky control agent was added to the pulp slurry, a decrease in coarse pitch and an increase in fine pitch were observed in the filtrate. Thus, it was confirmed that the pitch control agent detached the fine colloidal pitch from the pulp and dispersed it in the liquid.

Combining these results with conventional pitch evaluation methods may lead to the development of new evaluation methods and pitch sticky control agents.



## **Solution for operation stabilization by analysis of wet end monitoring sensor and defect information**

Hiroyuki Otake and Misa Noma  
Maintech Co., Ltd. Fuji Office

The number of problems caused by machine deposits has been increasing due to the worsening of the raw material of pulp situation. In addition, it is becoming increasingly difficult to respond to machine dirt deposits in a timely and appropriate manner due to the decrease in the working population at production sites and the retirement of experienced employees. To address this issue, we are developing "SmartPapyrus®", a system to prevent defects and sheet breaks by visualizing machine dirt deposits using IoT, analyzing it using artificial intelligence, and using machine dirt deposit prevention technology.

In addition, we are currently installing sensors at multiple locations in the stock preparation line and conducting continuous online measurements to identify the causes of defects classified by SmartPapyrus® 1.0.

In this report, we will introduce on the analysis results using sensor data from the stock preparation line for the defects and sheet breaks that have been classified by SmartPapyrus® 1.0.

## **Washing effect of Power Combi Cleaner 2.0 -equipped with Air venturi self-washing system-**

Kazuki Hasegawa and Claus Robberts  
ProJet Japan Corp, ProJet B.V.

ProJet B.V. is a leading company specialized in High pressure water fabric cleaning systems. Since its establishment in 1998, We have delivered over 1,000 units fabric cleaning systems to paper mills, nonwoven fabric factories, and food processing plants worldwide. In Japan, as of 2023, we have supplied over 80 units for wire part, press part, and dryer part for paper mill.

In particular, paper mills have a high re-utilization rate of the used paper, a canvas cleaning system that consistently achieves high cleaning effectiveness and stable operation is demanding in order to prevent product defects, paper break, and improve productivity. ProJet B.V. has been continuously innovating of cleaning technology since its founding. In 2021, we released the "Power Combi Cleaner 2.0", which a double air venturi-type cleaning head that maximizes cleaning effectiveness and mist collection performance to the utmost limit. Further we are equipped as standard patented technology "air venturi self- cleaning system" to prevent clogging of venturi tube, which is biggest weakness of air venturi type cleaner.

Here by, let we introduce the effects and features of the "Power Combi Cleaner 2.0" and "Air venturi self- cleaning system".

## **Operation Experience of ProJet's dryer fabric cleaner (PowerCombiCleaner 2.0)**

Shuheji Senju  
Saga Mill,Oji Materia Co.,Ltd.

Saga Mill, Oji Materia Co., Ltd. has three paper machines, Machine 1, Machine 4 and Machine 5. It is a sustainable mill that produces linerboard, medium and special paperboard from almost 99% of waste paper.

Sticky from waste paper has been increased recently while customers are focusing more on paper defects. Sticky is one of the causes of sheet breaks and paper defects as it accumulates on machine fabrics. So actions such as sticky control chemical dosage and screen slot size decrease were taken, but they can't solve the issue completely. It is an urgent task to take effective action against sticky defects due to customers' tough view especially to linerboard.

This article shows a case about dryer fabric cleaner upgrade that led to sticky defects reduction and steam consumption improvement in Machine 5 that produces linerboard.

## **Aikawa technology contributes to safety measures and labor savings in the papermaking process matter removal technology in the papermaking process**

Tsuyoshi Yoshino  
Design Department / AIKAWA IRON WORKS CO.,LTD.

The manufacturing workforce in Japan has been around 10.5 million people since the 2010s. However, due to the aging population and low birth rates, there has been a declining trend in young workers, leading to a long-standing labor shortage. The paper industry is facing a similar situation and has been taking measures such as introducing equipment and automation to achieve labor savings. Furthermore, safety measures have been improving year by year to ensure the safety of workers, minimizing the risks of accidents and injuries. In such circumstances, our company designs, manufactures, and sells equipment that contributes to safety and labor savings. This article introduces safety measures and labor-saving technologies in the papermaking process.

## **Productivity Improvement and Skills Transfer Using SmartPapyrus® -The Latest Trends and Future Developments in Defect Image Classification Systems-**

**Takayuki Shimo**  
**Technology Development Team, MAINTECH CO., LTD Fuji Technology Development Center**

In recent years, the number of problems caused by machine deposits has been increasing due to the worsening of the quality of waste paper. In addition, it is becoming increasingly difficult to cope with machine deposits in a timely and appropriate manner due to the labor shortage at production sites and the retirement of experienced employees. To address this issue, we are developing "SmartPapyrus®", a system to prevent defects and sheet breaks by visualizing machine deposits using IoT, analyzing it using numerical analysis, and using machine deposit prevention technology. For the next step, we developed SmartPapyrus® 1.0, a system that uses AI to automatically classify defects detected by Web Inspection System(WIS) based on their origin. SmartPapyrus® 1.0 makes it possible to determine in real-time when and where in the process so many defects have occurred.

To date, SmartPapyrus® 1.0 has been installed on many liner machines, and have shown amazing performance, including real-time evaluation of the effectiveness of operator's actions for defects countermeasures and their results, as well as investigation for specific defects to respond to complaints from the end user.

On the other hand, similar problems are occurring not only in liner machines but also in white board paper machines.

Since the quality requirements for white board paper are much higher than those for liner, the machines are operated with higher sensitivity of WIS so that even small defects of 1 to 2 mm or less can be detected.

However, WIS can detect over 2,000 defects per each jumbo roll, including not only small defects, but also noise.

We have up-graded SmartPapyrus® 1.0 system so that it can solve these problems.

In this report, we show how the system improved the productivity of white duplicate board manufacturing machines.

**ABB Digital transformation solution**  
**– Industry 4.0 Visibility approach for refining and Wet end control**

Hironmichi Yoda  
Division manager, Process Industry Division, ABB K.K.

Currently, industry got strong pressure from the market because Japan government announced carbon neutral industry by 2050. In Japanese industry, especially material industry, there are several serious potential issues like lack of human resource due to less attractiveness for young people, retirement of baby boomer and the technical transfer. On the other hand, there are bright future in paper industry because paper is excellent material for plastic reduction and new functional material, Cellulose Nano Fiber.

ABB started following four approaches to cooperate with customer to solve facing issues.

- 1) Reliable and high-performance online measurement for Refiner, Wet end control
- 2) Cutting-edge fiber analyzer for new material development
- 3) Speedy, Safety and high precise paper testing machine
- 4) High speed, high precise and reliable automated paper testing machine

In the paper, overview of ABB digital transformation solution and some actual results are described. You can understand how ABB L&W online measurement is reliable and how to utilize the measurement data for process optimization.

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### **Recycling technology for future waste paper raw materials**

Makoto Sakakibara  
AIKAWA Iron Works Co.,Ltd.

The rate of paper recycling in Japan reached 66.8% in 2023, surpassing the goal set by the Ministry of Economy, Trade and Industry to increase the rate to 65% by 2025 in 2020, and has continued to maintain this level ever since. This can be said to be the result of efforts by local governments and recycling companies to cooperate with waste paper collection, and by the paper industry's efforts in waste paper recycling technology. However, on the other hand, the need to utilize difficult-to-recycle waste paper that had previously been discarded is increasing year by year.

In this paper, we will introduce the breakthrough paper recycling technology, the Continuous Detrashing System known as the "S-PAL System" aimed at enhancing the removal of foreign contaminants in the pulping process.

### **Optimize Operations with in-line Fiber Analyzer, BTG SPM -Energy Savings On Your Tissue Machine With Minimal Capital Investment-**

James Litchwark, Klaus Kunschert, Sanjay Aggarwal, Grant Downham and  
Kenichi Ishihara  
Voith Turbo Co., Ltd. BTG Japan, Process Solutions

With recent volatility in energy markets worldwide, energy efficiency initiatives are a priority for many tissue manufacturers. While new technology and modern machine designs do offer better efficiency than older technology, it is not always necessary to have major capital investment to achieve significant energy reductions in your tissue process. Starting with diagnostic audits focusing on papermaking fundamentals, and layering new technology on top of strong foundations, it is possible to design customized solutions to suit any budget that can deliver significant gains in energy efficiency and raw material costs. Depending on the specific process circumstances, these solutions can include anything from process instrumentation, to advanced process control software, to improved operating procedures, based on the findings of an in-depth audit.

This paper outlines a holistic approach to energy reduction and raw material cost savings, and presents some real-world examples of successes achieved using this approach. The examples demonstrate that it is often possible to achieve significant gains in energy and raw material costs, while simultaneously maintaining or even improving paper quality and machine productivity.

this paper three topics which I was concerned to the development were briefly described.

### **Introduction of inline color sensor on liner paper machines**

Ryoji Nakamura  
RENGO CO., LTD. Paperboard Business Unit Fukui Group KANAZU MILL

In October 2017, Rengo Co., Ltd.'s Kanazu Mill upgraded its No. 2 paper machine from a machine that only made corrugating medium to a production facility that can also make linerboard. In 2019, it was selected as an IoT promotion model factory in Rengo because it only has one machine and can easily analyze and evaluate new technologies and equipment. Since then, we have been actively working on DX promotion and IoT utilization with the aim of further improving quality and productivity.

This article provides an overview and operational status of a new control system that we have introduced as part of our activities, focusing on adjusting the surface color of the linerboard on the machine.

## **Basics of approach part from stock preparation theory and transition, latest trend including introduce of Bale&Broke Pulper, Conical Refiner, Machine Screen**

Kouhei Oka  
Paper technology, Valmet K.K

The approach system for feeding raw materials to the paper machine and the stock preparation process are very important processes that ultimately control the quality of the product. Approach system equipment has also changed over time, and this paper will explain each equipment(pulper,refiner,screen) used by Valmet. Valmet, the world leader in this field as well in the pulp and paper industry, has a full range of equipment and service to improve stock preparation and approach system.

## **Latest Screening and Cleaning Technology**

Takashi Kanda  
Service Business Group, Andritz K.K.

Screening and cleaning play an important role in removing impurities in the stock preparation process. Recently, due to poor quality of recycled paper and increase in energy costs, not only screening and cleaning efficiency but also longer lifetime of wear parts and energy saving are conditions required by paper companies. In the long history of screening and cleaning, ANDRITZ has developed many unique products in the screening and cleaning fields to respond to a variety of demands. In screening, ANDRITZ has developed the “UTwist” basket where the height of the wire may be changed as needed, by twisting the wire. The ability to adjust the profile height within the ANDRITZ UTwist basket is unique. The twisted wire allows for an optimum profile height at any position on the basket. UTwist Basket makes it possible to improve quality and to increase the capacity from a new perspective in comparison to existing screen baskets. In cleaning, ANDRITZ has developed the Multi Injection Vortex Control (MIVC), which effectively adds dilution water from the bottom, making it possible to improve operation and capacity with only a small amount of dilution water. MIVC addresses many of the common problems that jeopardize daily operations — runnability issues, yield issues, and energy consumption. These products can contribute to quality improvement and energy saving and have already been used both domestically and internationally, but we would like to introduce these technologies here, as they are expected to play a vital role in solving the problems of many mills in the future.

## **Worker safety management and flow line management system using automatic recognition technology.**

Tsuyoshi Matsueda  
Business promotion center, TOPPAN DIGITAL Co., Ltd.

The 2024 problem in the manufacturing industry is the aging of workers and a shortage of human resources. And The manufacturing industry faces many challenges, including the 2025 problem, which will be the aging of the baby boomer generation.

To solve the shortage of human resources, there is an urgent need to build a system that provides an environment in which current workers can work efficiently and easily. Many IT companies provide systems for building systems for DX in the manufacturing industry. However, even if only the system is converted to DX, efficiency will not be improved if it is not possible to collaborate with the workers who will use it. I will introduce the latest automatic recognition technology that makes it easier to link with systems by visualizing the status of worker line management and health management.

## **Introduction to ‘Cooperative Process Optimization’ - Efforts to Reduce Loss and Save Labor through Improved Control -**

Ken-ichiro Wada  
P&W Solutions Div., Yokogawa Products HQ, Yokogawa Electric Corporation

The manufacturing process of pulp and paper involves multiple continuous processes, with numerous control loops. Optimizing such a plant requires understanding vast amounts of data to identify issues and their underlying causes, as well as considering process interferences. Our "Cooperative Process Optimization" service is designed to address these needs. This service offers significant benefits, including reduced loss time during grade changes leading to increased production and decreased use of raw materials and steam. It also suppresses process variability, enhancing product quality and reducing material usage and the rate of returns. Additionally, it extends the coverage and effectiveness of automated control, promoting labor and personnel reductions and standardizing operations.

In manufacturing environments, where current operations are often taken for granted, recognizing problems can be challenging. Even when problems are acknowledged, quantitatively evaluating the impact of improvements is difficult. This complicates the decision-making process for necessary investments. Our service addresses these challenges by first clarifying the existence of issues, demonstrating their potential for improvement, and then quantitatively estimating the effects of these improvements, all carried out comprehensively by our specialized control engineers. This article outlines the approach and details the examples, which include the introduction of Cooperative Grade Change Control between stock preparation and papermaking processes resulting in more than 20% reduction in the required time for grade changes, an expansion of the automation scope, and an improvement in operational individual differences. Another example is the improvement of fluctuations due to mutual interference between the stock preparation and papermaking processes, which achieved more than a 50% reduction in the convergence time of basis weight during grade changes.

## **Wastewater treatment operation optimization system using manufacturing process data**

Chise Fukuda  
Kurita Water Industries, Ltd.

In recent years, raw materials and operating conditions have changed significantly in the paper industry, and various efforts have been made to maintain stable product quality. These efforts have a significant impact on water quality for papermaking, and changes in the water quality can lead to unexpected problems.

Kurita has developed an operation optimization system for wastewater treatment by leveraging its extensive water knowledge, which is used in large quantities in paper mills, and its solutions for operations from the manufacturing process to the wastewater treatment process. The system predicts issues that arise in wastewater treatment and constantly optimizes operations to ensure that wastewater treatment is always stable, even under changing operating conditions.

In this report, we introduce three key technologies for building wastewater treatment optimization systems.

First, we will describe the S.sensing® system, which visualizes operational data. The S.sensing® system continuously monitors water quality data of the entire plant and visualizes the factors influencing key indicators.

Next, we will introduce the predictive analysis method that utilize the visualized data. The predictive analysis allowed automatic prediction of possible future changes in wastewater quality with a high degree of accuracy. In addition, our predictive analysis method can perform a pseudo-evaluation of important influencing factors on the predictive analysis results and select optimal operating conditions based on these results.

Finally, we will introduce our wide range of solutions and case studies as solutions to issues based on the results of predictive analysis.

## **Solves the problem of paper breaks and defects at the wet-end !**

**Locally chemical approach to improve productivity by preventing deposit and improving dehydration.**

Hiroyuki Kokubun  
Nissin Kagaku Kenkyusho Co., Ltd.

The deposits adhering to the wet-end cause operational troubles associated with paper breaks and defects, and often have a significant adverse effect on productivity and product quality in paper making process. There are many different factors that cause paper breaks and defects, so the best way to solve the deposit problem is also different depending on the situation. This is because the mechanisms that cause problems are complicated and the methods for solving them are not uniform. Therefore, for complex deposit problems, it is important to find the best solution by looking at them from various angles.

For more than 60 years, our company has been investigating the causes of deposit problems at many production sites, researching and developing problem-solving methods and proposing them, and striving every day to propose customized and optimal solutions. This paper introduces some examples of local countermeasures for various deposit problems in wire and press parts, from cause investigation to problem solving.

## **Competent for Turn Key System Project from Pulper to Wet-end and White Water Treatment**

Nobuhiko Okumura  
Engineering Division , Aikawa Iron Works Co., Ltd.

Three years have passed since the first Covid-19 infection in Japan, and we are now gradually returning to normal life, the pulp and paper industry is also suffering from the aftermath, such as changes in people's lifestyles and work styles due to the Covid-19 crisis, and inbound demand showing a recovery trend, boosted by the weakening of the Japanese yen. In a rapidly changing environment, we have had the opportunity to be involved in multiple new tissue machine installation projects. Through this opportunity, we have not only focused on stock preparation equipment, which is our main product, but have also provided an integrated service from system design to plant construction and commissioning by pouring our know-how in stock preparation treatment that we have cultivated over the years. This report introduces the compact layout and system design, including from pulper to wet end and fiber recovery from white water, and their turnkey service offerings.



## **Optimization of Wet-end Process by Slime Control Agent “CURECIDE” and Coagulant “REALIZER” PartII**

Shuhei Otake, Saori Takesue and Koichi Tadaki  
SOMAR Corporation

Due to the recent decline in the quality of pulp and recovered paper raw materials, there has been an increasing trend toward problems with paper machine tool contamination and paper making defects caused by adhesive foreign matters. In last year's report, we introduced the reduction of paper making defects by the combined addition of the oxidation type slime control agent “CURECIDE Series” and the multifunctional coagulant “REALIZER A Series” that introduces reactive polymer technology. In addition to defect reduction, this paper introduces the results of our study on reducing the addition of paper strength agents. The condition of the wet end tends to deteriorate year by year due to the decrease in the coagulation effect of sulfate bands caused by the neutralization of paper machines and the accumulation of dirt substances and increase in electrical conductivity caused by the closing of the machine. In addition, it is becoming increasingly difficult to maintain paper quality due to high ash content in the paper field and low basis weight in the paperboard field, and a new concept of agent is required to solve these problems. We have identified the problems with conventional oxidation type slime control agents and polymer type coagulants, and by applying the “CURECIDE Series” and the “REALIZER A Series”, which were designed based on a new concept, we have been able to improve the fixation of various internal additives such as paper strength agents while reducing paper making defects and adhesion to paper machine tools. The technologies to improve the fixation of various additives such as paper strength agents while reducing paper defects and adherence to paper machine tools are introduced.

### **Applications and Functions of the HYMO Wet End System -Approach to Reducing Environmental Impact-**

Natsuhiko Sato  
Shonan Research Center, Performance Chemicals Development Group, HYMO Corporation

In recent years, it has become very important to consider SDGs and take actions of reducing environmental impact. Therefore, we are committed to the development and improvement of products that are useful for environmental conservation and energy saving.

Among the wet-end chemicals, chemicals for papermaking processes such as coagulants, retention aids, and drainage aids have various functions that contribute to environmental impact and SDGs along with their roles. As for the specific functions of these chemicals, wastewater treatment improvement, reduction of energy consumption, fixation of other paper chemicals, effective use of the materials, and improvement of the paper quality are mentioned. Thus, we propose that it is important to optimize how to use the chemical products, such as the addition point, the addition method, and the combination of chemicals to maximize their functions by utilizing the chemical characteristics of coagulants, retention aids, and drainage aids. We call them the HYMO Wet End System.

For example, if we focus not only on the retention and drainage effect at the wire part, but also on the retention of chemicals such as sizing agents, strengthening agents, and dyes, it is necessary to consider the addition place of each chemical. In this case, the recommended addition points are mixing chests, machine chests, and stuff boxes located near the addition points of sizing, strengthening agents, dyes, or other chemicals. Meanwhile, we have developed a new drainage system. This system is the combination of high-molecular-weight anion chemicals and special cation chemicals added in that order. Although it depends on the paper stock condition, high drainage performance and effect of moisture content reduction of the sheet after pressing is obtained by using this system compared to the case where anion chemicals are added after cationic chemicals added. In addition, by using chemicals in consideration of their chemical characteristics, various benefit for reducing environmental impact, such as improved wastewater treatment, can be obtained in actual machine trials.

We are aiming to contribute to the reduction of environmental impact and energy consumption by making effective use of applications and functions of the HYMO Wet End System.

## **ANDRITZ's Processing System for Low-grade, Mixed Recovered Paper**

Tomohiro Hanada  
Andritz K.K. Capital Systems Sales

Japan has one of the highest collection and utilization rates of recovered paper in the world. This is due to cooperation of consumers, the government, the development of paper collection systems by paper collectors, and the development of paper utilization technology of pulp and paper manufacturers. However, in order to further realize the sustainable society that the paper industry is expected to contribute to, pulp and paper manufacturers are now shifting the recovered paper they use to lower grades, with the aim of widening the range of recovered paper utilized. From a paper recycling perspective, this shift is making a significant contribution to the effective use of resources, in the form of waste reduction. On the other hand, companies are also urgently faced with the task of reducing production costs in order to secure profits, which are expected of them, and are investing in equipment that can meet the requirements of both this shift and profitability.

ANDRITZ, which celebrated its 170th anniversary last year, has continued to manufacture and develop stock preparation systems for production of paper as one of its missions. In this report, the following three systems will be introduced: first, the "ultra-low-grade mixed recovered paper processing equipment using a large-size recovered paper processing line", which has been adopted overseas, second, the "low-grade mixed recovered paper processing equipment using a small-size recovered paper processing line", a good fit for the Japanese market, where it is difficult to secure installation space for large equipment, and lastly, the "FibreSolve Pulper," which was awarded the 50th Sasaki Prize by the Japan TAPPI last year, in 2022, for its ability to take recycled broke from paper manufacturing and finishing companies and to recycle them into raw materials, with approximately 20% less energy consumption compared to conventional methods.

## **Improvement approach of stock preparation system against raw material quality change**

Takanori Goto  
Voith IHI Paper Technology Co., Ltd.

The quality of the raw material (waste paper) is getting worse and worse. Until now, we have choices that we don't use poor quality raw material depending on requiring quality of final products. But the circumstances surrounding paper industry has been changing drastically nowadays and we come to the situation that we cannot help but use poor quality raw material for keeping stable production.

So, contaminants removal is one of the most important things in stock preparation line. For effective removal, contaminants should be removed in early stage as much as possible before contaminants turn into small pieces.

In this article, we will introduce some latest system for removing various kinds of contaminants such as plastic, sticky, metal pieces. TwinPulp system consists of IntensaPulper, IntensaMaxx and IntensaScreenDrum and enables to remove contaminants which are bigger size than perforation diameter of screen plate with frequent reject removal by enhanced detrashing system. Protector system including 2 stages HC cleaner with continuous reject as 1<sup>st</sup> stage and batch reject as 2<sup>nd</sup> stage enables higher cleaning efficiency. Combisorter is effective for removing plastic contaminants in the stage of coarse tail reject. Tandem screen system of fine slot screen enable to get high quality stock for paper machine even if the raw material including many sticky contaminants.

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### **Use of Wood in Space - The Impact of Outer Space on Wood**

Koji Murata  
Graduate School of Agriculture, Kyoto-University

Space wood project research has been conducted at Kyoto University by Professor Takao Doi since 2017. This research is part of manned space studies aimed at forming a permanent society in space. To address the problem of material procurement in space, the focus is on utilizing wood resources. Wood offers significant environmental and psychological benefits, and if a plantation forest in space is possible, it could contribute to the realization of a permanent society. The research investigates tree growth in low air-pressure and microgravity environments, as well as changes in the physical properties of wood in a vacuum environment. In 2022, a space exposure experiment involving wood was conducted on the International Space Station. Furthermore, in collaboration with Sumitomo Forestry, the development of a wooden satellite called "LignoSat" is underway, with a launch scheduled for October 2024.

LignoSat is a satellite that uses wood instead of aluminum or titanium, leveraging the strength-to-weight advantages of wood material. Wood is suitable as a satellite material because it does not suffer from biological degradation or flammability issues in a vacuum environment. In low Earth orbit, when a satellite re-enters the atmosphere after completing its mission, the wooden structure burns up into gas. This burnable property may reduce aerosols in the stratosphere, which an aluminum structure generates.

### **Pre-Emptive Life Cycle Thinking for Utilization of Lignocellulosic Resources**

Yasunori Kikuchi  
Institute for Future Initiatives, the University of Tokyo

Plant resources can be an essential alternative to fossil resources. Lignocellulosic resources can be obtained in diverse forms, such as herbaceous and woody species. By combining different plant resources in different regions, it is possible to obtain the raw materials needed to reduce fossil resources. As various conversion technologies for lignocellulosic resources with such potential are being developed from the research and demonstration stage to practical application, it is essential to evaluate them based on appropriate life cycle thinking. This study discusses the requirements for life cycle thinking regarding the utilization of lignocellulosic resources. Scenarios must be planned while preemptively analyzing future resource and energy structures, and the life cycle and material flow of lignocellulosic resources must be understood. In particular, paper mills have process systems that have utilized lignocellulosic resources as material, chemical, and energy, and are expected to increase in value in the future as hubs for aggregating renewable resources in the region.

### **Development of a high performance paper to be capable of erasing written ballpoint ink for a certain period of time**

Hiromi Uchimura, Bunta Imura, Tomoki Yabutani  
Paper Industry Innovation Center of Ehime University  
Graduate School of Agriculture, Ehime University

With the recent rapid digitization, records and communication processes are shifting from paper media to electronic devices. However, even today, paper media are still widely used for official documents such as contracts and resumes. Ballpoint pens are generally utilized for preparation of important and official documents. Characters written with a ballpoint pen can not be erased with a normal eraser when corrections are needed. There are several erasing methods for ballpoint pens, but all of them are not applicable to erasing written for official documents because they can erase the characters at any time. Thus, in this research, we attempted to develop a high performance paper having a unique function to be capable of erasing the ink for a certain of time and keeping it from erasing after a certain period of time.

## **The utilization of CNF sheets for reinforcing polycarbonate**

Taiga Koga and Hayato Fushimi  
Oji Holdings Corporation

We have been actively exploring the incorporation of cellulose nanofibers (CNF) into rubbers or thermoplastics for their application. However, difficulty arises when attempting to disperse CNF with polycarbonate (PC), as it leads to a loss of PC's excellent transparency. To address this issue, we have developed a technique that involves phosphorylated CNF sheets with PC, thereby improving the mechanical properties. We refer to these composite materials as CNF-PC composites.

The phosphorylated CNF is fully nanofibrillated, with a width of approximately 3 nm. Consequently, CNF sheets derived from phosphorylated CNF as a raw material exhibit outstanding mechanical strength, dimensional stability, and high transparency. Therefore, through laminating CNF sheets with PC, it is possible to improve the mechanical properties without compromising the transparency of PC.

In this presentation, we demonstrated several types of CNF-PC composites by varying the thickness of CNF sheets and PC films. The mechanical properties were improved without significant loss of transparency compared to polycarbonate sheets of similar thickness. Therefore, it may be possible to achieve weight reduction of PC components by reducing the amount of PC used. We also investigated the molding of CNF-PC composites and confirmed that their capability to be bent at a wide range of curvature radii. CNF-PC composites may be applicable to components with curved shapes.

## **Development of Micro Fibrillated cellulose**

Kei Funatsu, Yusuke Sugimura, Takeshi Nakatani and Haruo Konno  
NIPPON PAPER INDUSTRIES Co.,Ltd.

Cellulose nanofiber (CNF) is gaining attention as next-generation carbon-neutral material. CNF is expected to be used for a wide range of applications, including food additives, cosmetics, and industrial products. Production of CNF requires specialized equipment due to its high energy requirements. Therefore, we focused on micro-sized cellulose fibers, "Micro Fibrillated Cellulose (MFC)", that can be manufactured with lower energy consumption. We have conducted the studies on the manufacturing and utilization methods of MFC. In this paper, we introduce the production of MFC using conventional pressure washer, and the evaluation of MFC for some applications.

## **Intellectual Property Strategies in Companies**

Masahiro Samejima  
UCHIDA & SAMEJIMA LAW FIRM

In line with trends such as the Corporate Governance Code and economic security, we will explain how intellectual property strategies should be in companies.

## **Development of Dry Strengthening Agent with High Concentration Containing a Specific Functional Biomass Material**

Ryusuke Kambara

Research & Development H.Q., Water-Based Polymer Development Dept., Arakawa Chemical Industries, Ltd.

Paper is a recyclable material, but its strength tends to decrease after repeated recycling. Therefore, dry strengthening agent is widely used to reinforce the strength reduction of paper. We manufacture and sell amphoteric polyacrylamide-based dry strengthening agent (Polystron series). Polystron is used for a wide range of applications ranging from acid-to-weak acid papers, neutral papers, paperboards (e.g. liner, corrugating medium and core paper), fine papers and coat papers. The role of Polystron is to improve not only paper strengths, but also the retention of pulp fibers and various chemicals (sizing agents, dyes, etc.), and water drainage on the wire by aggregating the pulp fiber. This reduce the consumption of electricity and steam used in the drying process, contributing to improved productivity of paper machines.

In recent years, the utilization of biomass materials and the reduction of CO<sub>2</sub> in the life cycle have been attracting attention toward the realization of a sustainable society. The product form of Polystron is mainly an aqueous solution with a concentration of 15% to 20%. If it is possible to reduce the frequency of transportation by increasing the concentration, it is expected that CO<sub>2</sub> derived from transportation fuel can be reduced. As a result of the examination, we have developed PS-4000 and PS-4100 that increases the concentration and maintains the performance by blending a specific functional biomass material.

## **Development of a Novel Polyacrylamide Copolymer for Improving the Papermaking Process**

Kairi Yamato

Technology Management Department, Paper Chemical Business Division, SEIKO PMC Corporation

Recently, the quality of recycled pulp has deteriorated due to the decrease in strength and refined fibers when recycled paper is utilized at a high ratio. Furthermore, the fillers and starches in the repetitive recycled pulp accumulated in the papermaking system have caused many troubles for the papermaking processes. The spread of topics on Carbon Neutral and CO<sub>2</sub> Reduction also leads to challenges in Energy Reduction during papermaking processes.

Under these circumstances, we have developed Papermaking Improvers with the PM series, which can reduce the steam cost by improving the dewatering properties at the press section, improve the retention of internal chemicals, refined fibers, and fillers, as well as clean up the papermaking system.

Compared to the current dry strength resins, the PM series has higher amounts of cationic groups, is optimized in ionic balance to prevent over-aggregation, and is controlled in molecular weight. The utilization of the PM series can also decrease the dosage of aluminum compounds, improve the adsorption of sizing agents and other internal chemicals, as well as improve the retention of refined fibers and ash contents in the paper.

In the paper mill, the reduction of aluminum compounds and the papermaking chemicals, cleaning up the papermaking system, and improving operability have been achieved while maintaining the quality of paper.

## Surface Free Energy Analysis of Cellulose Nanofibers through Contact Angle Measurements

Tomohito Yagita, Tsuguyuki Saito, and Shuji Fujisawa

Department of Biomaterial Sciences, Graduate School of Agricultural and Life Sciences,  
The University of Tokyo

Accurate measurements of the surface free energy (SFE) are essential for determining the interfacial properties of materials, including the adsorption characteristics of solid particles at the water/oil interface in emulsions. The SFE of cellulose nanofibers (CNFs), which are nanomaterials derived from wood resources, has thus far been evaluated by inverse gas chromatography (IGC), and the emulsifying capacity of CNFs is effectively explained by the desorption energy calculated from the SFE. However, IGC suffers from a long measurement time and complicated analysis. Among the various methods proposed for measuring the SFE, contact angle measurements have the advantage of simplicity in both measurement and analysis. Here, the SFE of CNFs was evaluated by contact angle measurements. Two types of CNFs with different surface structures were prepared through ion exchange of surface-carboxylated CNFs: one with sodium and the other with tetrabutylammonium ions. The contact angle measurements were performed on the CNF films using a combination of three different probe liquids, and the SFE of the CNFs was determined based on the van Oss–Chaudhury–Good theory. However, a substantial decrease in the electron-donor component of SFE was observed through the ion exchange from sodium to tetrabutylammonium; this result was inconsistent with previous reports. Furthermore, the calculated desorption energies of the CNFs could not explain the emulsification behavior in the experimental system. These discrepancies were attributed to the swelling of the CNF films against the probe liquid. This study showed the limitations of contact angle measurements for accurate SFE determination of CNFs.

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### **Recent trends in biodiversity conservation**

Takayuki Harada  
Japan Paper Association

With regard to biodiversity conservation, the new global goal the Kunming-Montreal Global Biodiversity Framework (GBF) and the National Biodiversity Strategy (2023-2030) call for an integrated response to the twin crises of the climate crisis and biodiversity loss and the realization of nature-positive (nature restoration). In order to achieve the fundamental social reforms required for this purpose, efforts to incorporate biodiversity conservation measures into social and economic activities have begun.

In this paper, we will first introduce recent trends in biodiversity conservation, including international movements, public-private movements in Japan, and international framework-building movements at the private level, and second, the progress of efforts in the paper industry to date.

Finally, I would like to reorganize these trends from the perspective of integrating them with climate change countermeasures and incorporating them into socio-economic systems, and introduce my views on future measures at the corporate level, such as the importance of establishing a system to reconsider all business activities from the perspective of biodiversity conservation, and specific initiatives for the time being.

### **CFP calculation rules for copying paper and printing paper for products compliant with the Green Purchasing Law**

Masayuki Kawasaki  
Japan Paper Association

In order to build a carbon-neutral society, it is necessary to create a market where decarbonized and low-carbon products are selected, and visualization of CO<sub>2</sub> emissions per product through carbon footprint of products (CFP) is considered essential as a foundation for such a market. In 2023, the Japanese government released the cross-industry CFP guidelines for individual businesses to calculate their CFP, and launched a project to provide support to organizations that formulate product-specific calculation rules based on these guidelines.

As the Ministry of the Environment is considering the introduction of CFP calculation as a criterion for the Green Purchasing Law, Japan Paper Association decided to participate in the above-mentioned support project and formulate comparable CFP calculation rules for copy paper and printing paper among the paper products compliant with the Law.

The CFP calculation rules for paper and paperboard products were established by Japan Paper Association in 2010, and were reviewed in line with the government's CFP guidelines. Basically, we followed the 2010 CFP calculation rules, but reviewed the contents to make the rules comparable, and added new items such as biomass-derived carbon, mass balance, etc. We report the outline of the review.

### **CDP Water Security Initiatives by Companies in Japan**

Hirohito Yoshida , Kyosuke Katada and Rei Sato  
Yachiyo Engineering Co., Ltd.

CDP is a non-profit organization managed by a British charitable institution that scores companies based on the results of environmental questionnaires they distribute.

In recent years, the number of companies responding to CDP has been increasing, and the scoring results are utilized by investors and other stakeholders in the market. This report presents the trends in corporate responsiveness to water from the CDP Water Security 2023 Report. The findings show that companies responding for the first time in 2023 are currently less advanced in their water initiatives in many aspects compared to those that have been responding continuously. Therefore, it is expected that they will strengthen their actions in the future.

## **Flow of Noise Control Measures for Factories and workplaces**

Takeshi Hirata  
Nihon Onkyo Engineering Co., Ltd.

In recent years, a variety of manufacturing companies have made efforts to improve the quietness of their equipment, yet the issue of noise remains an unresolved challenge. The triggers for noise-related problems are diverse; for example, noises that were not previously considered problematic in areas solely surrounded by farmland became a source of noise pollution with the construction of factories and subsequent residential developments due to changes in urban planning. Furthermore, there has been an increasing focus on enhancing the work environment for employees within factories and workplaces, leading to a heightened concern for ambient noise.

In addressing noise control, one of the benchmarks for measures outside the premises is the environmental standards for noise set by the Ministry of the Environment. These standards, based on the provisions of Article 16, Paragraph 1 of the Basic Environment Law, define the "desirable standards to be maintained for the preservation of the living environment and the protection of human health concerning conditions related to noise," with specific standard values designated for regions by prefectural governors. Additionally, for noise affecting workers, the Ministry of Health, Labour and Welfare has developed "Guidelines for the Prevention of Noise-Induced Disorders," with reviews conducted at various meetings. While adherence to these standards is crucial, it is noted that noise issues may still arise, such as in cases where peak frequency characteristics are observed, even when these standards are met.

Thus, in factories and workplaces, noises generated during operations or consistently by equipment often become problematic, necessitating careful observation of their generation processes and propagation paths, as the strategies for addressing them differ based on the objectives set. Effective noise control requires thorough site surveys, estimations through calculations, and the proper planning and execution of measures.

This paper discusses the procedures and approaches for noise control in factories and workplaces, aligned with the noise prevention planning steps of the Architectural Institute of Japan, including (1) investigation of planning conditions, (2) determination of sound source characteristics, (3) creation of sound propagation path diagrams, (4) calculation of noise levels at affected points, (5) setting of target conditions, (6) consideration of calculation margins, (7) planning of control measures, and (8) explanation of various control measures and their effects.

## **Geological CO<sub>2</sub> Storage Technology Research and Development, and the Deployment in Japan**

Ziqiu Xue

Research Institute of Innovative Technology for the Earth (RITE)

Carbon capture and storage (CCS) is considered to be one of the few feasible technologies for reducing global anthropogenic carbon dioxide (CO<sub>2</sub>) emissions. The first pilot CO<sub>2</sub> storage project was carried out at Nagaoka, Niigata Prefecture in 2003. It took almost 20 years to step into the deployment stage from research and development. This talk presents an overview of CCS activities in Japan, including a concept for the middle and small-scale sources to reduce CO<sub>2</sub> emissions and to pursue carbon neutrality.

## About a "Pro-Growth Carbon Pricing Concept"

Miku Uchida  
Environmental Economy Office,  
Ministry of Economy, Trade and Industry

Based on the GX Promotion Act (enacted May 2023), the Japanese government adopted the "GX Promotion Strategy" in July 2023. The strategy sets forth necessary policies to be implemented to achieve 150 trillion yen of public and private investments to realize GX (green transformation), a transition from a fossil fuel-oriented economic and industrial structure since the Industrial Revolution to a clean energy-oriented one.

To promote the GX investment as described above, a "Pro-Growth Carbon Pricing Concept" will be embodied and implemented as soon as possible.

- 1) Government support for advance investment by issuing new government bonds
- 2) Introduction of carbon pricing to incentivize early GX investment
  - (1) Full-scale operation of emissions trading system in high emission industries [from FY2026].
  - (2) Introduction of a GX-Surcharge on fossil fuel supply [from FY2028]
  - (3) Allowance auctioning to be phased in gradually to power generation companies [from FY2033]
- 3) Strengthen financial support through public-private partnership (e.g. blended finance with the GX Promotion Agency)

The GX League is a framework in which a group of internationally competitive companies that are boldly taking on the challenge of transitioning to carbon neutrality will drive GX. As of FY2024, more than 700 companies have participated in the league.

These companies have been making significant efforts to reduce emissions, upholding their own targets of emission reductions not only for FY2030 but also for FY2025, and have also decided to participate in an emissions trading system currently being operated on a trial basis. Moreover, active discussions on and proposals for rulemaking, which is difficult for individual companies to undertake, have been held regarding areas such as emissions reductions throughout the supply chain and the input of green products into the market.

## Characteristics of Artificial Stone Produced from Boiler Ash and Its Treatment Methods

Takayuki Nuruyu, Daizo Fukuoka and Keita Kudo  
FKG Corporation .Inc

Approximately 32.4% of Japan's total power generation is derived from coal thermal power and biomass thermal power plants, producing about 12 million tons of combustion ash annually. While this ash is primarily used as a raw material for cement, its application as recycled aggregate material in civil engineering has not significantly expanded. To promote its utilization, we successfully endowed artificial stone made from combustion ash with multifunctional properties. This functional artificial stone exhibits high resistance to soil liquefaction, making it effective as lightweight embankment material. Its water absorption makes it suitable for construction during rainy conditions. Additionally, it possesses water purification capabilities, protecting residential and industrial areas from groundwater contamination. The nutrient ion adsorption properties enhance plant compatibility, benefiting green spaces and aquatic vegetation. Furthermore, the production process absorbs carbon dioxide, contributing to carbon neutrality. This environmentally friendly technology enhances resource recycling and is expected to mitigate natural disaster damage while improving living environments. This functional civil engineering material has already been proven effective as subgrade material, base course material, and backfill material, and it is expected to further contribute to mitigating natural disaster damage and improving living environments in the future.

## **Forest consulting service "Mimamori"**

### **- Forest information analysis and data utilization using remote sensing -**

Yotaro Masago

Kokusai Kogyo Co.,Ltd. Business Operation Headquarters RS Solution Department\*2

Kokusai Kogyo, known as a pioneer of Japanese civil aviation, led the industry as a pioneer of aerial photogrammetry after World War II, and is currently contributing to society as a leading company in geospatial information technology. One of the services we provide is "Shinmamori."

The starting point of our service is "forest measurement and analysis." We can also take photographs from the sky and measure on the ground using aircraft, drones, and satellites, which are our specialties. We provide a variety of measurement services according to purpose and use. The acquired data is "analyzed" using our own technology, and in addition to forest resource analysis such as estimating the number of trees and tree height, it is possible to extract existing road networks, analyze microtopography, and analyze collapse locations. On the other hand, due to changes in the legal system and tax system, the preparation of forest land registers is now essential. Therefore, this service supports the preparation of registers in accordance with the Forestry Agency's manual, and also supports local governments in solving various issues in the operation of the forest management system that began in 2019.

As you know, forests have many functions, and in addition to being used for the forestry industry, they are also useful for disaster prevention if properly managed, are valuable places for maintaining biodiversity, and have recreational functions. Another feature of Shinma Mori is that it can propose zoning to realize better utilization methods.

It is possible to visualize and share forest resources, and the greatest feature of Shinma Mori is that it provides consulting on how to make advanced use of them. We support you on the level of how to use forest information and ultimately how to make effective use of forests.

## **Membrane Bioreactor(MBR) using Kubota Submerged Membrane Unit**

### **-Solving Problems in Paper and Pulp Mill Wastewater Treatment-**

Eri Hayashida

Kubota Corporation, Membrane Systems Dept., Domestic Sales & Engineering Section \*2

Since pulp and paper mills use a large amount of water and have various processes depending on the content of production, wastewater treatment in paper mills is difficult to manage and has a large impact on the environment.

KUBOTA Submerged Membrane Unit is a membrane filtration equipment for membrane bioreactor(MBR). We hope that KUBOTA Submerged Membrane Unit which used in wastewater treatment in various fields, will contribute to solving various issues of activated sludge treatment and lead to the reduction of environmental impact in pulp and paper mills and contribute to the formation of a sustainable society.

## **Recycling combustible waste using aerobic fermentation drying method**

Naoto Misawa, Yasuaki Saito

Ebisu Shiryō Co., Ltd.

The Mitoyo Biomass Recycling Center in Mitoyo City, Kagawa Prefecture, is recycling combustible waste using Japan's first aerobic fermentation and drying method.

The aerobic fermentation drying method uses the power of aerobic fermentation of microorganisms to decompose food waste, flowers, etc. contained in combustible waste discharged from general households, etc., and ferment it, which causes the microorganisms to generate heat. The fermentation heat dries paper, plastic, and other materials that microorganisms cannot decompose, and by sorting them, they are recycled as raw materials for solid fuel.

The solid fuel produced is used by paper companies and other organizations as an alternative fuel to coal.

In Mitoyo City, Kagawa Prefecture, the recycling rate increased to 64% after introducing this method. In terms of CO<sub>2</sub> reduction, we have achieved a CO<sub>2</sub> reduction of approximately 10,000 tons due to both the elimination of incineration and the effect of substituting solid fuel for coal.

We will introduce the history of the introduction of the aerobic fermentation drying method, the processing flow, and its characteristics, and introduce the decarbonization effect of turning combustible waste into fuel and future prospects.

## **A Report on the 2nd International Lignin Symposium**

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Yasumitsu Uraki  
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The Lignin Society was founded on November 1, 2018. This foundation was accompanied by holding the annually domestic 64<sup>th</sup> Lignin Symposium, which corresponded to the 1<sup>st</sup> annual conference for the Lignin Society, as an international conference, the 1<sup>st</sup> ILS in September 13-15, 2019 at Hokkaido University, Sapporo, Japan. It was decided that the annually domestic Lignin Symposium would be held as the ILS every five years. The 2<sup>nd</sup> ILS was thus held in September 7-10, 2024 at Kyoto Institute, Library and Archives, Kyoto, Japan. Totally 192 (including 59 students and 45 attendants from abroad (12 countries)) participated in 3 keynote speeches and 107 presentations (35 oral and 72 poster). Dr. Hou-min Chang (North Carolina State University, Raleigh, NC, USA), Dr. Vincent Chiang (North Carolina State University, Raleigh, NC, USA), and Dr. Toshiaki Umezawa (Kyoto University, Uji, Kyoto, Japan) gave the keynote speeches and received the Meritorious Achievement Award from the Lignin Society. The 3<sup>rd</sup> ILS was scheduled to be held in Tokyo in 2029.

## **A Report on the 64th National Conference of the Pulp and Paper Industry on Safety and Health**

Kohei Watanabe  
Japan Paper Association

Japan Paper Association (JPA) held the 64th National Conference of the Pulp and Paper Industry on Safety and Health in person at Otsu-city in September 2024. The conference had about 300 participants from member companies and cooperating companies.

The conference took place over two days, and the program of the first day include plenary session, special lecture, and social gathering. In the second day, six breakout sessions were held, and each session had three presentations of case studies and group discussion. In the group discussion, each group (consisting of six to eight participants) discussed preset theme and set action targets. At the end of the group discussion, the contents of the discussion and the action targets were presented, and information was shared with the entire participants.

## **Reduction of chlorine dioxide consumption during ECF bleaching of hardly bleachable hardwood kraft pulp**

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We applied peroxymonosulfuric acid treatment to ECF bleaching of kraft pulp prepared from plantation hardwoods, which are hardly to be cooked, and compared the reduction in chlorine dioxide usage between hardly and easily bleachable pulps. Using H<sub>2</sub>SO<sub>5</sub> of 3.0 kg per ton of pulp reduced the chlorine dioxide usage. The total chlorine dioxide consumption was reduced by 2.65 kg per ton of pulp for an easily bleachable eucalyptus pulp, and by an average of 4.93 kg for the pulps from three species of acacia woods that are hardly to be bleached. We confirmed in the laboratory experiments the hypothesis that the effect on the reduction of chlorine dioxide usage by introducing peroxymonosulfuric acid treatment should be greater for hardly digestible/bleachable acacia pulps than for easily digestible/bleachable eucalyptus pulp.