

## CONTENTS

### The Special Issue of the 63<sup>rd</sup>—2020 JAPAN TAPPI Annual Meeting

#### 6 Message from the President

The 63<sup>rd</sup>—2020 JAPAN TAPPI Annual Meeting

“Challenges to the next generation of the Pulp and Paper Industry—Innovation of biomass technology will lead to the future”……Fumio Shindo

#### Technical Report

#### 27 “FabriKeeper”, The Solution to Dryer Fabric Deposition, which Combines DSP and Cleaning Technology……Hiroshi Sekiya and Tomohiko Nagatsuka

#### 34 High-Performance of Non-Stick DryOnyxH Coating That Can be Applied Onsite

—Introduction of Achievements at Japanese Paper Mills—

……Kimiaki Iwane, Noriyuki Yasuo and Daisuke Inoue

#### 40 Utilization Method and Practice Example of Online Hygiene Education as an Alternative to Collective Education……Risa Kamiya

#### 45 ABB's After-Service for Perfect Testing of Pulp & Paper and for Sustainable R&D

—Service and Solution for L&W Testing and Analyzing Instruments——……Ryo Yamashita

#### 51 Remote Service by Valmet……Yoshiyuki Hirano

#### 55 Benefits of Implementing Advance Process Control Technology Using MACS in Pulp & Paper Making Processes

……Guy Normandeau, Michael Doucet, Akhlesh Mathur, Yuji Nishino and Nozomu Wada

#### 64 New Type Turbo Blower Saves Energy & Stable Operation With IoT

—Air Foil Bearing Variable Speed Single Stage Turbo Blower TurboMAX—

……Go Kawazu and Tsuyoshi Masuda

#### Topics & Information

#### 69 An Essay on Methodology for Innovating “JAPAN TAPPI JOURNAL”

Part 9 : A New Normal State in the Post-Corona Age and “JAPAN TAPPI JOURNAL”

……Fumihiko Onabe

#### 03 Committee report

#### 72 Coffee break

#### 73 Papyrus

#### 79 Industry News (Domestic and International)

#### 82 List of Patents issued and Laid-open Publication

#### 92 Price list of Domestic Logs and Wood Chips by District

#### 93 Other Monthly Statistics

#### 95 News from the Association

**“FabriKeeper”, the solution to Dryer Fabric Deposition, which combines DSP and cleaning technology**

Hiroshi Sekiya

President MAINTech CO., LTD

Tomohiko Nagatsuka

System Development Team, Fuji Technology Development Center MAINTech CO., LTD

Maintech's Dryer Section Passivation (or DSP) has been introduced on 99% of paperboard production in Japan, and over 750 units of our chemical spraying equipment, MistRunner® and ShowerRunner® are operating across the world. In the field of recycled papermaking, the use of low-grade wastepaper leads to increased deposits on paper machines, causing defects, sheet breaks and machine speed limitation, therefore more effective measures are needed / need to be taken. In addition, it is dangerous for workers to check the dryer fabric condition inside the dryer hood under high temperature and humidity conditions to take measures against deposits. Thus, we notice the progress of deposits after increasing defects and sheet breaks.

Therefore, we have developed the innovative solution for preventing defects and sheet breaks by combining dryer fabric passivation and cleaning technology, “FabriKeeper®” with deposit monitoring and quantification, “SmartDepo.®”. We have successfully introduced these solutions to paper machines across Japan / across the world.

**High-Performance of Non-Stick DryOnyxH coating that can be applied onsite.**

**- Introduction of achievements at Japanese paper mills -**

Kimiaki Iwane

Sales headquarters, Tocalo Co.,Ltd

Noriyuki Yasuo

Tokyo plant, Tocalo Co.,Ltd

Daisuke Inoue

Overseas Business Division, Tocalo Co.,Ltd

In 2015, Tocalo Co.,Ltd. started on-site coating applications of DryOnyx H(hereafter called “DOH”), a release coating for dryer cylinders of paper machines licensed from Valmet Corporation, Finland, for Japanese paper manufacturers after closing a license agreement with the company in 2014 August. Valmet's DOH represents a package of unique technologies for coating formation that is highly recognized and used by paper manufacturers around the globe and is a successor, with improved features, to DryOnyx Z. The number of cylinders coated with DOH tops 600 as of 2020 April. Its functional coating surface has proved excellent releasing and non-stick properties for doctored dryer cylinders, contributing to drastic productivity improvements in papermaking processes.

One of the biggest advantages of DOH is its short time requirement realized by the on-site application, which eliminates the needs for removing large cylinders from the line and transportation to the coating facility as required in conventional release coatings. Low temperature cured paints and polytetrafluoroethylene (PTFE) fluoropolymer sheets are known as conventional on-site solutions for dryer cylinders, however, only few examples of actual use are found due to quality and short service life from their low durability to doctor blades. DOH is on-site coating technology designed to provide solutions for these challenges and now meets customers' expectations for shorter process time and longer service life.

During 5 year period from September 2015 to the June of 2020, Twenty eight cylinders have been applied with DOH, and We are increasing application to canvas rolls that have similar rust and dust problems in the dry part. In this paper, the basic characteristics and coating processes of DOH along with its performance are reported.

## **Utilization method and practice example of online hygiene education as an alternative to collective education**

Risa Kamiya

Sales Promotion Division, Ikari Shodoku Co.,Ltd

In recent years, consumers have become more conscious of foreign substances contamination in foods, and in particular, the contamination caused by pests such as insects and rodents tends to be a big problem due to the concern of hygiene and appearance. In order for companies to thoroughly manage pest control, education of employees is an important issue.

In response to a request from a major food company, we have begun to provide the educational and learning service "Ikari Smart Campus" through online hygiene education. Online hygiene education is a learning management system that can be accessed through the internet by various of devices such as computers, smartphones and tablets. The strength of e-learning is that you can take the courses anytime, anywhere and any number of times. All of the teaching materials provided by us are original, and by using abundant photographs and illustrations, we encourage students to take the course "as many times as possible" and hope that their knowledge will be firmly established.

Education is an indispensable effort for any company. Online hygiene education is an educational tool that is in high demand because it can be carried out easily even at the times when the implementation of group training is difficult, considering the recent situation. We need to regularly add new teaching materials and aim to enhance the service so that "Ikari Smart Campus" can be used by many companies as a new educational method.

## **ABB's After-Service for Perfect Testing of Pulp & Paper and for Sustainable R&D - Service and Solution for L&W Testing and Analyzing Instruments -**

Ryo Yamashita

Pulp & Paper Group, Industrial Automation Business Area, ABB K.K.

The customer often has questions. "Can you trust the result?" "How is the accuracy?" Regarding measurement, many guidelines are given in various measurement standards (JIS, ISO etc), and the measurement device and measurement procedure are specified therein. ABB, we aim to not only comply with the standard, but also share the value beyond that with our users.

For ABB's after-sales service, our specialized engineers share our worldwide knowledgebase, experience of maintenance, inspection, service, calibration and etc. that have been carried out for decades through our own network, and provide high quality service.

Since instrument always deteriorates, regular service and calibration are required to maintain high accuracy of instrument. Our company proposes and provides some service to maintain the accuracy of the instrument by updating the software, such as maintaining the accuracy of the instrument by concluding a Preventive maintenance agreement (PMA). The contracted user not only obtains reliable results, but also expects to budget for maintenance costs, and further extends the life of the instrument.

We propose and provide the upgrade of our instrument, which is updated year by year, to the desired users. The advantages of updating the old model and measuring with new hardware and software are great. As for whether to acquire a new measuring instrument or to extend the life of the old model by maintenance, we would like to consult with the user separately and mutually propose the most rational method.

ABB's products and services are said to be of very high quality, which means that users trust our product and ultimately win-win profits. Our company think that high quality service is not something that can be obtained naturally, and that new expertise and management in various ways suited to the times are always needed.

## **Remote Service by Valmet**

Yoshiyuki Hirano

Valmet K.K.

The main target of Remote services is to continuously improve mill efficiency by improving process performance and by supporting mill operations in their daily tasks.

Valmet offers various solution methods to solve these problems, and we will share innovative ideas with customers and bring them to market. Providing applications that contribute to satisfaction by continuously grasping technological innovations that change with the times.

## **Benefits of implementing Advance Process Control technology using MACS in Pulp & Paper Making Processes**

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An optimum process control requires manipulation of multiple MV's (manipulated variables), FF's (Feed Forward variables) and constraints matrix to achieve multiple CV (control variables) to remain in desired operating limits. It is extremely challenging to optimize each of the controlled variables to maintain the process close to required quality targets. While it is of utmost importance to have the field instruments, sensors and regulatory controls functioning accurately it is practically impossible for operators to manually optimize the process. For example, in a bleach plant, it is challenging to achieve final pulp brightness at minimal cost continuously using regulatory controls due to the complex multivariant nature of the process and the lengthy time delays introduced by dead times from Bleach towers. To overcome this challenge, Multivariable Advanced Control System (MACS), a proven advanced nonlinear control platform, has successfully been implemented resulting in large savings to mills. MACS uses dynamic process models to account for the effect of process disturbances on downstream pulp or paper properties and manipulates the chemical charges for instance to compensate for these disturbances. MACS corrects for unmeasured disturbances via feedback control, and accounts for varying process delays and non-linear process response curves via real time model adaptation.

Utilizing a model predictive control solution coupled with an optimizer allows for optimization of the individual unit operations as well as a coordinated optimization between different departments. This is especially critical when considering the changing objectives from a facility which can range from production maximization requiring the minimization of bottlenecks to an objective of minimizing overall production costs. In most facilities there will be a balance between these two objectives that will continuously be changing based on the current market demands and operational costs.

We are now seeing the adaptation of these solutions by the P&P industry as single unit optimizations as well as entire process optimizations. MACS can be implemented in all unit operations from wood handling through to paper finishing as well as the utility areas.

This paper highlights some industrial case studies of implementing MACS solution to key unit operations in a Kraft process – Digester, Bleach Plant, Evaporators, Recovery Boiler, Recast and Lime Kiln. The objective and the control strategies could be different for different unit operations, but the basic concept of developing mathematical correlations between MV's, CV's, FF's and constraints are developed to predict the future behavior of the process. MACS Models provide new process setpoints to remain within target process conditions. MACS can manage 100's of variables at the same time respecting all the operating targets while maintaining the process at the lowest cost point.

## **New Type Turbo Blower Saves Energy & Stable Operation With IoT —Air foil bearing Variable speed Single stage Turbo blower TurboMAX—**

Go Kawazu  
Design Department Ono Plant Fluid Division, ShinMaywa Industries, Ltd.  
Tsuyoshi Masuda  
Fluid Division, ShinMaywa Industries, Ltd.

In this paper I would like to introduce the advantages and technologies of TurboMAX turbo blower. TurboMAX turbo blower consists of superior technologies like air-foil bearing, permanent magnet synchronous motor, high efficiency impeller, high speed control technique and so on. As for the overall structure, blower, motor, inverter, touch panel controller and blow off valve are installed in one enclosure. This is a new style turbo blower called “air foil bearing-variable speed-single stage turbo blower”. Compare to the conventional blowers, TurboMAX turbo blower has many advantages in “Saving energy” “Low noise and vibration” “Saving maintenance cost” “Space-saving and lightweight”. Especially, compare to the conventional root blowers, TurboMAX turbo blower can reduce power consumption by 20% on average.

As global warming is serious issue around the world now, reducing the power consumption is required to all industries regardless of its type and scale. Especially for paper industry which uses and disposes a large amount of water, reducing the cost for waste water treatment is a big challenge. In the process of waste water treatment, aeration blower's power consumption makes up the large proportion, and aeration blower usually runs for 24 hours every day. So, high efficiency aeration blower can contribute to



the cost reduction of waste water treatment significantly.

In the latter half of this paper, I introduce an actual case of replacing 2 root blowers with 1 turbo blower (MAX100) at municipal sewage-treatment plant for the field trial. As the result, we could confirm 25% energy saving, 16dB noise reduction, 25μm vibration reduction, and 6°C blower room's temperature reduction.

ShinMaywa Industries, Ltd. launched TurboMAX turbo blower since 2012 in Japan, and some blowers have been delivered to paper factories. As for paper factory, we have delivered blowers to 8 paper factories so far and 12 blowers are in operation now. Especially, one of these blowers are used for flotator which is used in the deinking process during manufacturing recycled paper from used paper, and we confirmed TurboMAX turbo blower can reduce power consumption in non-aeration use too. I expect TurboMAX turbo blower can reduce the power consumption in many other uses too. I hope TurboMAX turbo blower contributes to the energy saving in many fields and it leads to the reduction of environmental burden of the globe.

## **An Essay on Methodology for Innovating “JAPAN TAPPI JOURNAL”**

### **Part 9: A New Normal State in the Post-Corona Age and “JAPAN TAPPI JOURNAL”**

Fumihiko Onabe

Professor Emeritus, The University of Tokyo (Paper Science)

#### **Abstract**

Pandemic coronavirus Covid-19 has immense amount of potential energies to change from a daily normal state to a newly emerged “New Normal State” through human societies and business worlds. To cope with these crises, a variety of countermeasures are proposed so far.

The ninth article of this series is intended to foresee the structural change of human society and business world with particular attentions on paper-related areas: i.e. Japanese paper industry, Japan TAPPI, and Japan TAPPI journal. The overall contents are described as below.

1. Introduction
2. Corona disaster as stressor on human being
3. Normal State and New Normal State
4. New Normal State : reversible or irreversible
5. Normal and New Normal States for paper industry
6. Normal and New Normal States for the Japan Tappi
7. Personal experiences from the attendance of the Online-type Annual Meeting of Japan Tappi
8. Information gathering and human five senses
9. A cognitive science viewpoint on the comparison between on-site attendance and online attendance
10. Problems proposed through corona disasters to the Japan TAPPI JOURNAL
11. Epiloguen

## CONTENTS

### CNF

- 1 Commercialization and Application Development of Nanoforest.....Sohei Hagiwara
- 7 Development of Xanthated Cellulose Nanofiber  
—Approach for Practical Application——.....Tomoyuki Nakatsubo
- 11 Cellulose Material Fused with Nano/Micro Fiber.....Keiichi Nakamata
- 15 Cellulose Nanofiber Prepared by Phosphorylation and its Utilization  
.....Mio Yamanaka
- 20 Contribution to Environmental Issues by Structural Materials Utilizing CNF  
—A Report of NEDO Project and Our Effort to CNF Reinforced Resin Composites—  
.....Takashi Date

### Topics & Information

- 29 Next-Generation Quality Control with the Latest Finnish Measuring Equipment  
.....Yohei Suzuki
- 33 Effective Management for Seal Water in Pulp and Paper Mills  
—Stable Operation and Environmental Load Reduction——.....Daisuke Tsuchiya
- 39 Maintenance about Continuous Digester Vessel (Pressure Vessel)  
.....Fumio Takayasu
- 44 Revolutions in the History of Civilization Induced by Paper  
Part 1 : The Arrival of Paper to Japan.....Kiyooki Iida

### Introduction of Research Laboratories(137)

- 52 Laboratory of functional biomolecules (Nakamura Lab), Department of Applied  
Life Sciences, Faculty of Agriculture, Shizuoka University

### Research Report(Original Paper)

- 55 Kraft Cooking with Teak Wood Extract and Determining Residual  
2-Methylantraquinone in Eucalyptus Pulp.....Yulia Anita, Augusta Samodra Putra,  
Keishi Tanifuji, Akiko Nakagawa-Izumi, Hiroshi Ohi and Evelyn Evelyn

### Pulp and Paper Mills in Japan(88)

- 76 Kishu Mill, Hokuetsu Corporation

- 03 Committee report
- 51 Essay on Intellectual Property
- 54 Coffee break
- 81 Papyrus
- 88 Industry News (Domestic and International)
- 92 List of Patents issued and Laid-open Publication
- 101 Price list of Domestic Logs and Wood Chips by District
- 102 Other Monthly Statistics
- 104 News from the Association

## **Commercialization and application development of nanoforest**

Sohei Hagiwara

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

The cellulose nanofiber (CNF) which is produced by the Aqueous Counter Collision (ACC) method and named as "nanoforest" is suggested to have an amphiphilic fiber surface expressing high affinities for not only water but also oils in addition to general characteristics of CNFs such as light weight, high strength, and low linear thermal expansion. "

This article explains the manufacturing methods and characteristics of nanoforest and the commercialization of nanoforest.

As for the activities of the commercialization, the sample provision is carried out, and the examination is advanced in various fields.

On CNF composite material, the problem became clear in carrying out the sample work, and countermeasures and new development are advanced.

Moreover, this article introduces an outline of the construction of pilot plants for a production of high-functioning CNFs, which was released in May 2019, and the products of those new plants.

## **Development of Xanthated Cellulose Nanofiber**

### **-Approach for practical application-**

Tomoyuki Nakatsubo

Central Laboratory, Rengo co., Ltd.

Cellulose nanofiber (CNF) is produced by fibrillating pulp to the nano-sized fibrils either through chemical or mechanical processes. It possesses interesting properties, such as high strength, high elastic modules, low thermal expansion, and thixotropy of the suspension. For these properties, it can be used for various applications, and is drawing great attention in recent years as a promising next-generation material.

Our company, Rengo, has been manufacturing cellophane from pulp for many years. Since cellulose xanthate, an intermediate product in the production process, is an anionic cellulose derivative, we tried to make CNF using this intermediate. We found that xanthated cellulose nanofiber (XCNF) with a diameter of about 3-10 nm can be generated efficiently. Such obtained XCNF can be easily converted (regenerated) to a non-substituted cellulose nanofiber (RCNF) form by treating XCNF with either heat or acid<sup>(1)</sup>.

In this presentation, we reports the physical properties of RCNF for practical application.

First, viscosity characteristics of RCNF was investigated. The viscosity of RCNF slurries with different concentrations (0.02~1.0%) was measured and it was confirmed that the viscosity of RCNF slurry was higher than that of hydroxyethyl cellulose in the high concentration region. Further, it was confirmed that the high viscosity was maintained even in the presence of salt and the temperature dependence was low. This suggests that RCNF is useful as a thickener.

Next, emulsifying ability of RCNF was examined. RCNF slurry was mixed with some oily substances and the emulsification performance of RCNF was investigated. RCNF exhibited emulsification performance for many oily substances. Furthermore, it was found that the emulsifying performance was sufficiently exhibited at a low concentration such as 0.5%. This means that RCNF is also useful as an emulsifier.

As the other features, RCNF shows the dispersion stability of the fine powder such as calcium carbonate, and can be dispersed in organic solvents.

From the above results, RCNF is expected to be used in a wide range of applications.

## **Cellulose Material Fused with Nano/Micro Fiber**

Keiichi Nakamata

Nobel Material Development Office, Hokuetsu Corporation

Vulcanized fiber is an all-cellulose material made from cotton and wood pulp. This material was invented in the United Kingdom in the middle of the 19th century, and was used in Edison's numerous inventions due to its excellent characteristics such as impact resistance and electrical insulation. Recent research revealed the reason for the strength of the vulcanized fiber. Cellulose fibers are chemically defibrillated to form a network of cellulose nanofibers (CNF) with a diameter of several nm to several tens of nm, and this CNF network shrinks and binds tightly when water is removed during the drying process. The vulcanized fiber has revived in the present age when cellulose nanomaterials are drawing much attention, leading to new developments that combine with carbon fibers.

## **Cellulose Nanofiber Prepared by Phosphorylation and its Utilization**

Mio Yamanaka

Innovation Promotion Division, Oji Holdings Corporation

Cellulose nanofibers (CNFs) are obtained from wood pulp by isolating crystalline microfibrils in which molecular chains of cellulose are regularly arranged. Since CNF is not only a sustainable natural resource but also has unique features, its multifaceted utilization is expected. By subjecting softwood bleached kraft pulp to phosphorylation and then mechanical treatment, the CNFs with phosphate groups on their crystal surface could individually be dispersed in water. The dispersion had unique rheological properties, and the phosphate groups provided stability in a wide pH range to the dispersion. The aqueous dispersion of phosphorylated CNF was commercialized as a thickening and dispersing agent for cosmetics, taking advantage of its high transparency, high viscosity and high dispersant ability. In addition, phosphorylated CNF was adopted for the pump primer to prevent concrete blockage in pumping pipe by forming a thin and uniform lubricating layer on the inner surface of the pipe at construction sites. Due to the rheological properties of the CNF, lubricating layer can be stably formed, and components in pump primer can be stably dispersed and the pump primer can adapt to pumping speed. We can manufacture CNF sheet from aqueous dispersion in which phosphorylated CNFs are individually dispersed. The CNF sheet was adopted for materials used in table tennis rackets. By combining the CNF sheet and the base material wood, a table tennis racket with a new hit feeling has been realized. On the other hand, phosphorylated CNF with further modification can be dispersed in organic solvents. The CNF is provided in powder form and is dispersible in various organic solvents, and the dispersion has characteristics common to CNF aqueous dispersion. This CNF powder made it possible to study applications for use in non-aqueous solvents. Furthermore, we have succeeded in development of the composite material with much more excellent properties (high elastic modulus, and low thermal expansion) than those of conventional materials by combining polycarbonate (PC) with CNF. We will further promote the utilization of phosphorylated CNF.

## **Contribution to Environmental Issues by Structural Materials Utilizing CNF**

### **-A Report of NEDO Project and Our Effort to CNF Reinforced Resin Composites-**

Takashi Date

Nippon Paper Industries Co., LTD.

Cellulose is a most abundant, renewable and environmentally friendly bio-based polymer, which is available from non-edible biomass sources such as woods, grasses and agricultural residues. Cellulose nanofibers (CNFs), including cellulose microfibrils and their bundles, have received much industry attention for use in film, rheology control such as in paints and coatings, paper and paper packaging, cosmetic and medical materials and composites. In particular, reinforcement of polymers to improve their mechanical properties is one of the most promising applications of CNFs.

Nippon Paper Industries Co., Ltd. had taken part in the Kyoto University leading NEDO Project entitled "Development of the technology for the continuous production process "Kyoto Process®" of ligno cellulose nanofibers and their applications for the structural members" between 2013 and 2020.

In this NEDO project, we developed a chemically modified pulp with an improved heat resistance and would be easy to fibrillate to nano order but would not be chopped under melt compounding, and obtained many new knowledge using this modified pulp. The chemically modified CNF, at 10wt% loaded as a filler, increased the Young's modulus and bending strength of PA6, PLA, POM, HDPE and PP by 1.5~2.5 times. We found that Fir (Todomatsu in Japanese) was an ideal biomass for this process by

screening of several biomass. The ligno CNF reinforced resin composites maintained its strength after several times recycling unlike GFRP.

Nippon Paper Industries Co., Ltd. then built a demonstration facility for high strength CNF composite resin materials by implementing this technology, and started to operate at 2017.

The details of the NEDO project and the current situation of the demonstration facility will be described in this paper.

## **Next-Generation Quality Control With the Latest Finnish Measuring Equipment**

Yohei Suzuki  
Shin-Nihon Corporation

In recent years, attention has been paid to plastic-free worldwide, and the paper industry has an opportunity. Introducing Finland's latest measurement equipment for new products such as barrier coatings.

Permi Online Porosity Analyzer is a revolutionary system that it measures porosity online in real time. By stabilizing the porosity of the base paper, the coating quality can be maintained. Porosity measurement can also detect web breaks beforehand.

The AX-100 High shear rate viscometer can measure viscosity at high shear rates, which was previously impossible. The viscosity of the coating color actually used in the coater machine can be measured. Prevents troubles due to coating color. You can also reduce costs by optimizing materials.

The RoQ roll hardness tester can profile the winding hardness of the roll in the width direction. It is also possible to detect wrinkle detection inside the roll that could not be detected by the Schmidt hammer.

## **Effective management for seal water in Pulp and Paper mills**

—Stable operation and Environmental load reduction—

Daisuke Tsuchiya  
Engineering Dept., John Crane Japan, Inc.

Mechanical Seal Engineering Dept., John Crane Japan, Inc.

It is one of main issues at the paper mill plant, where there are many rotating equipment are installed, to maintain those equipment stably in the operation by reducing the troubles from the mechanical seal area. John Crane, the world leading company in the mechanical seal, has found from analyzing the past trouble data, that the most cause of those troubles is due to a lack of control of quenching water.

In order to eliminate this most cause of troubles, Safeunit, Smartflow, Safejet and Safeclean were developed to supply the quenching water with the correct flow rate, pressure and quality.

John Crane hopes to draw an attention to the importance of quenching water by our presentation this time, and assures you that they will help to maintain your equipment stably in the operation and save the water at your plant, by supplying the correct flow rate, pressure and quality of water.

## **Maintenance about Continuous Digester Vessel (Pressure Vessel)**

Fumio Takayasu  
Valmet K. K.

In recent years, KP facilities in Japan have been worn out and corroded by long time use for 30 to 40 years after installation. In particular, it is necessary to inspect and repair the first-class pressure vessels, which are required to be inspected by law. Repair methods for pressure vessels include complete renewal, partial renewal, lining, and overlay. Peripheral equipment such as the steaming vessel can be repaired by lining, partial renewal, or in some cases, complete renewal, depending on the state of wear and corrosion. On the other hand, it is not easy to completely or partially replace the continuous digester due to its size. Since the base material of domestic continuous digester is made of carbon steel when they are installed, most repairs are done with lining repairs. Lining repairs can be made partially and inexpensively within the construction period to repair only the areas of wear and corrosion. However, cracks may occur at the welded point because the welding is between different materials that attach a stainless steel plate to a carbon steel base metal. Also, the chemical solution can penetrate between the base metal and the stainless steel plate from the cracks, and corrosion of the base metal can progress. Therefore, if a crack occurs, the stainless steel plate must be temporarily removed and the soundness of

the base material must be checked before the stainless steel plate is re-installed. On the other hand, the overlay (Uddcomb method) described in the main paper is a method to form a new duplex stainless steel layer on the surface of the base metal by directly welding the stainless steel onto the base metal. It is an effective and permanent repair method for extending the service life of the base metal of continuous digester and batch digester without the risk of corrosion of the base metal and separation of thermal spraying, which are common in the repair of linings.

## **Revolutions in the history of civilization induced by paper**

### **Part 1: The arrival of paper to Japan**

Kiyoaki iida

How the paper has induced revolutions in the history of civilization will be studied.

Shoso-in documents recorded how paper was used in the 700's in Japan. One category was administrative documents. The government filed family registers in paper all over its control territory, and administrated tax collection. The instruction of the government on paper was delivered to one country, which copied the document and passed it to a neighboring one. At the same time, each country replied back to the government by paper. It also reported tax collection status. The population at that time was estimated to be about several millions, and the government controlled them by delivering documents.

The second category was copying sutras. It was a cultural project nationwide, and more than one hundred thousand volumes were copied. Many scribes were engaged, and greatly improved literacy.

The volume of paper demanded was supplied from governmental paper factory, copying stations of sutras and local paper factories. Most of paper was made of paper mulberry. Some sheets of paper were already made of recycled fibers.

Then, when did the paper arrive at Japan? There is not an accepted theory yet. According to the recent study on wooden slips found in Japan, it would be shortly after characters became in use in Japan.

## **Kraft Cooking with Teak Wood Extract and Determining Residual 2-Methylantraquinone in Eucalyptus Pulp**

Yulia Anita, Agusta Samodra Putra, Keishi Tanifuji, Akiko Nakagawa-Izumi and Hiroshi Ohi

Graduate School of Life and Environmental Sciences, University of Tsukuba

Evelyn Evelyn

School of Pulp and Paper Technology, Faculty of Engineering, University of Riau

Anthraquinone (AQ) is used in the pulp and paper industries as a cooking catalyst. However, because AQ is "possibly carcinogenic", it is no longer approved in Germany for the manufacture of paper and paperboard that contact food. To address this problem, we examined 2-methylantraquinone (2-MAQ), a natural anthraquinone from teak (*Tectona grandis*) wood. *Eucalyptus globulus* wood was subjected to kraft cooking at 145 °C for 3 h with 0.03% 2-MAQ and 15–19% active alkali to provide pulp in 55.5–58.1% yield. Kraft cooking with the acetone extract of Myanmar teak wood increased pulp yield by 1.6% but decreased kappa number by two points compared to that with only 2-MAQ. Ames testing suggests that 2-MAQ is not mutagenic. Unbleached and oxygen-bleached pulp contained 0.40–2.90 ppm and 0.21–0.39 ppm residual 2-MAQ, respectively, while 2-MAQ was not detected in fully bleached pulp; therefore, this pulp should be safe for food-packaging use.

## CONTENTS

### Process Control and Automation/IoT

- 1 General Review of 44<sup>th</sup> Pulp and Paper Process Control Symposium  
.....Process Control and Automation Committee, JAPAN TAPPI
- 2 Next-Generation Online Anomaly Detection System Using Artificial Intelligence  
.....Motomi Kohata
- 7 “PlantLogMeister (PLM)” is Contributing to Work Style Reform at The Operation Site for DX in The Pulp & Paper Industry.....Yoshito Katsuki
- 15 Remote Automation Project Service (RAPS)  
—A New Project Methodology in the Era of Uncertainty—.....Takashi Kai
- 21 Transition to Smart Factory with Data Integration & Visualization  
.....Takuya Maekawa, Ryohei Watanabe and Soon Hin Loo
- 27 Proposal of a New Production System with Flexibility and Robustness Corresponding to Changes in the Manufacturing Environment  
.....Kazutaka Fujita and Keiji Sato
- 35 Example of Using a Sign Detection System in a Power Plant  
—Equipment Diagnosis and Operation Support Using AI—.....Atsuhiko Kumagai
- 39 Introduction Example of Automatic Product Transfer Equipment Using an Automatic Guided Large Clamp Vehicle.....Hiromasa Kondo

### Topics & Information

- 43 IoT Transformation for Lifecycle Business.....Kazuhiro Funai
- 47 Cooperative Optimization Control Solution for in Paperboard Process  
.....Atsushi Toyoda
- 52 Valmet Products Which Have Both Improved Safety and Better Workability  
.....Kiyoshi Yaguchi
- 57 Revolutions in the History of Civilization Induced by Paper  
Part 2 : From Bamboo and Wooden Slips to Paper—Invention in China.....Kiyoaki Iida

### Introduction of Research Laboratories(138)

- 62 Laboratory of Forest Chemistry and Biomass Science (Kamei Lab.),  
Department of Forest and Environmental Sciences, Faculty of Agriculture,  
University of Miyazaki

- 03 Committee report
- 64 Papyrus

- 74 Industry News (Domestic and International)
- 78 List of Titles in Foreign Journals Received by JAPAN TAPPI
- 81 List of Patents issued and Laid-open Publication
- 93 Price list of Domestic Logs and Wood Chips by District
- 94 Other Monthly Statistics
- 96 News from the Association

### **Next-generation online anomaly detection system using Artificial Intelligence**

Motomi Kohata

AI Group, IT service promotion department, Engineering Headquarters, Advanced Automation Company, Azbil Corporation

It has been several years since the word AI (artificial intelligence) began to appear in everyday conversation. This keyword has appeared in various contexts and has been talked about as a next-generation solution technology with high expectations.

In this paper, we will briefly introduce the "Online anomaly detection System BiG EYES \*" that we are developing as an advanced predictive maintenance solution that applies AI.

### **"PlantLogMeister (PLM)" is contributing to work style reform at the operation site for DX in the pulp & paper industry**

Yoshito Katsuki

Toshiba Mitsubishi-Electric Industrial System Corp. (TMEIC)

In recent years, each company is promoting digital transformation to build next-generation business models and to strengthen the competitiveness using big data analysis. As in the process industry, this digital transformation is an urgent task for safe and stable operation, productivity improvement, and work style reform. However, in plant operation, the operation diary, which is an important record for operation, is created by handwriting or Excel document, etc., and it is necessary to promote the digitalization of the operation site first.

In this connection, TMEIC is forwarding PlantLogMeister, a system that can collectively manage data related to plant operations using a unified database of this operation diary. The implement of this system will contribute to higher work efficiency, faster troubleshooting, realization of technology transfer, and work style reform at the operation site.

In this article, we are focusing on the diary function, which is the basic package, and introduce examples of applying PlantLogMeister including three topics the author participated in the development.

### **Remote Automation Project Service (RAPS)**

-A New Project Methodology in the Era of Uncertainty-

Takashi Kai

Honeywell Process Solutions Honeywell Japan Ltd.

With new threats impacting business on both local and global scales, companies are adapting rapidly during these unprecedented and challenging times. One aspect borne out of this is the capacity for project teams to work remotely while ensuring productivity – a situation that may well be normalized to varying degree for the foreseeable future. This brings a range of issues and challenges when it comes to delivering automation projects on time.

To help address this, Honeywell Remote Automation Project Services (RAPS), rooted in LEAP methodology with enabling technologies, is well placed in providing end to end capabilities for Design and Implementation, through to carrying out Remote FAT and Assisted Remote Commissioning.

This paper will provide the basis and the many benefits that RAPS brings, including:

- Gaining flexibility in the project schedule
- Efficient allocation of global resources and expertise
- Improvements in quality and avoid rework/repetition
- Significant reduction in travel costs
- Rapid checkout of target system during FAT



## **Transition to Smart Factory with Data Integration & Visualization**

Takuya Maekawa, Ryohei Watanabe and Soon Hin Loo  
Voith Turbo Co., Ltd. BTG Japan

“Smart Factory” means an advanced factory that has implemented “Industry4.0”. In other words, “Smart Factory” is a factory that can create a new added value by the “Data Integration & Visualization” with collecting all of operational & quality data thru IoT and utilizing & analyzing the causality of these data.

It is undeniable that the pulp & paper industry has fallen a step behind other industries on the realization of “Smart Factory” although it has accelerated in various industries in recent years. It can be said that the “Smart Factory” is indispensable to find the solutions against the shrinking market, fast change in the market trend, human resource issue, and remote management that will happen in the pulp & paper industry in the near future.

At present, it takes a huge time and labor to collect and analyze data as the operation, quality, and cost information are provided by the different devices & resources, and this is the cause to hinder the quick decision and accurate judgement. In this article, we will introduce dataPARC provided by BTG Capstone that is a leading-edge & user-friendly system for “Data Integration & Visualization”.

## **Proposal of a New Production System with Flexibility and Robustness Corresponding to Changes in the Manufacturing Environment**

Kazutaka Fujita, Keiji Sato  
Yokogawa Solution Service Corporation

Customers have many missions, such as maintenance, KAIZEN activities and trouble shooting. Manufacturing sites are required to operate more flexible and robustness since customers must not only execute their missions every day, but also respond to changes in the manufacturing environment. To resolve such issues, a paradigm shift of the process management method equivalent to the invention of DCS is necessary.

In this paper, we propose a new production system that has the flexibility and robustness to respond to changes in the manufacturing environment. This white paper outlines the business model, functional model, and system architecture to realize this new production system, and introduces an example of a "hypothesis verification type" workshop conducted with Nippon Paper Group.

## **Example of Using a Sign Detection System in a Power Plant -Equipment Diagnosis and Operation Support Using AI-**

Atsuhiro Kumagai  
Ishinomaki Mill, Nippon Paper Industries Co., Ltd.

In recent years, many systems and tools that utilize AI (Artificial Intelligence) have been put into practical use, but there are few cases of introduction in manufacturing plants. This time, at the Ishinomaki Hibarino Power Plant of Nippon Paper Ishinomaki Energy Center Co., Ltd., we introduced a sign detection system using AI, which could be used as an effective tool for detecting signs of equipment abnormalities and supporting operations.

In this presentation, we will report on these cases.

## **Introduction example of automatic product transfer equipment using an automatic guided large clamp vehicle**

Hiromasa Kondo  
Mishima Mill, Daio Engineering Corporation

The Kawanoe Mill of Daio Paper Co., Ltd. was restarted in October 2018 with the latest equipment as a production base for sanitary paper. Equipped with a Crescent Former paper machine (KN1M/C), toilet winder, tissue interfolder, and ply machine, it produces tissue paper and toilet paper and ships 54,000 tons annually.

The Kawanoe Mill incorporates a wide range of automation, centrally manages papermaking instructions, production control, quality information, and shipping, and automates each production process.

In this paper, we will introduce in detail the automatic guided large clamp vehicle, which is one of the latest automation processes introduced at the Kawanoe Mill.

## **IoT transformation for Lifecycle business**

Kazuhiro Funa  
P&S sales department, Voith IHI Paper Technology Co., Ltd.

Voith IHI is focusing on spare and consumable parts business including maintenance service. In this article, we introduce WebShop, SmartBasket and OnCall\_Video which is life cycle management system using IoT technology.

WebShop system has been already started up. You can get quotation only in 20seconds, check delivery schedule and order as well. This WebShop equipped with search function as well as operation manual for each devices, which help you to specify the parts. This WebShop can link with smart basket which is an inventory system of basket. Also possible to link with OnCare Asset which is Voith's asset management system.

OnCall.Video is an audio-visual communication system that enables worldwide access to Voith's expert knowledge via an internet-based video collaboration platform. With this service you can be supported by real-time analyses anytime. Furthermore, this solution also offers many valuable use cases for improving internal communication. OnCall.Video enables the expert to see in real time exactly what you see at the paper machine, to display relevant information and drawings and thus provide concrete instructions and assistance.

## **Cooperative Optimization Control Solution for in Paperboard Process**

Atsushi Toyoda  
IA-PS Analyzer Center P&W Solutions Dept., Yokogawa Electric Corporation <sup>\*2</sup>

With the aim of improving the pulp and paper manufacturing process, we have released a Cooperative Process Optimization solution service in 2019. This paper will first describes the data collection and analysis service, which is the main part of this service. This paper then presents a case study of a paperboard machine.

## **Valmet products which have both improved safety and better workability**

Kiyoshi Yaguchi  
Valmet K. K.

There is one famous theory as known as Heinrich's Law: For every accident that causes a major (1) injury, there are (29) accidents that cause minor injuries and (300) accidents that cause no injuries. For avoiding a major accident, it is necessary to eliminate with this at near-miss stage when an accident or disaster is predicted. In the background of major accidents there is a stack of small near-misses. Thus, small risks that could lead to serious accidents must be eliminated in advance thorough 5S, Kaizen activities, near-miss reporting, regular safety patrols.

On the other hand, depending on the type of work, the safety depends on the equipment used for work, so there is something that cannot reduce the risk of an accident just by paying attention to safety. In order to achieve zero accidents, it is necessary to update equipment, which may result in investment costs. However, productivity and working conditions improve when processes become safe. In other words, it is no exaggeration to say that efficiency and safety are closely related, and safety will make profit. On this report, equipment that achieves improved workability while ensuring improved safety are introduced.

## **Revolutions in the history of civilization induced by paper**

### **Part 2: From bamboo and wooden slips to paper -Invention in China**

Kiyoaki Iida

In China, written characters came into use in the 11th century B.C. , and successive dynasties wrote their histories on bamboo and wooden slips insistently. In the fifth century B.C., the genres of philosophy and literature were invented. Bamboo slips were used by those concerned to discuss their opinions and record their outcomes, and helped develop a new kind of culture. Bamboo scrolls, however, were very bulky and person's knowledge was expressed as an equivalent volume of a number of loaded carts.

Then, Cai Lun invented a new paper making process in 105. He made use of bast fiber such as paper mulberry and hemp instead of wasted textile products in an old method, and produced paper of high quality. He was credited for the invention and its spread in the country. His paper gradually replaced bamboo slips, due to its easier handlings, higher recording density and probably less cost.

As civilization developed and population grew, the demand for paper increased for which fiber supply got short. A complement was bamboo, which gradually replaced paper mulberry itself. Bamboo, after repeated retting in water and boiling in solution containing wood ash, could be pulped with pounding, though more times of repeating were required than those for paper mulberry. Bamboo paper could be manufactured in a larger scale, due to its abundance in resource, and would be competitive in cost to that of paper mulberry. Bamboo fiber is thinner and shorter, and is formed to a sheet of smoother surface. Wood block printing became popular in the Song dynasty and was at its peak in the Ming and the Qing dynasties, and would prefer bamboo paper because of its better printability.

## CONTENTS

### Welcoming New Employees

- 1 Introduction of Paper Feeder.....Hiroaki Fukasawa
- 6 Latest Pulping System for Waste Paper  
—Continuous Detrash System—.....Yoichiro Iwatani
- 10 Improved Sizing and Machine Efficiency Using a Novel, Simplified Approach  
.....Stephen Marrou, William Johnson and Laura Sherman
- 17 Operating Experience of Surface Coated Dryer Cylinder at PM9  
.....Ryoichi Nagai
- 21 Process audit for Stock Preparation System.....Masamori Tanaka
- 25 Analysis of Factors Causing the Increase in Paper Strength Agent dosage in  
Summer.....Keita Anoyama, Yukinori Kobayashi and Manabu Yamamoto
- 30 Report on the Results of the Fiscal 2020 Follow-up Survey on “JPA’s Committed  
Action Plan for a Low Carbon Society” and Related Information on Measures  
against Global Warming in the Japanese Paper Industry.....Yasuharu Sakina

### Topics & Information

- 48 An Essay on Methodology for Innovating “*JAPAN TAPPI JOURNAL*”  
Part 10 : The Reason for Existence of Paper as viewed from Contemporary Philosophy  
.....Fumihiko Onabe
- 52 Revolutions in the History of Civilization Induced by Paper  
Part 3 : The Clay Tablets That Inscribed the History of Mesopotamia.....Kiyooki Iida
- 60 Three Paper Scrolls, the Most Important Treasures Preserved in the Shosoin for  
1300 Years.....Naohiko Tsujimoto

### Introduction of Research Laboratories(139)

- 68 Biomass structure and function laboratory, Institute of Agriculture, Tokyo  
University of Agriculture and Technology

### Research Report (Original Paper)

- 71 Effects of Soluble Anthraquinone Application on Prehydrolysis Soda Cooking of  
*Acacia crassiparva* Wood.....Syelvya Putri Utami, Keishi Tanifuji, Augusta Samodra Putra,  
Akiko Nakagawa-Izumi, Hiroshi Ohi and Evelyn Evelyn

### Pulp and Paper Mills in Japan(89)

- 85 Sobue Mill, Oji Materia Co., Ltd.

- 03 Committee report
- 70 Essay on Intellectual Property
- 90 Papyrus
- 92 Industry News (Domestic and International)
- 96 List of Patents issued and Laid-open Publication
- 105 Price list of Domestic Logs and Wood Chips by District
- 106 Other Monthly Statistics
- 108 News from the Association

### **Introduction of Paper Feeder**

Hiroaki Fukasawa

Paper Machinery Engineering Dept., Kobayashi Engineering Works, Ltd.

Tail threading systems and equipment has been developed over the years to be able to automatically thread the tail wherever an open draw occurred from one section to the next section of the machine. Some eighty years ago the rope threading system was introduced to thread the dryer section, calender and reel. Approximately sixty years ago the vacuum belt was introduced for threading systems at the dry end. The airfoil application was developed by Crown Zellerbach fifty some years ago.

The core parts of the paper feeding system introduced here are made in-house by utilizing the process know-how and skills accumulated over many years in the Japanese paper industry. This combination has succeeded in the epoch making improvement of tail handling system for whole parts of paper machine.

### **Latest pulping system for waste paper - Continuous detrash 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 China. 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.

### **Improved Sizing and Machine Efficiency Using a Novel, Simplified Approach**

Stephen Marrou, William Johnson and Laura Sherman

Nalco Water, an Ecolab Company

Sizing is a critical specification for paper grades across a wide range of industry segments, providing important liquid resistance to the manufactured paper or paperboard. Despite innovations that have occurred over the last few decades, there is still a need to enhance sizing performance and machine efficiency while reducing chemical requirements and minimizing program complexity. To address these needs, this paper outlines the development of a unique alkenyl succinic anhydride (ASA)-based sizing offering which provides best-in-class size performance while simultaneously reducing shipping & inventory logistics. This new technology enables the papermaker to maximize the efficiency of their sizing program while minimizing overall chemical use and simplifying the storage and handling of related size chemistries.

### **Operating Experience of Surface Coated Dryer Cylinder at PM9**

Ryoichi Nagai

No.7 Production Department, Niigata Mill, Hokuetsu Corporation

PM9 at the Niigata Mill started commercial operation in September 2008, and is producing mainly A3 coated paper as a wide, high-speed, and light weight papermaking machine. Taking advantage of this wide and high-speed process, PM9 continues to grow with the goal of being a machine with high productivity and cost competitiveness.

Twelve years have passed since the commercial operation of PM9 started, and due to the aged deterioration of equipment, operation and quality issues have come to occur. Among them, the deterioration of the surface of the dryer cylinder caused a decrease in operation efficiency and product quality. In 2017 and 2018, the surface coating of the dryer cylinder was applied for two periods. In this paper, the operating experience before and after the dryer surface coating is introduced.

## **Process audit for Stock Preparation System**

Masamori Tanaka  
Voith IHI Paper Technology Co., Ltd.

The service of audit for Stock Preparation System provides several benefit to optimize the condition of system and machine. After condition check is done, a report is provided which include the result of investigation and recommended counter action depends on priority. The merit of this audit is to clarify the cause of problem not only from single machine but also from whole process of system, and it enables to minimize necessary counter action and its workload and maximize the performance of counter action. The service of audit is also useful for planning of maintenance and it enhances more stable operation without troubles. This service is available for the system with several type of raw material and also for each single machines.

## **Analysis of Factors Causing the Increase in Paper Strength Agent dosage in Summer**

Keita Anoyama, Yukinori Kobayashi and Manabu Yamamoto  
Pulp and Paper Innovation Center, Innovation Promotion Division, Oji Holdings Corporation

The annual amount of paper strength agent in the paperboard machine has been significantly fluctuating in recent years. In particular, the volume of paper strength agent increases in the summer season. Consequently, the total cost goes up while making the corrugated boxboard.

In this report, we analyzed the factors related to the variable dosage, focusing on three viewpoints such as material strength, sheet formation and wet-end in A factory. Although the material strength was not affected, the paper strength decreased due to the worse wet-end condition and sheet formation when the dosage of paper strength agent rose. It was found that the main root causes were the decrease in efficiency of chemical additives following the deterioration of the wet-end conditions and the worse sheet formation caused by the rapid de-watering.

## **Report on the Results of the Fiscal 2020 Follow-up Survey on” JPA’s Committed Action Plan for a Low Carbon Society” 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 2012, JPA newly started “the Action Plans towards a Low Carbon Society” and has been actively addressing global warming prevention in order to achieve the following targets set in the plan:

- Compared to BAU scenario(based on specific CO<sub>2</sub> emission rate of 2005), reduce fossil energy-derived CO<sub>2</sub> emissions by 1.39 million tons by fiscal 2020 .
- In view of securing forest resources and increasing forest carbon sink, expand forest plantation areas owned or managed by the paper industry at home and abroad to 700 thousand hectares by fiscal 2020.

According to the results of the fiscal 2020 follow-up survey (actual results for fiscal 2019), fossil-energy derived CO<sub>2</sub> emissions in fiscal 2019 was 16.58 million tons, a 4.9% reduction compared to the fiscal 2018(17.42 million tons). Compared to BAU scenario, fossil energy-derived CO<sub>2</sub> emissions were reduced by 3.81 million tons, achieving the target of 1.39 million tons reduction by fiscal 2020.

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, outline of the next phase of JPA’s Action Plan for Low Carbon Society spanning the ten-year period from fiscal 2021 through 2030 and the latest information of countermeasures against global warming.

**An Essay on Methodology for Innovating “JAPAN TAPPI JOURNAL”**  
**Part 10: The Reason for Existence of Paper as viewed from Contemporary Philosophy**

Fumihiko Onabe  
Professor Emeritus, The University of Tokyo (Paper Science)

From the birth of ancient Greek philosophy to the present, “existence” or “raison d’être” keeps the position of significant major topics in philosophy.

The tenth article of this series is intended to analyze the meaning of existence of paper mainly along with the post-war French philosophical traditions. The overall contents are described as below.

1. Introduction
2. Existence and birth of paper
3. Genealogy of contemporary philosophy and understanding of paper
4. Paper media capable of remaining the evidence of human process of thought
5. The reason of existence of paper in the digital era
6. The essential areas indispensable of paper in human life
7. The trend of contemporary philosophy and new focuses on “intelligence of object”
8. Epilogue

**Revolutions in the history of civilization induced by paper**  
**Part 3: The Clay Tablets That Inscribed the History of Mesopotamia**

Kiyoaki Iida

Sumerian in Mesopotamia began to use clay tablets for recording their cuneiform letters in the age earlier than 3000 B.C. The clay tablets were used until the third century B.C. when the Orient and the Mediterranean regions became integrated, and papyri and parchments took over them.

The successive dynasties in Mesopotamia consistently recorded their histories in clay tablets with their cuneiform letters, and kept them in libraries and storage houses. When libraries were destroyed and burnt down, clay tablets were incinerated and remained in ruins. Since 1800, they have been excavated, which is more than half a million pieces in number. With those lots of remains, their letters have now been deciphered and their societies and cultures are being unraveled.

In about 3000 B.C., the recorded in clay tablets were administrative documents and vocabulary texts, which suggests that dynasties administrated with letters. In around 2600 B.C., transactions of estates and houses were recorded, and literal texts such as epics and tales appeared. In about 2300 B.C. sealed documents and letters were inscribed. In 2000 B.C. legal systems were in order. In 500-1000 years after they got letters and recording medium in hand, their community was civilized with literature and philosophy.

As they became familiar with letters in Mesopotamia, they used wax tablets that was rewritable and papyri, other than clay tablets, and enjoyed civilization based on letters.

**Effects of Soluble Anthraquinone Application on Prehydrolysis Soda Cooking of *Acacia crassicarpa* Wood**

Syelvya Putri Utami, Keishi Tanifuji, Augusta Samodra Putra, Akiko Nakagawa-Izumi,  
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Graduate School of Life and Environmental Sciences, University of Tsukuba

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*Acacia crassicarpa* has a potential source as a renewable forest material in Indonesia. This research clarified the conditions to produce dissolving pulp with suitable properties from *A. crassicarpa* wood by prehydrolysis at 150 °C for 3 h and soda cooking at 160 °C for 3 h with application of 0.1% soluble anthraquinone (SAQ: 1,4-dihydro-9,10-dihydroxyanthracene sodium salt). The presence of SAQ in soda cooking exhibited a significant increase in pulp yield (1.8%) compared to kraft cooking at a given kappa number (approximately 11). The bleaching ability of the soda-SAQ pulp in elemental chlorine-free process with peroxymonosulfuric acid (O-D<sub>0</sub>/P<sub>sa</sub>-E<sub>p</sub>-D<sub>1</sub> sequence) was sufficiently good for dissolving pulp properties. The α-cellulose content, brightness, viscosity and ash content were 94.1%, 88.1% ISO, 10.3 mPa·s, and 0.02%, respectively.

## CONTENTS

### Biomass/Deplasticization

- 1 The Biorefinery Status of Nippon Paper Industries, Gotsu Mill  
—Old and New Business Model—.....Yuki Kokufu
- 5 Eliplapaper  
—Eco-friendly Product Alternative to Plastic—.....Toru Ikeda
- 8 Development of the Consistent Chemical Production Process from Woody Biomass.....Ayumu Tagami
- 12 Development of Water Based Emulsion for Paper Coating that Achieve Reduction of Plastic Usage.....Yasushi Fujiwara

### Topics & Information

- 17 Odor Analysis of Paperboard Mills.....Sho Misawa
- 22 Insect Characteristics to Consider for Design of Effective Insect Control Measures.....Tomohiro Ohba
- 27 An Essay on Methodology for Innovating “*JAPAN TAPPI JOURNAL*”  
Part 11 : The Reason for Existence of “*JAPAN TAPPI JOURNAL*” as viewed from Its Readers Standpoints.....Fumihiko Onabe
- 30 Revolutions in the History of Civilization Induced by Paper  
Part 4 : Papyrus That Enriched Civilization in Egypt, Greece Rome.....Kiyoaki Iida
- 37 Research Projects of Universities and Government Research Institutes  
.....Wood Science Committee, JAPAN TAPPI
- 44 Corporate Profile & Product Information (46)  
C.T.TAKAHASHI CO., LTD.

### Research Report (Original Paper)

- 49 Development of a Novel Method to Distinguish Poor-recyclable Prints and the Application of the Method for Field Survey  
.....Hirohiko Koizumi, Moe Fuchise-Fukuoka, Takanori Otsuhata and Shisei Goto

- 03 Committee report
- 48 Coffee break
- 65 Papyrus
- 71 Industry News (Domestic and International)
- 75 List of Patents issued and Laid-open Publication
- 84 Price list of Domestic Logs and Wood Chips by District
- 85 Other Monthly Statistics
- 87 News from the Association



**The biorefinery status of Nippon Paper Industries, Gotsu Mill  
-Old and New business model-**

Yuki Kokufu

Gotsu Mill, Nippon Paper Industries Co., Ltd.

Effective use of bio-derived resources, especially wood, have attracted worldwide attention in recent years. Nippon Paper Industries' Gotsu Mill is the sole sulfite pulp plant in Japan and has been manufacturing various products from wood using our unique biorefinery technology.

Cellulose, hemicellulose and lignin are three main components of wood and they can be separated with sulfite cooking. The Gotsu Mill uses all of them effectively to manufacture wide range of products. Cellulose obtained as sulfite pulp can be used as a raw material to produce cellulose derivatives. We have also produced powdered cellulose, carboxymethylcellulose (CMC) and cellulose nanofibers from sulfite pulp. Decomposed products of hemicellulose derived with sulfite cooking are used as a nutrient source to produce yeast. Lignin is converted to lignosulfonates with sulfite cooking and lignosulfonates can be used as dispersants and/or binders. We also use a part of hemicellulose and lignosulfonate dissolved in black liquor as fuel to generate energy.

With such wide range of wood-derived technologies and products, Gotsu Mill has been practicing old but new biorefinery business for almost 70 years. We will continue to provide a wide range of products and services that take advantage of the outstanding properties of wood.

**Eliplapaper  
-eco-friendly product alternative to plastic-**

Toru Ikeda

Kani mill, Daio Paper Corporation

Plastic is used as a light and durable material in various forms around us, but in recent years its environmental impact has been drawing attention, and the flow of deplasticization has become active. Under such circumstances, the importance of paper has been recognized again.

We have started to sell "Eliplapaper" as a paper alternative to rigid plastic. Eliplapaper is a high-density cardboard that has rigidity close to that of plastic. In addition, it has excellent biodegradability and is a product with a lower environmental load than plastic.

**Development of the Consistent Chemical Production Process from Woody Biomass**

Ayumu Tagami

Nippon Paper Industries Co., Ltd

Nippon Paper Industries joined the NEDO project "Technology development of Manufacturing Process for Non-edible Plant-derived Chemicals/ Development of an Integrated Process for Manufacturing Chemicals from Woody Biomass". In this project, we are developing a technology for separating major wood components, cellulose, hemicellulose, and lignin, based on the sulfur-free soda cooking. Lignin is one of the main components in the second most abundant bio-macromolecule after cellulose in nature.

This work summarizes the outcomes of project, especially product quality of lignins. We provided kg-scale of lignin products to chemical companies which derived from different batch of black liquor. The quality of products listed below, molecular weight, purity, solubility in acetone, and content of functional groups, are stable.

## **Development of Water Based Emulsion for Paper Coating that Achieve Reduction of Plastic Usage**

Yasushi Fujiwara

Technology Management Department, Resin Business Division, SEIKO PMC CORPORATION

Recently ocean plastic pollution has been highlighted, and the demand for 'reduction of plastic usage' is increasing worldwide. In Japan, the use of paper for products, including plastic straws and confectionery bags, has been promoted. Superiority of plastic to paper includes resistance/barrier property against liquid and vapor and processability derived from thinning/adhesiveness, etc. Polyethylene laminated paper products are widely used in making a composite of paper and plastic. However, since these laminated paper causes obstacles for recycling, European countries are requesting their manufactures to replace laminated papers with resin coated papers. Polyethylene laminate is a highly reliable material in terms of safety as has a coating film physical property that works excellently with various resistances and processabilities, and is used for food packaging paper, etc. We have developed an emulsion for paper coating that replaces polyethylene laminate, for the use of paper instead of plastic. Regarding 'performance', we focused on water resistance, oil resistance, moisture-proofness, and heat sealability. Regarding 'safety', we studied the conformity with the US FDA (Food and Drug Administration) CFR (Code of Federal regulations) Title 21. Among the studies, we have succeeded in developing a water based emulsion for paper coating that shows a comparable level of performance to that of polyethylene laminate. In this report, we introduce styrene acrylic type 'HIROS-X·NE-2260', which conforms with the FDA and has a wide application range for overseas inventories, wholly acrylic type 'HIROS-X·PE-2273' with excellent characteristics in heat sealability and without usage restriction by the FDA, and 'XP8812', a coating agent for paper processing, having moisture proofness and heat sealability.

## **Odor Analysis of Paperboard Mills**

Sho Misawa

Material Analysis Center, Innovation Promotion Division, Oji Holdings Corporation

In 1971, the Offensive Odor Control Law was enacted to control offensive odors generated in the course of business activities at mills or other places. The Offensive Odor Control Law has regulation on site boundary line, emission gas, and discharged water.

At our group company's paperboard mill, odor of paper and sludge smelled sometimes around the area of the boundary line. Odor analysis was carried out and odor level, odor causing substances and locations of odor occurrence were researched. As a result, sulfur substances contained in the gas of the boundary line and discharged water were under the regulation standard. Odor of paper smelled from gas taken at the north site boundary line, and longifolene and longicyclene which has characteristic of odor of paper were detected by Adsorbent Collection-Thermal Desorption-Gas Chromatography Mass Spectrometry. Gases were taken from the wastewater treatment facilities, and odor of sludge was smelled. Hydrogen sulfide which has characteristic of addled egg like odor was detected by GC at relatively high concentration. Also, longifolene and longicyclene were detected at relatively high amount. Hydrogen sulfide, longifolene and longicyclene were specified as odor causing substances. The wastewater treatment facilities were specified as the locations of odor occurrence of the odor causing substances. These were thought to be carried by winds to the area around the boundary line and caused odor of paper and sludge.

The odor from mills can cause unpleasant and disgusting feelings to people who live around mills. Hence, odor analysis is needed. Odor is needed to be controlled when manufacturing paper and we move forward business activities harmonizing with the environment by odor analysis.

## **Insect characteristics to consider for design of effective insect control measures**

Tomohiro Ohba  
Earth Environmental Service Co., Ltd

In order to design effective insect control measures, it is important to consider where and what kind of insects will be a problem in your factory. It is not known that the measures that were effective at other factories are effective. It is necessary to take measures that are appropriate to the problems of your own factory. Before planning concrete measures, it is necessary to carry out a risk assessment.

It is useful to understand the characteristics of insects when risk assessments and designing insect control measures. Insects respond variously to environmental factors such as temperature, light, air flow, and odor. There are also variations in insect habitat and individual size. In this report, we summarized the main characteristics of flying insects that are likely to cause problems in paper mills. Then, we discussed the precautions for designing insect control measures based on these characteristics.

## **An Essay on Methodology for Innovating “JAPAN TAPPI JOURNAL”**

### **Part 11: The Reason for Existence of “JAPAN TAPPI JOURNAL” as viewed from Its Readers Standpoints**

Fumihiko Onabe  
Professor Emeritus, The University of Tokyo (Paper Science)

The writing and reading are fundamental human mental behaviors. The eleventh article of this series is intended to analyze the relationship between journal's editor and readers with particular attentions on cognitive scientific theories. The overall contents are described as below.

1. Introduction
2. Reading and Writing
3. The objective of editor's side
4. The requirement of reader's side
5. A variety of perspectives required for readers
- 5.1 Phenomenon and Essence
- 5.2 Human characters and environments that determine the human way of thinking
- 5.3 Macroscopic and microscopic views
- 5.4 Short-term and Midterm or long-term views
6. Lessons learned from historical studies
7. Sensationalism and populism that affects on human evaluation on journal's articles
8. Roles of journals in transmission of information in contemporary society
9. Epilogue

## **Revolutions in the history of civilization induced by paper**

### **Part 4: Papyrus That Enriched Civilization in Egypt, Greece and Rome**

Kiyoaki Iida

Papyrus was developed as a recording media in Egypt at around 3000 B.C. and was used till the Roman age for about 4000 years.

Though the process of making papyrus was once lost, it was restored in the 20th century. The stem of papyrus is spitted vertically to thin pieces, about 40 cm long. After retting, they are laid parallel each other like a sheet. The other layer is put on them, its axis being rotated at the right angles to the lower. The composite is beaten to make some fibrization, pressed for dewatering and dried. Egyptian dynasties monopolized the product and got high return.

In Egypt, literature texts written on papyrus appeared in the 20th century B.C., after early administrative documents. Ostraca were also used to supplement papyrus in daily life.

Since the 10th century, Greece became dominant in the Mediterranean world, and used papyrus delivered by Phoenician as a media for their civilization. The Roman Empire succeeded hegemony in the region and still used papyrus from Egypt.

In the 3rd century B.C., parchment was developed which gradually took over papyrus and replaced it in the 5th century.

## **Development of a novel method to distinguish poor-recyclable prints and the application of the method for field survey**

Hirohiko Koizumi, Moe Fuchise-Fukuoka, Takanori Otsuhata and Shisei Goto  
Nippon Paper Industries Co., Ltd.

In recent years, the quality of recovered paper has been deteriorated due to an increase of materials to be avoided, such as prints with Ultra Violet (UV) curable ink. The aim of this paper is to develop a method which can easily and promptly distinguish those poor-recyclable prints from recovered paper, and to put the method into practical use in deinked pulp (DIP) mills. In order to achieve this purpose, first, the spectrum data of several kinds of prints were obtained by using the attenuated total reflection infrared spectroscopy (ATR-IR). Second, the recyclability of those prints was evaluated by lab-experiments. Third, a database was made by correlating the spectrum data and their recyclability, so as to develop the ATR-IR method. Finally, the ATR-IR method was applied to inspection of bales in DIP mills. By examining each print with ATR-IR apparatus, characteristic peaks were detected which helped to determine the type of ink. From the results of lab-experiments, the numbers of dirt speckles in DIPs from UV, UV varnish over coated, and polystyrene over coated prints, respectively, were much higher than those of conventional prints (oil-based ink). In case of using the ATR-IR method, those prints were distinguished more precisely compared with the conventional solvent detection method used in DIP mills. As for the application of the method for incoming inspection in the mills, it has turned out that there was a certain tendency to decrease incidence rate of dirt troubles in DIP production after the application.

## CONTENTS

### Energy Saving I

- 1 Report of the 25<sup>th</sup> Saving Energy Seminar.....Energy Committee, JAPAN TAPPI
- 3 Efforts to Save Power at the Woody Biomass Power Generation Plant, Sendai Mill.....Jun Wakamatsu
- 8 Operation Experience of High Efficiency Recovery Boiler (HERB)  
.....Katsuya Yoshida
- 13 Energy Saving by Reducing Refiner Operation Time.....Masahiko Ueyama
- 20 Example of Drive Load Reduction by Forming Fabric.....Kei Furutaka
- 25 Operational Experiences of Ecopump turbo blower.....Akio Kato

### Topics & Information

- 29 Activities for Reduction of Bleaching Chemicals in Sendai Mill  
.....Mitsuhiro Takata
- 34 Hachinohe Mill Air Compressor Energy Saving Initiatives.....Shoichi Ogata
- 38 High Concentration Evaporators and HERB Recovery Boiler-Energy Creation  
by High Concentration Evaporators  
—State-of-the-art Recovery Process Technology by Andritz—.....Masato Tsuchitana
- 42 Revolutions in the History of Civilization Induced by Paper  
Part 5 : Parchment and Vellum that Succeeded Papyrus.....Kiyoaki Iida
- 46 An Essay on Methodology for Innovating “JAPAN TAPPI JOURNAL”  
Part 12 : Bidirectionality of Information required for Qualitative Enhancement and  
Vitalization of The Journal.....Fumihiko Onabe

### Research Report (Original Paper)

- 51 Preparation of Raw Materials for Cellulose-nanofiber Blending Water-based  
Paints  
—Application of Soda-anthraquinone Cooking and Peracetic Acid Bleaching—  
.....Kengo Magara, Eiji Togawa, Satoshi Kubo and Tomoko Shimokawa

### Pulp and Paper Mills in Japan (90)

- 67 Gotsu Mill, Nippon Paper Industries Co., Ltd.

- 03 Committee report
- 49 Essay on Intellectual Property
- 50 Coffee break
- 73 Industry News (Domestic and International)
- 76 List of Titles in Foreign Journals Received by JAPAN TAPPI
- 79 List of Patents issued and Laid-open Publication
- 88 Price list of Domestic Logs and Wood Chips by District
- 89 Other Monthly Statistics
- 91 News from the Association

### **Efforts to save power at the woody Biomass Power Generation plant , Sendai Mill**

Jun Wakamatsu  
Sendai Mill, chuetsu Pulp & Paper Co.Ltd

Based on the FIT (Feed in Tariff) act enforced in July 2012, Chuetsu Pulp & Paper Co., Ltd. Sendai mill started a power generation business using 100% wood fuel as of thinning wood and general wood from November 2015. It was realized by taking advantage of the rich forest resources in south Kyushu and our traditional efficient wood harvesting system. The problems such as facility rising troubles and output reduction phenomenon were solved, total operation has been stabilized finally. After that we tried to reduce equipment's own power consuming ratio to maximize the external power sales volume. As a result of taking actions (1) installing appropriate inverter system, (2) replacement of fan and pump to the efficient type, (3) setting improvement of each system, the own power consuming ratio reduced from 10.7% to 10.1% and we achieved sales increase. In this paper we introduce the power saving method in the wood biomass generating facility's operation, implementation cases for each equipment and finally the result of electric power saving.

### **Operation Experience of High Efficiency Recovery Boiler (HERB)**

Katsuya Yoshida  
Mishima Mill, Daio Paper Corporation

Daio Paper Co. installed New High Efficiency Recovery Boiler at Mishima Mill, and the commercial operation was started from July, 2020. We have been operated this new Recovery Boiler with own know-how of the mill, and generated power has been supplied to power grid with Feed-in Tariff scheme.

The specialty of this new Recovery Boiler plant is to include new HD concentrator which concentrate heavy black liquor from 78 wt % DS to 85 wt % DS. The capacity of the new Recovery Boiler plant is 1,330 DS T/D without ash. The new HD concentrator is stand-alone evaporation unit which is completely separated from the existing Evaporation Plant. The new recovery boiler includes vertical air system, emulsion type liquor burner, and flue gas cooler etc. And also the composite tube is adopted at lower furnace for measures against corrosion.

The commercial operation of the power plant with black liquor was started from July 3, 2020. At the beginning of commercial operation, tuning of combustion was not enough. NOx in the flue gas was relatively high, and char-bet formation was not stabilized. But the boiler operation had been tuning to stabilize the boiler combustion to keep the contract power generation to the grid constantly. As the result, operation was stabilized from September 2020.

The new power plant with RB has been operated commercially for 8 months, and we have been concentrated to stabilize the operation. Our next targets; further improvement of smelt reduction ratio, increase of steam generation efficiency (boiler generated steam /black liquor dry solid), lower the water consumption, and 2 years continuous operation without SD etc...

## **Energy saving by reducing refiner operation time**

Masahiko Ueyama  
Saga Mill,Oji Materia Co.,Ltd.

Saga Mill, Oji Materia Co., Ltd. has three paper machines, Machine 1, Machine 4 and Machine 5. Almost 99% of product materials are used paper, so we are playing a part of Oji Materia as a resource recycling mill which is producing containerboards and special paperboards. Recently, the guidelines for paper dust has become stricter and we have been forced to deal with it. Under these circumstances, we have operated refiner which is used to adjust freenes in usual to make paper dust in materials finely divided. However, refiner consumes a large amount of energy such as 300kW and power consumption unit per 1 ton of the pulp has increased. Therefore, we have discussed how to reduce paper dust without operating refiner.

In this paper, we will introduce about energy saveing by revising the screen equipment in used paper pulp-treatment process.

## **Example of drive load reduction by forming fabric**

Kei Furutaka  
Technical Dept. PMC • EF In-House Company Nippon Filcon Co.,Ltd

A forming fabric is an integral component in the forming section of a paper machine. It has 3 functions: ① dewatering; ② formation; and ③ carry. The emphasis is on formation which directly affects paper quality. Paper grades can differ widely in weight from low to high gsm. Forming fabric performance must also meet requirements for dewatering and carry, which influence production grades.

The paper industry constantly seeks high-quality paper and increased productivity. Modern paper machines have been developed to accommodate much greater widths and run at higher speeds. Following demands of paper makers, forming fabrics have been developed to keep up with changing trends in paper manufacturing.

The world shares the common goal of developing a more balanced society with respect to economy and the environment, which is exemplified by the Paris Agreement to reduce greenhouse gas emission and Sustainable Development Goals (SDGs). The Energy Conservation Law in Japan is composed of standards that guide industry and society to supply energy with lower carbon emission along with energy savings.

Power generation in Japan is still partially dependent on burning fossil fuels, which emits significant CO<sub>2</sub>. We need to move to power generation sources which emit less CO<sub>2</sub>. Many paper mills have privately-owned electrical power facility because the paper industry consumes a great amount of electricity. Cogeneration systems have been developed utilizing medium and low pressure steam. By investing in fuel source change and energy saving, the Japanese paper industry's privately-owned power facilities emit less CO<sub>2</sub>.

Forming fabrics have already successfully reduced drive load. The Forming unit of a paper machine can consume up to a hundred million Japanese yen per month in electricity costs. Drive load reduction can have a positive impact on energy savings. In the past, forming fabrics designs achieved reduced drive load at the expense of fabric lifetime. Now, the latest fabric designs are able to reduce drive load without sacrificing fabric lifetime. This is a significant breakthrough in forming fabric technology and performance. Here we describe actual results of drive load reduction achieved by our new and improved forming fabric.

## **Operational Experiences of Ecopump turbo blower**

Akio Kato  
Yashio Mill, Rengo Co.,Ltd.

In recent years, the importance of corporate activities for the environment has been demanded, and our company has set a medium-term target of reducing CO<sub>2</sub> emissions to 26% below FY2013 levels by FY2030, with environmental efforts as the most important issue. To achieve this goal, the Yashio Mill has been actively introducing energy-saving equipment. However, regarding the vacuum system, the existing equipment had been using, and energy saving was not achieved at all. The eco-pump turbo is easy to adjust the vacuum, and there is a possibility that the power used in the vacuum system can be significantly reduced. This paper reports on the outline, operation experience, and energy saving effect of the eco-pump turbo that started operation in January 2020.

## **Activities for Reduction of Bleaching Chemicals in Sendai Mill**

Mitsuhiro Takata  
Sendai Mill, Chuetsu Pulp & Paper Co.,Ltd.

The pulp & paper industry has been facing a challenging situation of lower demand and pricing due to declining domestic population and shift from paper to digital media. This has forced every paper industry to look at opportunities of reducing their costs. Since pulp is the single largest cost in paper making, pulp mills have been forced to reduce their costs in turn. The kraft pulp production lines at Sendai mill of Chuetsu Pulp & Paper Industries has two lines – a continuous digester line (LBKP) and a batch digester line (NUKP, NBKP). The bleach plant with 3-stage bleaching (D<sub>0</sub>-EP-D<sub>1</sub>) was suffering from high bleaching chemical costs in addition to high brightness variability.

The two key factors responsible for these high costs were [1] The bleach plant does not have an Acid Stage (A-Stage) due to which uncontrolled and high carryover of hexenuronic acid (hereinafter called HexA) entered into the bleaching which in turn consumes higher Chlorine Dioxide (ClO<sub>2</sub>). [2] The bleach plant was overdosing bleaching chemicals & running higher brightness to remain safe with quality specifications.

To address the above mentioned challenges, Sendai mill installed a chlorine dioxide/peroxymonosulfuric acid combination dosing equipment on D<sub>0</sub>-stage in 2018, which has helped significantly. To further fix the challenges associated with manual process control, operator bias, and ability for bleach plant to handle incoming variability, a Model Predictive Control system (MACS) together with bleach load analyzers was implemented across the whole bleaching process in 2019. These projects have resulted into significant reduction in bleaching chemical costs and final brightness variability. This paper reports on details of these activities and obtained results.

## **Hachinohe Mill Air Compressor Energy Saving Initiatives**

Shoichi Ogata  
Mitsubishi Paper Engineering

In recent years, the importance of corporate activities with respect to the environment has been required, and the Mitsubishi Paper Mills Group is working to reduce total energy and fossil fuel energy consumption, making environmental efforts as an important issue. The power consumption of the compressor is said to account for a large percentage of the total power consumption at the manufacturing plant. In case of Hachinohe Mill, five compressors were constantly operating regardless of fluctuations in demand, so we needed to adjust the air pressure according to demand. Therefore, we decided to introduce the compressor number control system in order to reduce power consumption. In this paper, we report the energy-saving efforts and their effects by this control system.



**High Concentration Evaporators and HERB Recovery Boiler-Energy Creation by High Concentration Evaporators**  
**-State-of-the-art Recovery Process Technology by Andritz-**

Masato Tsuchitana  
Andritz K.K.

The modern kraft pulp mill is integrating fibroline processes, recovery processes. By upgrading or integrating a HD-unit into Recovery boiler can create more green energy and more efficiently from the black liquor. Andritz has the state of art for the integrating the mill process to produce more green energy from the HD-unit and Recovery boiler as the integrated one unit.

**An Essay on Methodology for Innovating “JAPAN TAPPI JOURNAL”**  
**Part 12: Bidirectionality of Information required for Qualitative Enhancement and Vitalization of The Journal**

Fumihiko Onabe  
Professor Emeritus, The University of Tokyo (Paper Science)

The relationship between the editor and readers is significant issue for innovation of journals. To keep symmetry of information in the journal will be attained by introducing bidirectionality in editing process.

The twelfth article of this series is intended to analyze the significance of bidirectionality of information and existence of critical spirits in the journal. The overall contents are described as below.

1. Introduction
2. Bidirectionality in communication
3. Bidirectionality and critical spirits
4. Critical spirits indispensable in the age of crisis
5. A paradigm shift in the Japanese paper industry and the necessity of critical spirits
6. A method for introducing bidirectionality in the Journal
7. Editorial engineering aiming for systematization of editing techniques
8. Epilogue

**Revolutions in the history of civilization induced by paper**  
**Part 5: Parchment and vellum that succeeded papyrus**

Kiyoaki Iida

Parchment and vellum were used more than 2000 years as writing media, are made of untanned skin of animals such as sheep, calf and goat. Vellum is the finest one made from young animals,

Animal skin had a long history of writing media. Then, in the 3rd century B.C., Egypt banned on the export of papyrus, main writing media at that time, to Pergamon. To cope with it, Pergamon developed mass production of parchment. The most laborious work in manufacturing is scraping skin, which is comparative to beating in paper and papyrus productions.

Compared to papyrus, parchment is thin, strong and written on both sides of a sheet, and can be formed to codex, though unstable to humidity change,

Parchment codices steadily substituted papyrus scrolls in Roman society. In medieval Europe, though paper spread in the region by way of Islam, variable books were still of parchment. Then, the Reformation turned Europe to society of paper.

## **Preparation of raw materials for cellulose-nanofiber blending water-based paints - Application of soda-anthraquinone cooking and peracetic acid bleaching -**

Forest Research and Management Organization  
Kengo Magara, Eiji Togawa, Satoshi Kubo and Tomoko Shimokawa

We have studied selected applications of cellulose nanofibers (CNFs) prepared via the wet fibrillation of pulp treated with cellulase in a bead mill. We observed that the weatherability of water-based wood paint can be improved when using CNFs as an additive in the undercoat paint (sealer). For the application, however, the low dispersibility of CNFs obtained from commercially available papermaking pulp caused a major problem while adding the CNF to the sealer. From a preliminary study, we established that a uniform blend comprising the CNFs and sealer needs low-viscosity CNFs prepared from a low-viscosity pulp. In this study, we used the soda-anthraquinone (AQ) cooking method to prepare a low-viscosity pulp for reducing the viscosity of the CNFs. The soda-AQ cooking and the following multistage bleaching with oxygen, peracetic acid, and alkaline hydrogen peroxide decreased the viscosity of the pulp to about 3 mPa·s, while brightness ranged from 73% to 81% ISO. Furthermore, the simplified process of single-stage bleaching with peracetic acid after soda-AQ cooking also resulted in a low-viscosity pulp (viscosity of 3.7 mPa·s) with a brightness of 73% ISO. From this result, we concluded that the process is appropriate for small-scale operations to produce CNFs for the specified small-scale industries with no experience in pulp production.

## CONTENTS

### Energy Saving II

- 1 Steam Reduction by the Applied Thermo-compressor to PM14 Drainage System  
.....Kanji Kobayashi
- 5 Development of LEDsystems Available Under High Temperatures and Humidities of Paper Dryer Hoods.....Yasuyuki Funagayama
- 10 Water Saving Activities at Niigata Mill.....Yousuke Namekata
- 14 Realization of Energy Saving in Factory Water Supply Equipment Through E-pump.....Nobuo Omura
- 18 Activities of Energy-conservation at Kumagaya Mill.....Tatsuya Miyazaki
- 23 The Activities for Energy Saving in Tomioka Mill.....Masafumi Nii

### Topics & Information

- 28 "Nano Adhesion Technology" and "Coating Reinforcement Technology" Solve "Trouble..." in the World.....Yohei Watanabe
- 31 Operating Experience of Automatic Tail Threading.....Mayumi Kawano
- 35 Water Treatment Comprehensive Solutions for Stable Operation by Kurita  
.....Yasuhiro Kagawa, Hiroki Katsura, Keiji Suruga and Takashi Saigusa
- 41 Revolutions in the History of Civilization Induced by Paper  
Part 6 : Silk Road, India and South-East Asia.....Kiyoaki Iida
- 50 An Essay on Methodology for Innovating "JAPAN TAPPI JOURNAL"  
Part 13 : New Possibilities of the Journal as Viewed from the Origin of Editing of  
Informations.....Fumihiko Onabe

### Introduction of Research Laboratories(140)

- 54 Institute of Wood Technology, Akita Prefectural University

### Research Report (Original Paper)

- 56 Examination of the Microminiaturization of Cellulose Composite Particles for Ink-Jet Printing Application.....Takashi Okuda and Yasushi Ozaki

### Pulp and Paper Mills in Japan(91)

- 71 Nakatsu Mill, Oji F-TEX Co., Ltd.

03 Committee report

75 Papyrus

83 Industry News (Domestic and International)

87 List of Patents issued and Laid-open Publication

96 Price list of Domestic Logs and Wood Chips by District

97 Other Monthly Statistics

99 News from the Association

### **Steam reduction by the applied Thermo-compressor to PM14 drainage system**

Kanji Kobayashi

Fuji Mill, Nippon Paper Industries Co.,Ltd

Nippon Paper Industries has set a target of "reducing total energy consumption by 1.0% year-on-year" as a measure against global warming as stipulated in the "Environmental Action Plan" based on the Nippon Paper Group's Green Action Plan. At the Fuji Plant various energy-saving activities are promoted and efforts are made to achieve the target, under the energy conservation promotion system through subcommittee activities for each manufacturing process.

In this paper, we introduce a case where steam saving could be attempted by installing an additional thermo-compressor in the pre-dryer of No.14 paper machine, which is a liner paper machine.

### **Development of LED systems available under high temperatures and humidities of paper dryer hoods**

Yasuyuki Funagayama

Kyoritsu Densyo Co.,Ltd.

The dryer process at paper mills is extremely harsh with a temperature of 90 degrees  $\pm$  5 degrees and a humidity of 90%. In the field test, typical LED lightings could be lit continuously for only several months because of abnormalities in the LED lighting and troubles in the power supply. Our company has been working on many experiments for several years and succeeded in commercializing LED lightings with the heat resistance of 70 degrees, but there was concern that the LED lightings and the power supply would be defective in the heat resistance range of 80 to 100 degrees. With the cooperation of Oji Materia from the spring of 2019, we have set the goal of "Development of Products with Heat Resistance of 100 degrees and Humidity Resistance of 95%" in the dryer hoods, and by breaking away from existing LEDs in terms of heat insulation system and durability. We have commercialized "Special Structure LED (Separated Power Supply Type)". We started the actual equipment test in May 2019 and achieved our first goal of 12 consecutive months of lighting. (As of December 20, it has been lit for 19 consecutive months)

### **Water saving activities at Niigata Mill**

Yousuke Namekata

Hokuetsu Corporation Niigata mill

HokuetsuCorp. has a "Minimum Impact" that minimizes all the burdens on the environment. So far, we have aimed to build a minimum impact mill by reducing CO<sub>2</sub> emissions as a measure against global warming, taking measures against air pollution, and taking measures against water pollution. In particular, the Niigata Mill, which is a core mill, has been actively implementing various initiatives and capital investment to lead all mills because of its large scale. The idea is the same for saving water. The Niigata Mill launched a water-saving project in December 2017, and all departments cooperated in water-saving activities. Introducing the content of the initiative.

## **Realization of energy saving in factory water supply equipment through E-pump**

Nobuo Omura  
GRUNDFOS PUMPS K.K.

Grundfos is a pump manufacturer based in Denmark with annual production of 16 million units worldwide and sales offices in 55 countries. The E-Pump, which we developed based on the principles of the SDGs adopted by the United Nations in 2015, is an energy-saving product that contributes to Goal 13: "Take concrete actions on climate change". The vertical, multistage centrifugal pump, which we launched for the first time in the world in 1973, is equipped with a pump controller that enables optimal operation, which contributes to energy conservation by optimizing not only wasteful water consumption but also the entire pump system. The E-pump integrates the functions of the control box into the pump, and can control the pump (constant pressure, constant flow, constant water level, constant temperature, etc.) via sensors and external input/output signals connected to the on-board controller. In this project, we use the constant pressure control and flow rate stop functions to utilize the volume control function, which enables us to control the required number of pump operations according to load fluctuations. As a result, the power consumption and CO<sub>2</sub> emissions of the water supply system in the plant were significantly reduced.

## **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 26% 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 installing gas engine cogeneration system and replacing RPF production equipment through energy services.

## **The Activities for Energy Saving in Tomioka Mill**

Masafumi Nii  
Tomioka Mill, Oji Paper Co., Ltd

The Tomioka Mill has set an energy saving target of "1.5% reduction in annual energy saving". Then, the entire mill is working in energy saving activities.

In recent years, the environment surrounding the Tomioka Mill, where paper for printing are the main products, has become increasingly severe, and energy saving activities is a major pillar supporting not only CO<sub>2</sub> emission but also profit of the mill.

In order to achieve energy saving targets and contribute to the mill profits, we are raising the awareness of all employees, and grass-roots activities are being continued, such as digging into past energy saving cases and horizontal deployment of energy saving cases from other mills.

In this paper, we will introduce our energy saving activities and examples at the Tomioka Mill.

## **"Nano Adhesion Technology" and "Coating Reinforcement Technology" Solve "Trouble..." in the World**

Yohei Watanabe  
Somay-Q Technology

Somay-Q Technology is a technology development laboratory that solves problems in the world. It is possible to reinforce and prolong the life of deteriorated concrete, iron parts, etc. using the "nano adhesion technology" and "coating reinforcement technology", which are the unique technologies of Somay-Q Technology. Somay-Q Technology can be reinforced only by painting without replacing the objects, so wasteful industrial waste is not generated. In addition, no replacement is required, resulting in significant cost savings. It is also widely used in niche fields such as floor paints that can be applied even with oil and rust preventive paints that do not require *keren* (Work to remove rust). We have many achievements already, and we are expanding not only to the private sector but also to public works.

## **Operating Experience of Automatic Tail Threading**

Mayumi Kawano  
Yashio Mill , Rengo Co., Ltd.

The Japanese population has been declining since its peak in 2008, and the labor shortage problem has emerged and started to become social issue. In order to allow diverse human resources to perform an active role, we are reviewing work styles from the viewpoint of long working hours and work-life balance. In addition, we are also trying to improve total factor productivity (TFP) in our company. As part of this, we are reviewing the work that requires a long time experience and promoting the installation of equipment that allow both new employees and women to handle paper machine easily.

In order to make our working environment better, we have installed the automatic sheet threading device that can shorten the threading time, secure operator's safety and enable everyone to do a good performance without experiences. This report introduces the outline of the automatic sheet threading system and the operation status after the installation.

## **Water treatment comprehensive solutions for stable operation by Kurita.**

Yasuhiro Kagawa, Hiroki Katsura , Keiji Suruga *and* Takashi Saigusa  
Pulp and Paper Industries Department, Kurita Water Industries Ltd.

Recent environment around paper industry has been changing, especially in regard to increasing paper recycle rate. It causes in fluctuation of furnish quality, that influence on machine running stability and paper product quality. In such a complicated situation, we focus on "water" used a lot in paper-making process to improve productivity.

In this report, we first describe the problems caused by changes in the raw materials used. Next, we will introduce effective microbial control methods that use a combination of inorganic slime control agents and aeration, optimal wet end control technology that follows changes in water quality, and water quality control methods that use S.sensing®. Then, we will report the case where the water quality control of the raw material process and the paper making process contributes to the stable operation of the entire factory including the drainage process.

## **Revolutions in the history of civilization induced by paper**

### **Part 6: Silk Road, India and South-East Asia**

Kiyoaki Iida

The paper which became common in the third and the fourth century in China was spreading westward via the Silk Road that was a trade route since ancient ages. The manuscripts, found at Loulan and written in the period between the third and the sixth century, consisted of a large volume of wooden slips and few paper documents. The Dunhuang, manuscripts which covered the age from the fifth to the eleventh century, were mainly paper documents. A large number of Buddha's texts copied on Kozo paper in Tang dynasty were there, along with documents written by several native kingdom tribes living along the road with their own languages. It suggests that native tribes developed their own languages and civilization based on writing with their own letters in the several centuries between the dates of the two manuscripts. The paper that became available might induce the move, which the Buddhism definitely helped. It made the area including China a common culture region.

The paper making in India started in the eighth century by way of Islam and grew big in the 15th century. Many Chinese Buddhist monks visited Nalanda in India to get original Buddhism texts. One monk described use of paper in Indian Buddhist society in the 7th century.

The sea lane which left the Southern China, turned round the Malay Peninsula, passed the Indian Ocean and arrived at the Arabia was the other important trade route, which some Chinese monks traveled. A monk reported that Sumatra Island was prosperous with Buddhism from India using paper from China in the 7th century.

## **An Essay on Methodology for Innovating “JAPAN TAPPI JOURNAL”**

### **Part 13: New possibilities of the Journal as viewed from the origin of editing of informations**

Fumihiko Onabe

Professor Emeritus, The University of Tokyo (Paper Science)

Returning to the starting perspectives of the editor and readers relationship, the significance of information in editing was analyzed. The significant points to be emphasized are that the readers as human being are collective entity or ensemble of a variety of huge and multiple information obtained innately and acquired during growth and learning processes. The thirteenth article of this series is intended to seek innovation of the Japan Tappi Journal based on the above notion. The overall contents are described as below.

1. Introduction
2. The editor and readers relationship as viewed from editing of information
3. A methodology for enhancing the reason for existence and the value of the Journal
4. The difference of the meaning between “editing” and “compiling” in editing process
5. A possibility of enhancing added values by relative increase of “editing”
6. General principles for enhancing attractiveness of the Journal
7. In search for a methodology for innovating the Japan Tappi Journal
8. Parallel use of the paper media and electronic media for the Journal
9. Epilogue

## **Examination of the microminiaturization of cellulose composite particles for ink-jet printing application**

Takashi Okuda, Yasushi Ozaki  
Research Institute, National Printing Bureau, Japan

Cellulose nanofibers (CNF) are expected to be a utility new material made by finely pulverized wood pulp. With the introduction of CNF, various functional materials will be able to be added to paper to enhance anti-counterfeiting technology.

In order to develop new functional papers, CNF and functional materials were mixed and treated in a spray dryer. As a result, it was possible to produce cellulose composites into which functional materials and CNF had been integrated.

In this study, ink-jet printing (IJP) techniques were applied to effectively fix cellulose composite particles on paper. For the purpose of discharging droplets of the cellulose composite particles with IJP, it was important that the particle size must be small and uniform. Three kinds of cellulose composite particles which were produced by using CNF of different degrees of disintegration were estimated for IJP.

The particle size of cellulose composite particles made from TEMPO-oxidized CNF was the smallest and the most uniform. However, the particle cellulose composites made from TEMPO-oxidized CNF were formed gel in water. Because of that, discharge liquid of IJP was prepared as the liquid based with solvent. Eventually, the cellulose composite particle droplets could be stably discharged with IJP and strongly fixed to the paper.

As it is possible to discharge droplets with IJP, this technique can be expected to be applicable in variable security fields in the future.



## CONTENTS

### Pulp

- 1 Report on 26<sup>th</sup> Pulping Seminar.....Pulp Technical Committee, JAPAN TAPPI
- 4 Organic Chemistry of Cooking and Bleaching Reactions.....Yuji Matsumoto
- 11 Application of Catalyst Technology in Pulping Process  
—Application Development to “Catalyzer-type Cooking Accelerator”—  
.....Takashi Tanaka, Toshio Yamada and Shun Iwayama
- 21 The Keenest Stock Preparation Technologies for Board Paper  
—Countermeasures for Worse Waste Paper Quality.....Jiro Urata
- 26 Diagnosis of Lime Kiln for Improvement Kiln Operation.....Kiyoshi Inoue
- 32 History about Steels Used for Equipment in Kraft Pulp Mills.....Masaharu Menjo
- 35 ANDRITZ A-Recovery+ Chemical Recovery Concept.....Kazunori Ohmori

### Topics & Information

- 40 —Keep Proposing Better Solution ! —  
A Breakthrough Chemical Approach to Operational Stability with NISSIN-PCM  
(Nissin Pitch Control Method), Which Has been Inherited Since Its  
Establishment.....Osamu Tanino
- 45 Revolutions in the History of Civilization Induced by Paper  
Part 7 : Korean Peninsula, Vietnam and Japan.....Kiyoaki Iida
- 49 An Essay on Methodology for Innovating “JAPAN TAPPI JOURNAL”  
Part 14 : Significance of Maintaining the Diversity in the Dual-natured Journal  
.....Fumihiko Onabe
- 53 The Next Japan Paper Association’s Target for the Recovered Paper Utilization  
Rate.....Tatsuyuki Okuda

### Research Report (Original Paper)

- 59 Safety Evaluation of Cellulose Nanofibers produced from Soda-anthraquinone  
Sugi pulp by Enzymatic Treatment and Wet milling  
.....Tomoko Shimokawa, Kengo Magara, Masanobu Nojiri and Noriko Hayashi

- 03 Committee report
- 57 Essay on Intellectual Property
- 58 Coffee break
- 76 Papyrus
- 82 Industry News (Domestic and International)
- 86 List of Patents issued and Laid-open Publication
- 96 Price list of Domestic Logs and Wood Chips by District
- 97 Other Monthly Statistics
- 99 News from the Association

### Organic chemistry of cooking and bleaching reactions

Yuji Matsumoto

Wood Chemistry Laboratory, The University of Tokyo

The basic understanding of delignification reactions was achieved almost half a century ago. However, it was not clarified until recently why the difference of wood species affects the easiness of delignification. Hardwood lignin and softwood lignin are different by the presence of syringyl type aromatic nuclei in the former. In addition, there are wide varieties in the lignin characteristics (structure and amount) depending on wood species, environment of growing site, portion in the wood, portion in the cell wall, and so on. However, clear tendencies were found to be observed in the variety of lignin characteristics by taking the syringyl/guaiacyl ratio as an index. We have shown that the lignin chemical structure has a significant effect on the chemical reactivity such as delignification during chemical pulping. In this report, I review the recent achievements of my laboratory about the quantitative relationships between lignin structure and reactivity.

### Application of catalyst technology in pulping process

#### -Application development to "catalyzer-type cooking accelerator"-

Takashi Tanaka, Toshio Yamada and Shun Iwayama

Functional Chemicals Development Laboratory

Product Development Department

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Nicca Chemical Co., Ltd

Recycling of waste paper is an important issue for environmental protection. In recent years, decreasing of demand for recycled pulp and shortage of waste paper as raw material have become serious problem due to decrease in the subscription volume of printed materials such as newspapers and magazines. The paper industry needs to consolidate recycled pulp equipment to adjust production volume. Among them, many efforts have been made to close the gap between the used paper collection rate and the used paper utilization rate. Therefore, there are now situations where even poor quality used paper must be used.

There are two significant quality problems in the deinking process of used paper. One is the problem of UV curable ink printed matter. In 2016, we combined surface science and catalyst science, and we proposed a "catalyzer-type deinking agent" that was excellent in miniaturization of the ink.

The other is a problem called pitch (dust, dirt) generated during the paper manufacturing process using used paper. There are many origins of pitch, such as the adhesive for postal slip, back glue and resins in coating agents.

In particular, used paper recycling plants are facing this pitch problem as often as UV curable ink problems. Thus, as the solution of pitch problem, the development of a new generation of pitch control agents has been required for many years in the paper industry.

This time, we have developed the "hydrolyze-type pitch control agent" that can accelerate the dissolution of pitch and prevent it from becoming huge by decomposing the resin by applying the catalytic technology used in the "catalyzer-type deinking agent".

On the other hand, in order to produce pulp from plant lignocellulosic materials such as wood, it is generally treated with alkali or sulfites for cooking. Pulp is produced by the cooking method, which remove lignin or natural resin components from lignocellulose material by dissolving, dispersing, decomposing, and filtering.

However, at present, reckless deforestation of natural resources such as timber is regulated due to environmental problems, and the price of timber is rising. Therefore, increasing pulp production per unit of raw wood and producing high quality pulp products have become more and more important.

As a method for solving these problems, a method using a cooking accelerator that enhances cooking efficiency is known. Furthermore, in recent years, a safer cooking accelerator has been demanded. This time, we have found that this catalyst technology can be applied not only to deinking agents and pitch control agents, but also to pulping processes from lignocellulosic materials.

In this paper, we introduce newly developed "Catalyzer-type cooking accelerator" that has the potential of pitch control effect as well as the cooking promotion effect in the cooking process.

## **The Keenest Stock Preparation Technologies for Board Paper - Countermeasures for Worse Waste Paper Quality -**

Jiro Urata  
AIKAWA Iron Works Co.,Ltd.

Due to a change in the Chinese recycle paper procuring policy, the amount of recycle paper exported to China from Japan has been fluctuated significantly, decreasing from 2,750 thousand tons in 2018 to 1,283 thousand tons in 2020. There is a marked tendency for recycle paper to be oversupplied in Japan.

On the other hand, from the middle of 2019, the demand from our customer, the paper mill, has been shifting from improving yield to energy saving, but recently, the desire to maintain the paper quality by using low-priced recycled paper has become conspicuous.

There are two ways to save energy, one is to achieve the target by simply reducing energy consumption, and the other is to increase the capacity of existing equipment and improve the power intensity.

Regarding the improvement of the power intensity and the use of low-priced waste paper, there is an overlap of strengthening the dust removal capacity compared to the conventional equipment. I will introduce the process that focuses on the pulping system, together with some case studies.

## **Diagnosis of Lime Kiln for Improvement Kiln Operation**

Kiyoshi Inoue  
Consulting Department, Taiheiyo Engineering Corporation.

TEC has developed techniques to diagnose more than 100 cement Kilns and to achieve energy-saving and to increase production.

By using the energy-saving techniques adopted in cement plants, TEC has conducted extensive study in Lime Kiln operation, achieved following successful results towards reduction of the fuel consumption and production increase.

- 1) Diagnosis of Lime Kiln : TEC have conducted a diagnosis study on Lime Kiln towards the existing process/operational problems and to found optimal countermeasures for reduction of the fuel consumption.
- 2) Replacement of existing Kiln Burner: By replacing the existing Kiln Burner with Taiheiyo's TMP Burner (Taiheiyo Multi-purpose Burner), has achieved improved burnability efficiency and reduction in the amount of primary air.
- 3) Adjustment of Lime Cooler: For the improvement of heat recovery efficiency of existing Lime Kiln Cooler, Grate Speed Control and Airflow Control was adopted to Lime Kiln Cooler, for better cooling efficiency.
- 4) Adjustment of Kiln Operation: TEC has conducted O<sub>2</sub> concentration control and the of raw meal filling ratio in the Lime Kiln have optimized.

As a result of adopting above countermeasures, 8% to 15% reduction of the fuel consumption is achieved.

## **History about steels used for equipment in Kraft pulp mills**

Masaharu Menjo  
Valmet K. K.

Most of Japanese Kraft pulping mills were installed between 30 and 40 years ago. Under the corrosion circumstances, the equipment is easily and gradually corroded and several anti-corrosion materials which are superior than original materials have been selected as a solution to stop further corrosion. For the opportunity of upgrading whole equipment, superior materials can be used as well.

There are various equipment and machines in Kraft pulping mills and the materials used for such equipment and machines also has a long history. Chemicals used for equipment and machines at fiberlines are generally clarified, thus, the selection of anti-corrosion materials (for example, Titanium alloy) is relatively easy. However, the materials used for continuous digesters has been always the same. That is the steel-based material. In this paper, the history of these steels will be focused and briefly described.

## **ANDRITZ A-Recovery+ Chemical Recovery Concept**

Kazunori Ohmori  
Andritz K.K.

Over the years, chemical recovery technology suppliers have worked with pulp mills to “close” the chemical recovery loops in order to reduce emissions and effluent – and also to increase recovery efficiency. These loop closures have sometimes led to a build-up of certain chemicals and the creation of side streams that are either ignored or disposed of.

A major target of ANDRITZ's recent development work has been to innovate solutions for utilizing the side streams of a Kraft pulp mill to unleash the hidden potential for generating profit, as what was once considered “waste” can be converted to valuable raw materials for commercial-grade bio-products. The objective continues to be operating chemical recovery systems as efficiently and environmentally sound as possible while minimizing capital investment and maximizing profits.

**-Keep proposing better solution ! -**

**A breakthrough chemical approach to operational stability with NISSIN-PCM (Nissin Pitch Control Method), which has been inherited since its establishment**

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

The paper industry is promoting the recycling rate and environmental load reduction to increase the utilization rate of used paper and to closed system, and it is exposed to an environment where pitch troubles due to sticky substances are likely to occur. In recent years, pitch troubles in the papermaking process have tended to increase and become more complicated due to a decrease in the amount of high-quality waste paper distributed due to restrictions on the import of mixed waste paper in China and an increase in the utilization rate of planted trees such as Akashiya. This is one of the troublesome issues for paper manufacturing engineers aiming for stable operation and quality improvement. Since its founding in 1931, we have proposed NISSIN-PCM (Nissin Pitch Control Method) as the most important way of thinking about pitch measures, and have been searching for new proposals for solving pitch problems to this day.

Among these efforts, we consider that it is the most important to take optimal pitch measures in the quality process, and believe that implementing local and necessary pitch measures in each process will lead to improved quality and productivity of paper products. In this paper, we describe our latest approach to pitch problem solving.

## **Revolutions in the history of civilization induced by paper Part 7: Korean Peninsula, Vietnam and Japan**

Kiyoaki Iida

China took the direct presence in Korean Peninsula in the first Century B.C., and the paper which became common in China was introduced there. The successive Korean Dynasties, Goguryeo, Baekje and Silla, received Buddhism along with its manuscripts, and nurtured their cultures written on paper. Though Chinese influence stayed strong, Korean culture progressed and invented Hangul in the 15th Century. Its traditional paper making process is very similar to the old Japanese process.

Japan imported Buddhism and paper by way of two routes (Goguryeo and Baekje). Around 600, it began to contact China in direct.

Vietnam was occupied by China for about 1000 years from 111 B.C. of which influence stayed long. In the 13th Century, it invented a writing system in which Vietnamese language was adapted to Chinese characters, and used it along with an older system. The writing system was standardized in 1945 after the revolution. Its traditional paper making process is very similar to the old Japanese process except it uses inner bark of dó tree.

The paper making process which had arrived at Japan grew to perfection as Washi. It is valued that Japanese culture written on paper expanded a new possibility of the function of paper.

**An Essay on Methodology for Innovating “JAPAN TAPPI JOURNAL”**  
**Part 14: Significance of maintaining the diversity in the dual-natured Journal**

Fumihiko Onabe  
Professor Emeritus, The University of Tokyo (Paper Science)

An organization of the Japan TAPPI has dual nature: i.e. industrial and academic. Therefore, maintaining the diversity in the management of organization as well as editing the journal is not easy task. The fourteenth article of this series is intended to analyze the problems stemmed from this nature and seek possibilities of maintaining the diversity based on the overseas documents (Finland and UK) and author's past experiences in Canada and France. The overall contents are described as below.

1. Introduction
2. Fundamental sciences vs applied sciences & technologies
3. Fundamental and applied sciences & technologies in the area of pulp and paper (Finland and UK)
4. UK's Fundamental Research Symposium focused particularly on fundamental sciences in the area of pulp and paper
5. The dual nature of the Japan TAPPI as briefly glimpsed from its research meeting business
6. Personal experiences on the relationship between fundamental research and applied research :an example in the area of Wet End Chemistry
7. Author's research experiences in Canada and France
8. Epilogue: dual nature & diversity

**Safety Evaluation of Cellulose Nanofibers produced from Soda-anthraquinone Sugi pulp by Enzymatic Treatment and Wet milling**

Tomoko Shimokawa, Kengo Magara, Masanobu Nojiri, Noriko Hayashi  
Department of Forest Resource Chemistry, Forestry and Forest Products Research Institute

Cellulose nanofiber (CNF) is a promising new material used in a wide range of industries. The application of soda-anthraquinone cooking of sugi (Japanese cedar) and subsequent nanofibrillation of the enzymatically treated pulp by wet milling enabled us to establish a simple integrated manufacturing process to obtain sugi-CNFs. However, there are concerns that the sugi CNF might be mutagenic or cause skin irritations; therefore, we tested these hypotheses. Acute oral toxicity test using mice showed no abnormality, with an LD<sub>50</sub> value of over 2000 mg/kg. Also, the sugi CNF was found to be non-mutagenic in the bacterial reverse mutation test. In addition, no anomalies were detected in the *in vitro* chromosomal aberration test using Chinese hamster lung fibroblast cells. Moreover, the CNF treatment of rabbits in dermal irritation or corrosion tests did not produce severe dermal irritation or corrosion or distinctive signs of toxicity. Erythema was observed in the site of 5wt% CNF application in all the tested animals one hour after the CNF application ended; however, erythema disappeared by the 48th hour. As a result, the sugi CNF was evaluated to be in the non-irritating category. According to the results from the guinea-pig maximization test, which predicts skin sensitization, the effect of the sugi CNF was classified as the weakest grade. In conclusion, the sugi CNF is unlikely to cause mutagenicity in organisms. In addition, the level of skin irritation caused by the sugi CNF is within the normal range of handling.



## CONTENTS

### Papermaking Technology I

- 1 Report of the 25<sup>th</sup> Papermaking Technology Seminar  
.....Papermaking Technology Committee, JAPAN TAPPI
- 4 History and Current Trends of Forming Fabrics.....Takashi Iwamura
- 12 Press Part of Basic Theory and Transition, Latest Trend.....Yoshiki Kabutoya
- 17 Performance and Effects of Thermal Spray Application to Various Wire Rolls  
—TS-03112  $\mu$  Which Greatly Extends the Life of Plastic Wire——.....Kimiaki Iwane

### Topics & Information

- 22 Operating Experience of Canvas Cleaning Equipment.....Tetsuya Saito
- 26 Latest Dryer Surface Cleaning Technologies.....Tsuyoshi Yoshino
- 31 Novel Combination Strategy of Branched-type Amphoteric Polyacrylamides for  
Paper Strengthening Agent.....Makoto Kobayashi
- 35 GOEBEL-IMS—IMS Technologies Group  
—Tailormade Slitter Rewinders for Specialty Papers——.....Shinichi Tanaka
- 40 Revolutions in the History of Civilization Induced by Paper  
Part 8 : Islamic Empire.....Kiyoaki Iida
- 49 An Essay on Methodology for Innovating “JAPAN TAPPI JOURNAL”  
Part 15 : A Futurological Perspective Required by the Journal.....Fumihiko Onabe

### Research Report (Original Paper)

- 54 Inkjet Printable Polypyrrole-ITO Conducting Inks  
.....Yukihiro Tsugita and Shuichi Maeda

### 62 74<sup>th</sup> JAPAN TAPPI General Meeting

- 03 Committee report
- 53 Coffee break
- 65 Papyrus
- 72 Industry News (Domestic and International)
- 76 List of Patents issued and Laid-open Publication
- 84 Price list of Domestic Logs and Wood Chips by District
- 85 Other Monthly Statistics
- 87 News from the Association

## History and current trends of forming fabrics

Takashi Iwamura  
Technical Dept. PMC • EF In-House Company Nippon Filcon Co.,Ltd

Forming fabrics are used at the forming section of a paper machine in the papermaking process.

The main functions of a forming fabric are: ① Dewatering pulp slurry; ② Dispersing pulp fiber and the creating the sheet; and ③ Transferring sheet from the forming section to the press section of a paper machine.

Before reaching the forming fabric, the pulp slurry consists of about 99% water and is mixed in Head Box. On the forming fabric the pulp slurry is dewatered, and it is transformed to sheet for paper products. As the sheet is transferred from the forming section to the press section, the sheet has a moisture content of about 80%.

It is said that the origin of forming fabric is very old. We have used forming fabric before Louis Robert of France invented the first continuity paper machine in the world in 1798. Early Forming fabric was first made of metal. Metal forming fabrics were still used until around 1975.

Later, plastic forming fabric was developed to aim for high productivity. Paper machines have evolved, increasing in size and speed to meet the current demand from the paper industry, aiming for high quality and high productivity. To meet the current demands of paper industry and the latest machines, forming fabrics have evolved as well.

In this session, we introduce the history of forming fabrics structure from single-layer to triple-layer, and their evolution alongside the advancement of paper machines. Finally, we present NIPPON FILCON's latest designs, including the cutting-edge "N" series for high speed paper machines.

## Press part of basic theory and transition, latest trend

Yoshiki Kabutoya  
Paper Technology, Valmet Japan

Situation of automatically paper machine operation with high speed ask more efficiency energy cost more stable operation. The main role of press part is removing wetting mechanically before dry part. This is very important because of the amount of water dewatered in the press part affects heat consumption and cost in the subsequent dry part. Further, when dewatering efficiency in press part is quite good, the strength of the wet paper is increased, and trouble due to paper break and wrinkles are less likely to occur. Paper quality also regarded important because it require less difference in density between top and bottom surface, and smoothness and bulkiness of surface.

In this section, according to the required role of the press part, I focus on changing the basic form of the press part and changing press type to improve water removal and operation. And introduce shoe press, equipment, latest trend.



## **Performance and effects of thermal spray application to various wire rolls -TS-03112μ which greatly extends the life of plastic wire -**

Kimiaki Iwane  
Tocalo Co., Ltd Sales Division

In the wire part of a papermaking machine, the wire roll (Wire roll, Breast roll, Drive roll) is usually a rubber cover roll.

Recently, ceramic spraying has been increasing. Rubber cover rolls cause uneven wear in 1 to 2 years due to friction with plastic wire. Uneven wear has an adverse effect on the life of the plastic wire, and it is necessary to replace the wire early at the papermaking site. As a remedy, ceramic spraying has been used for more than 20 years and has achieved a certain effect. However, the ceramic sprayed coating has a low coefficient of friction and easily slips with the plastic wire, and cannot be used for a drive roll. Therefore, the effect of improving the life of the plastic wire is limited. We started to develop special ceramic thermal spray coating (TS-03112μ) with high friction coefficient more than 15 years ago. After various evaluation tests with the cooperation of a wire manufacturer, the first roll was delivered to the on-top former drive roll in 2005. After undergoing various evaluation tests with the cooperation of a wire manufacturer, the first roll was delivered to the on-top former drive roll in 2005. As a result, it was proved that the slip ratio was equal to or higher than that of a rubber roll for a drive roll. As a result, it was proved that the slip ratio was equal to or higher than that of a rubber roll for a drive roll. Since then, TS-03112μ has been mainly used only for drive rolls, but its surface performance has also greatly contributed to extending the life of wires by adopting it for normal wire rolls and breast rolls. Many customers who have adopted TS-03112μ have reported that the wire life has reached 1.5 to 2 times.

## **Operating Experience of Canvas Cleaning Equipment**

Tetsuya Saito  
Kushiro Mill,Oji Materia Co.,Ltd

L-1 M/C in kushiro mill, Oji Materia, which produces linerboard 1,207 ton per day, is one of the largest linerboard machines in Japan. The linerboard of this machine is composed of three layers; bottom layer is formed by Fourdrinier, middle and surface layers are done by Belbond-former.

Although we had taken a variety of measures against paper sheet defects derived from sticky substances in dryer part to improve production yield, we had problems especially at the upper side of the first section canvas. As a countermeasure, we installed the “fabriKeeper” in May 2019 and have obtained good results. We will report consideration of introduction and our operating experience about this equipment.

## **Latest Dryer Surface Cleaning Technologies**

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

There are increasing problems of the dirt and rust due to the deterioration of the raw material quality and the unevenness of the dryer surface caused by a long-term usage. The dirt on the dryer causes the paper break, which leads to poor drying efficiency and uneven moisture profile. In addition, the removing the coating waste by hand is a time-consuming work and creates a health and safety issue. Furthermore, the improvement of product quality is more and more required, and the dirt removal from the dryer cylinder is therefore essential. This paper introduces the latest technology of the cylinder surface cleaning on the paper board making machines, specialty paper making machines, and tissue making machines.

## **Novel Combination Strategy of Branched-type Amphoteric Polyacrylamides for Paper Strengthening Agent**

Makoto Kobayashi

Research & Development H.Q., Paper Chemicals, Arakawa Chemical Industries, Ltd.

In recent years, recycling of waste paper and closure of water systems in paper machines have been progressing from the viewpoint of environmental protection. However, if waste paper is recycled, the strength of pulp fiber and the fibrils on fiber surface are reduced, and the strength of paper obtained from recycled pulp fiber is reduced. In addition, since the fiber length of the pulp is shortened, the freeness is reduced and the productivity is deteriorated. In order to supplement them, paper strengthening agent is essential at the time of paper making. As paper recycling and water systems closure progresses, fine fibers and dissolved electrolytes are accumulated in the papermaking system, leading to an increase in electrical conductivity. Under these circumstances, the internal paper strengthening agent cannot give an inherent flocculating and strengthening effect, because the ionic bonds between pulp and paper strengthening agents are blocked by dissolved electrolytic substances such as anionic trash.

We have internal paper strengthening agent suitable for high electrical conductivity, but we are not able to deal with sudden environmental change caused by increased usage of waste paper and seasonal factors meticulously. In order to solve these problems, we have developed a novel combination strategy by using two kinds of branched-type amphoteric paper strengthening agents which have different properties and adjusting their mixing ratio in accordance with changes of the papermaking condition.

### **GOEBEL-IMS – IMS Technologies Group -Tailormade Slitter Rewinders for Specialty Papers-**

Shinichi Tanaka

Itochu Machine-Technos Corporation

GOEBEL IMS is the world's leading provider of slitter rewinders for converting paper and board, tobacco, films, alum foil, aseptic packaging and other special materials. The range of products includes slitter rewinders and winding machines for the production and converting process, as well as inspection and spindle machines for processing. Our machines are developed and manufactured at production sites in Germany and Italy. Itochu Machine-Technos Corporation is responsible for Japanese market.

Everyone knows the several advantages of paper, however, not all people are aware about the thousands of innovation and improvement to give to paper new applications on new markets. Everyday somewhere around the world someone is experimenting a way to combine paper with other materials to reach new features and find an application on the market. Sometimes the single markets are pushing the innovation, sometimes the scientific community is offering new products or new features to be profited on the market. We share our fundamental philosophy to manufacture the tailormade machine.

### **Revolutions in the history of civilization induced by paper Part 8: Islamic Empire**

Kiyoaki Iida

The Islamic Empire which rapidly expanded its territory, starting from the Arabian Peninsula, collided with the Tang dynasty which enlarged its control over central Asia at the Talas River. Due to their direct contact, the paper making technology was transferred to the Islamic society.

Abbasid Caliphate made use of paper enthusiastically to govern its large territory and to civilize society around. In 300 years since the Talas war, paper production even spread to the Iberia Peninsular. A book market was born and prosperous in Bagdad. It moved to Damascus after the devastation by Mongol. After the Timur occupation of Damascus, Cairo became the center. In the 13th century, Italian who got the production know-how exported paper to Islamic world. Then, the Islamic production and book market was prosperous in Iran in the 14 century and on.

The Islamic paper was made of linen rag from fax, which was beaten using wheel power. After sheet-forming, the sheet was air-dried. Then, it was coated several times with slurry of wheat powder to make its surface hard enough for pen-writing.

The paper, in the beginning, was accepted to write Koran on it. Then, encouraged by Abbasid Caliphate, book production, mostly hand-copied, exponentially increased, as civilizations such as Heroicism and Indian's were translated and Islamic civilization itself developed finely such as in mathematics, commerce and so on. The 14th century was regarded as its golden age.

## **An Essay on Methodology for Innovating “JAPAN TAPPI JOURNAL”**

### **Part 15: A Futurological Perspective required by the Journal**

Fumihiko Onabe  
Professor Emeritus, The University of Tokyo (Paper Science)

We are living in a chaotic contemporary society and it is not easy task to foresee the future fraught with uncertainties. Covid 19's pandemic environment further increases the haziness and uncertainties in the future society. However, the management judgement has to be adequately done even under these difficult business environments.

The fifteenth article of this series attempts to analyze the methodology of futures studies associated with the paper industry based on the recent academic achievements of “futurology” or “futures studies”. The overall contents are described as below.

1. Introduction
2. What is “futurology” like ?
3. The reason for considering plural scenarios for painting a vision of the future
4. The difference between the science & technology and political, economical & social issues in future prediction
5. The new areas created to the paper industry's perspectives by the futurology
6. An author's experience from “Pulp and Paper Technology Forecasting Committee”
7. The necessity of developing scenarios and roadmaps with multi-layered perspectives
8. Epilogue

### **Inkjet Printable Polypyrrole-ITO Conducting Inks**

Yukihiro Tsugita and Shuichi Maeda  
Information Science and Technology, Graduate School of Science and Technology, Tokai University

We have prepared organic conducting nanocomposite particles which utilize polypyrrole as conducting parts and small ITO particles as dispersants. The nanocomposite particles of polypyrrole and ITO represent potentially useful processable forms of polypyrrole, normally intractable conducting polymers. The conductivity of polypyrrole-ITO nanocomposite particles was two orders of magnitude higher than bulk polypyrrole under the same condition. We confirmed that these polypyrrole-ITO nanocomposite particles can be utilized as conducting inks due to their high colloidal stabilities.

## CONTENTS

### Papermaking Technology II

- 1 Roles of Retention and Drainage Aids in Papermaking Process  
.....Naho Murata, Kenji Sakai and Goichi Hayashida
- 7 Tissue Machine Technology of Andritz  
—Stock Preparation and Shoe Press—.....Toshio Okunishi
- 14 Latest Technologies and Grade Conversions in Overseas.....Arisa Oki
- 21 Introducing Inertial Shaking unit Allimand.....Yasuo Harikae

### Topics & Information

- 26 Development of Choi-Suki Kun Series  
—Challeng of Sheeting Technology for Cellulose Fibers and New Materials—  
.....Yasuyuki Yazaki
- 31 “Reactive Polymer” of AXISZ system for Wet-end Optimization  
.....Kazutaka Kasuga, Koichi Tadaki and Hiroyuki Oishi
- 35 PCMC’s Approach to Adapt to Changing Conditions.....Taihei Kashibe
- 40 Polyacrylamide-based Pitch Control Agent for Pulp and Papermaking Process  
( II ) .....Shuji Hitoosa and Takuji Sodeyama
- 45 Revolutions in the History of Civilization Induced by Paper  
Part 9 : Paper and Printing.....Kiyooki Iida
- 52 An Essay on Methodology for Innovating “JAPAN TAPPI JOURNAL”  
Part 16 : Functions of Journals Required as External Storage Devices of Human Beings  
.....Fumihiko Onabe

### Introduction of Research Laboratories(141)

- 55 Conservation Science Laboratory, Graduate School of Conservation, Tokyo  
University of the Arts

### Pulp and Paper Mills in Japan(92)

- 58 Kanto Mill (Katsuta), Hokuetsu Corporation

- 03 Committee report
- 63 Papyrus
- 68 Industry News (Domestic and International)
- 73 List of Patents issued and Laid-open Publication
- 81 Price list of Domestic Logs and Wood Chips by District
- 82 Other Monthly Statistics
- 84 News from the Association

### **Roles of Retention and Drainage Aids in Papermaking Process**

Naho Murata, Kenji Sakai and Goichi Hayashida  
Shonan Research Center, HYMO Corporation

In papermaking process, retention and drainage aids provide many benefits such as improving sheet quality, enhancing productivity, and extending life of fabric.

The roles of these aids have become more and more important because the rate of fines and filler in furnish has increased as the papermaking environment has changed.

Retention and drainage aids have ability to coagulate and flocculate pulp and filler through ionic interaction mainly. However, too large floc worsens the formation, paper strength and dewatering. Therefore, suitable chemicals and systems are required. Polyacrylamide, water-soluble synthetic polymer, is one of the typical chemicals because it can adjust the molecular weight, ionicity and charge density easily.

The technology of retention and drainage system made advanced to address acid-free papermaking, increasing speed of paper machines and reduction of fresh water. However, in recent years, more complicated and difficult issues in papermaking process have been increasing, for example deterioration of runnability caused by low-quality materials and demand for maintaining sheet quality despite the basis weight reduction. We have solved these problems by applying characteristic pitch control agent in combination with retention aid and new retention aid developed by our unique "selection-technology".

### **Tissue machine technology of Andritz -Stock preparation and Shoe press-**

Toshio Okunishi  
Andritz K.K.

In this report,described are three characteristic topics which Andritz has in its tissue machine technology. First the ShortFlow system,which can realize a concept “ Paper is made in the stock preparation process” is made up of few numbers of equipment and verified control technology. It can improve reproductivity of the operation and make changes of paper grade and color smoother. Next we reviewed a basis of the refining theory and then two types of the Andritz refiner is presented,that is,Cylinder type refiner ( Papillon refiner) and Disc type refiner ( Twin flow refiner). Both can realize to improve fiber strength and fiber flexibility with keeping refining conditions constant during refining process. Last Andritz third generation shoe press is presented. Its load mechanism can make the cross direction line load perfectly even. It has also a flexible shoe design and edge control system. Therefore the shoe can follow the Yankee contour faithfully. It has both higher dryness mode and higher bulk mode and the mode adjustment can be made on the run.

## **Latest Technologies and grade conversions in overseas**

Arisa Oki  
Valmet K.K.

As we all know it the world is changing fast; the consumption of newsprint and printing/writing paper is decreasing. The consumption of packaging grades are increasing due to the increasing e-commerce and sustainability awareness. An old paper machine can be updated with a grade conversion rebuild to produce more profitable products like containerboards, cartonboards or special papers.

The main idea of this article is to discuss about considerations and things to look out for based on experiences from paper machine grade conversion projects. Formerly grade conversions have been conducted typically for higher value end products. Nowadays grade conversions are typically concentrated of converting printing grades to packaging grades or to specialty grades. Valmet has gained wide experience of grade conversions.

The change of paper and board making environment is greatly influencing in further development of production lines. Traditionally paper and board making lines have been more far away from each other. Higher production speeds due to light weighting of containerboard has brought these processes closer to each other. In addition, new technologies in wet end and sizing give wider production flexibility compared to conventional paper or board machines.

The successful grade conversion requires a market study and plans, how new raw materials are purchased. The concept selection and target dimensioning should take the current premises into account and a sufficient schedule for planning and conversion phases should be in place. The sufficient quality level of new end products is needed to be able to enter the markets and low enough production costs should be secured.

The new technologies enable wider possibilities to utilize existing premises with limited modifications and can give a great boost to show the potential along this development.

## **Introducing Inertial Shaking unit Allimand**

Yasuo Harikae  
ITOCHU MACHINE-TECHNOS CO.,INDUSTRIAL MACHINERY 3 DEVISION

This paper introduces an inertial shaking device as a recent wire part technology in Allimand's technology.

It is known that the operation of the shaking device in the wire part of the Fourdrinier paper machine improves the increase in moisture passing from the fiber through the wire, the texture, and the improvement in the strength of the paper.

Allimand's inertial shaking device, combined with the Breast roll's sliding bearing mechanism, makes it possible to eliminate unwanted vibrations from the device, make it compact, and improve the ease of setting the Breast roll amplitude and frequency.

## **Development of Choi-Suki Kun series**

### **-Challeng of sheeting technology for cellulose fibers and new materials-**

Yasuyuki Yazaki  
Research & Development Dept, Kobayashi Engineering Works,Ltd.

It has been over 200 years since fourdrinier machine was developed as continuous paper machine in 1798. After that, cylinder paper machine was developed and paper industry has achieved outstanding progress. In addition to wood pulp, animal origin: leather, feather, plastic origin: chemical fiber and mineral origin: mica have been used as raw materials. We developed many products such as Success Former and Ultra Former Series, and have been provided them to paper industry. Along with that, we have dealt with paper machine for friction material base-paper, battery separator and specialty paper for car, medical, aerospace and airline industries. In recent years, many industries including paper, have been specializing in new materials such as CNF (Cellulose Nano Fiber). Accordingly, we have received testing inquiries for making sheets of synthetic fibers mixed with these fibers, inorganic fibers and mixed these two materials.

In this paper, we introduce how the development of Choi-Suki Kun went, all sorts of testing machine, the results of testing and delivery cases.

## **“Reactive Polymer” of AXISZ system for Wet-end Optimization**

Kazutaka Kasuga, Koichi Tadaki, and Hiroyuki Oishi  
SOMAR Corporation

The ultra-high molecular weight type retention agent that we have introduced so far has achieved high retention properties and improved drainage on many papermaking machines. However, in recent years, when applying a retention agent to a paperboard machine, it is often required not only to improve the retention properties, but also to improve the fixability of paper chemicals and drying property and further reduce the paper defects. To solve these problems at the same time, we have developed a new concept, "Reactive Polymer Technology", which has an optimized polymer structure.

Since the retention effect of "Reactive Polymer" is sustained due to the share of screens, etc., it is possible to improve the formation and dryness of problems when an ultra-high molecular weight type retention agent is applied to a paperboard machine. In addition, as a function that conventional retention agents do not have, the action of the polymer after shearing improves the fixability of the pitch component and the internal additive. Therefore, papermaking can be performed with a small amount of internal additive, which is effective in reducing white water load and paper defects. Currently, as the next step, we are studying with the goal of introducing "reactive polymer" from the retention agent to the coagulant.

In this report, we will introduce application examples based on the test results of the new “Reactive Polymer”.

## **PCMC's approach to adapt to changing conditions**

Taihei Kashibe  
Paper Converting Machine Company Far East Inc. Japan Branch

PCMC's Forte Surface Rewinder has unique winding technology. It keeps the embossing even from the beginning to the end of the winding process, making it possible to produce high-quality rolled products such as toilet paper and kitchen paper. It is possible to produce from the standard small diameter products for the household to a large-diameter commercial product with one unit. Conventionally, different machines were required for each category, but by being able to use them together, it will save space and enable operations by a small number of operators.

It has an open design, good accessibility, and easy to understand the status of parts and operating status of each part, which brings clean and highly efficient work to the production site. In addition, rolls without a paper tube (coreless) can be produced, which not only expands the product lineup and promotes sales at the paper mill, but also contributes to environmental protection by reducing household waste. It can also be used for non-woven fabrics and can also produce bottles and center pulls (canister products).

In this article, I would like to introduce Forte's characteristic technology that allows it to continuously produce high-quality products with its simple and sophisticated design.

## **Polyacrylamide-based Pitch Control Agent for Pulp and Papermaking Process(II)**

Shuji Hitoosa and Takuji Sodeyama  
Paper Chemicals Development, R&D Center, R&D Company, Harima Chemicals, Inc.

Deposits of organic contaminants can cause serious problems on runnability or quality of paper. The contaminants come from natural wood (pitch) or synthetic resin from recycled fiber (stickies). They bring negative impact on the paper making process from pulp mills to paper mills.

Recently, there is an increase in usage of cheaper and lower quality wood in Kraft pulp process. This trend is bringing more wood contaminants in the system, resulting in more pitch troubles in pulping and paper making process. There is also increasing demand for the measures to solve these problems.

In Japan paper industry, the conscious for food safety and health have been growing. Paper chemicals including pitch control agents for food packaging materials need to be compliant with regulations for food contact materials in each country.

To solve these problems, we have developed FDA approved poly acrylamide-based pitch control agents, “AS series” for both pulping and paper making process. In this report, we report the features, optimal condition for the chemical program, product lineup and trial results of AS series.

## **Revolutions in the history of civilization induced by paper**

### **Part 9: Paper and Printing**

Kiyoaki Iida

As paper became available, more copies of texts such as Buddhist scriptures were wanted. Then, printing was developed.

In Japan, one million miniature towers, 20 cm high, were fabricated in the 8th century and each contained a sheet of printed scripture, 5.4 cm wide, in it. They were the first printed products with the clear date in the world. The copying by hand, however, was being common, and temples occasionally published scriptures by woodblock printing for their believers. In the early Edo period, metal movable type printing was tried and in vain. So, the culture, prosperous in the Edo, was supported mostly by fine woodblock printing.

In Korea, Buddhist scriptures were frequently printed by woodblock in the 13th-15th centuries. In the 14th century, metal movable type was invented for printing, first in the world. Hangul was developed which was favorable for movable type in the 15th century. In spite of them, and partly by historical prohibition of Hangul use, the metal movable type printing could not be pervasive and was used only in privileged class.

In China, woodblock printing was in use in the 7th century, and got to its golden age in the 13th century. In the 15th century, many kinds of books were published by woodblock printing. As the need for copies increased, movable type printing was devised. The clay type was used in the 11th century, wooden type in the 14th century, and copper type was in the 15th century. A large number of Chinese characters, however, made it difficult to be pervasive..

The Islam got to know paper in the 8th century, and published books by hand copy as well as woodblock print, a number of which increased exponentially. In the 15th century, Italian printers mastered metal movable type printing, started to print Arabic texts and exported them to the Islam. The Islam, on the other hand, prohibited to print Arabic texts, accepting an advice from Koran copyists. It was a turning point for them to be left behind the advanced civilization they had once enjoyed.

## **An Essay on Methodology for Innovating “JAPAN TAPPI JOURNAL”**

### **Part 16: Functions of Journals required as External Storage Devices of Human beings**

Fumihiko Onabe

Professor Emeritus, The University of Tokyo (Paper Science)

Emergence of writing materials had liberated human brains from memorizing a variety of daily happenings and informations. This historical fact led to the birth and evolution of human culture and civilization.

The sixteenth article of this series attempts to analyze the roles and functions of journals as human external storage or memory devices. Human-Journal system is regarded as an information eco-system. The overall contents are described as below.

1. Introduction
2. Complimentary and widening relationship between human-being and machine
3. Internal and external storage devices of human-being
4. Formation of micro-cosmos in a human brain as internal storage device
5. The roles of journals as external storage devices required for productivity enhancement and innovation
6. Combined and parallel usage of analogue and digital devices and equipments as external storage devices
7. The predominant characteristics of paper media reconsidered from media theories
8. Reframing the birth of the Digital Agency in September 2021
9. Epilogue



## CONTENTS

### Pulp and Paper Research Conference

- 1 Report on the 88<sup>th</sup> Pulp and Paper Research Conference  
.....Wood Science Committee, JAPAN TAPPI
- 10 Woody Biomass Refinery by Thermochemical Conversion  
—Expected Role for the Pulp and Paper Industry——.....Haruo Kawamoto
- 14 Miscibility between Cellulose Nanofiber and Polymer Emulsion : A Colloidal Science Perspective.....Hiroto Soeta, Yohsuke Goi and Kazuhito Jinno
- 16 X-ray Diffraction Analysis of a Trace Amount of Components in Papers Using the High Speed Detector.....Toshitatsu Takei and Eriko Tawara

### Topics & Information

- 20 The Effect of Paper Lint on Misfeeding and Its Evaluation Method  
.....Yosuke Tsukiyama, Tetsuya Tsumori, Misaki Asada and Isami Nitta
- 25 Wood-Based New Functional Materials “MinerPa<sup>®</sup>”  
—Development of Mineral Particles/Pulp Fibers Composites——.....Hiroto Matsumoto, Moe Fuchise-Fukuoka, Toru Nakatani, Masatoshi Oishi and Shisei Goto
- 29 ANDRITZ Cutting-edge Digital Technology for Stable and Safe Recovery Boiler Operation.....Kazunori Ohmori
- 34 Revolutions in the History of Civilization Induced by Paper  
Part 10 : Developments in Europe.....Kiyooki Iida

### Research Report (Original Paper)

- 42 Safety Assessment of Cellulose Nanofibers Obtained from Soda Cooking Bamboo Pulp : Bacterial Reverse Mutation Test, Mouse Lymphoma Thymidine Kinase Assay, Micronucleus Test, and Repeated dose 90-day Oral Toxicity Study in Rats  
.....Tomoko Shimokawa, Kengo Magara, Tsutomu Ikeda, Noriko Hayashi, Mutsumi Ogawa, Tetsuya Takao and Eiko Nakayama

- 03 Committee report
- 41 Essay on Intellectual Property
- 75 Papyrus
- 81 Industry News (Domestic and International)
- 86 List of Patents issued and Laid-open Publication
- 96 Price list of Domestic Logs and Wood Chips by District
- 97 Other Monthly Statistics
- 99 News from the Association

**Woody Biomass Refinery by Thermochemical Conversion  
– Expected Role for the Pulp and Paper Industry –**

Haruo Kawamoto  
Graduate School of Energy Science, Kyoto University

Due to the global warming issue, CO<sub>2</sub> emissions from the use of fossil resources need to be reduced by substitution to renewable resources. In such a background, the use of woody biomass as chemicals and materials is drawing attention, because about 10% of petroleum is currently used for material production. Thermochemical conversion is one of the conversion technologies expected for that purpose. Renewable electricity has multiple options, including solar, wind and geothermal, but biomass is the only renewable carbon source. Therefore, it is important to develop an efficient thermochemical conversion technology that can replace the petrochemical industry. In this presentation, the issues of pyrolysis of woody biomass in the production of low-molecular-weight monomers will be presented from the viewpoint of the molecular mechanism of pyrolysis. Finally, the expected role of the pulp and paper industry in the future will be discussed.

**Miscibility between Cellulose Nanofiber and Polymer Emulsion:  
A Colloidal Science Perspective**

Hiroyo Soeta, Yohsuke Goi, and Kazuhito Jinno  
DKS. Co., Ltd.

Cellulose nanofiber (CNF) has unique characteristics as rheology modifiers, dispersants, and reinforcing fillers. Incorporation of the CNF into waterborne polymer emulsion is required to improve the rheological properties of the emulsion and mechanical properties of resulting polymer materials such as film and coating. Miscibility between the CNF aqueous dispersion and the polymer emulsion, however, depends on types of polymers, and the miscibility trends are unclear. Therefore, we systematically investigated the contributions of the chemical compositions of polymer onto phase separation behavior of CNF dispersion/polymer emulsion mixture. It was found that the chemical compositions of polymer significantly affected the miscibility; the increase in the amount of anionic functional groups led to agglomeration of CNFs and emulsion particles. The result was discussed based on the theories in colloid science and suggests that repulsive force induced by electric double layers and attractive force induced by depletion effect competitively affected the dispersed particles. The increase in the surface charge is likely to enhance the depletion effect rather than the repulsive force, resulting in particle agglomeration. The chemical modification of polymer emulsion was then carried out to improve miscibility with the CNF dispersion. Accordingly, changing the anionic functional groups to nonionic groups led to obtaining a homogenous mixture of CNF dispersion and polymer emulsion. These findings pave the way to expanding the application of CNFs to paint and coating fields.

**X-ray diffraction analysis of a trace amount of components in papers  
using the high speed detector**

Toshitatsu Takei, Eriko Tawara  
Material Analysis Center, Innovation Promotion Division, Oji Holdings Corporation

The X-ray diffraction has widely been used for identification and structural analysis of crystalline substances. Although the Scintillation detector(SC detector) is generally used for the X-ray diffraction analysis, the sensitivity is not enough for the qualitative analysis of a trace amount of components. Therefore, we investigated to apply the high speed detector to the X-ray diffraction analysis of a trace amount of components. The high speed detector detection unit with multiple semiconductor elements allows much shorter measurement time than the SC detector. Also the high speed detector has high sensitivity, and therefore is suitable for measurement of a trace amount of components. In this research, we report an example of analyzing trace substances in commercially available functional paper and red precipitate in the pipes with the high speed detector.

## **The effect of paper lint on misfeeding and its evaluation method**

Yosuke Tsukiyama, Tetsuya Tsumori, Misaki Asada and Isami Nitta  
Institute of Science and Technology, Niigata University

One of the general problems of the MFPs is misfeeding due to paper lint. Despite the generality of this problem, the detailed friction mechanism is not clear. Furthermore, in recent years there are so many paper brands in overseas markets and the development of a simple evaluation method about paper lint is a growing demand among major manufacturers of the MFPs. In this paper, we describe the mechanism of the decrease of friction between rubber roller and paper in association with paper lint. Because the mechanism depends on the relative size of the paper lint particle to surface roughness of paper, we should evaluate not only the paper lint amount on the paper, but also the effect of the relative size of the paper lint on the contact and friction. We conclude that the evaluation method JBMS-88 is one of the simple and low-cost methods as the friction-based evaluation method.

## **Wood-Based New Functional Materials "MinerPa<sup>®</sup>" -Development of Mineral Particles/Pulp Fibers Composites-**

Hiroto Matsumoto, Moe Fuchise-Fukuoka, Toru Nakatani, Masatoshi Oishi and Shisei Goto  
Nippon Paper Industries Co., Ltd.

One of the useful approaches to functionalize paper is hybridizations of inorganic fillers and pulp fibers. By adopting a unique pulp-modification technology, Nippon Paper Industries have developed composites of mineral particles and pulp fibers, named as "MinerPa<sup>®</sup>", which are wood-based functional materials. Herein, we will report some practical examples of using MinerPa<sup>®</sup> which we have conducted; preparations and evaluations of papermaking adequacy and functionalities in sheet.

Each composite of calcium dioxide ( $\text{CaCO}_3$ ), Barium sulfate ( $\text{BaSO}_4$ ) or hydrotalcite was individually prepared by *in-situ* reaction under existence of pulp fibers in water. Scanning electron microscopy (SEM) observation showed that the surface of pulp fiber was densely covered with inorganic particles, which was observed at three composites. By using obtained composites as raw materials, a papermaking process was conducted to evaluate its practical usage by using a machine. A sheet of  $\text{BaSO}_4$ /pulp composites was continuously producible and made with remarkably high first-pass retention (97.0%) and first-pass ash retention (96.5%) despite of its high ash content (over 65%). Further investigation of a sheet of  $\text{BaSO}_4$  or hydrotalcite/pulp composites was conducted to evaluate its functionality. Each composite sheet showed a characteristic function attributed to inorganic particles loaded on pulp fibers. A sheet of  $\text{BaSO}_4$ /pulp composites showed X-ray shielding properties, and a sheet of hydrotalcite/pulp composites revealed to have a high deodorant and anti-bacterial performance.

These results suggest that MinerPa<sup>®</sup> would provide a new functional material based on wood-based resources, which will be considered to contribute to protect global environment or ecosystem and facilitate using sustainable resources.

## **ANDRITZ Cutting-edge digital technology for Stable and Safe Recovery Boiler Operation**

Kazunori Ohmori  
Andritz K.K. Capital Systems Sales

Digital technology, such as IT, IOT, and AI has been rapidly progressing and is pervading into people's lives, supporting them and enriching their lives. These digital technologies are creating a new added value for the pulp and paper industry as well. ANDRITZ has developed "Recovery Smart Business" for Evaporator, Recovery boiler, White liquor plant and Power boiler. The Recovery Smart Business is a technology solution that combines cutting-edge digital technology and ANDRITZ's process know-how. Its state-of-the-art digital technology is divided into six sub-technology groups such as Smart sensor, Robot solution, Digital Twin, Process optimization system, Digital advisor and Advanced visual analysis. One of the Recovery Smart Business using these cutting-edge technologies has already been put into a practical use in the Recovery boiler process as "Smart Recovery Boiler", and not only stable operation but also the safety of the equipment and the operator has been improved. The Smart Recovery Boiler can be installed for the recovery boiler whether it is new or existing.

## **Revolutions in the history of civilization induced by paper** **Part 10: Developments in Europe**

Kiyoaki Iida

Islam got paper in hands in the 8th century. Abbasid Caliphate not only used it for administration but also copied precedent civilizations on paper and evolved its own culture, which increased paper consumption exponentially. Cairo had prosperous paper industry and book market.

On the other hands, Europe, after the collapse of the Roman Empire (372-410), suffered from troubles like invasions by different ethnic tribes, reduction of population, decline of trade and business, and increased immigrants. However, things turned around in the 13th century. The population and the economy grew significantly, and science and philosophy restored. At that age, Europe began to use paper. In the 1000s, paper was manufactured in Islamic Spain and Sicily. Between 1000 and 1300, the examples of paper use were recorded and found in several places in Europe. In the late 1300s, a paper mill started operation in Italy, the technology of which was transferred to Germany and later advanced to England.

In those days, Europe was superior to Islam in mining and metal engineering, which helped Italian to develop mold with metallic wire and stamper covered with iron. These developments and their original gelatin immersion reduced the cost of paper production, and Italian exported their paper to Islam as an exchange for pepper and silk. In the 18th century, Cairo became just a despot to Arab business and lost its book market.

In Europe, the economy grew steadily and civilization was restored, paper consumption increased and more numbers of copies were wanted. Then, the metallic movable type printing system was invented, which, cooperative with paper, helped to induced historical social revolutions.

Their paper making process is briefly reviewed.

**Safety assessment of cellulose nanofibers obtained from soda cooking bamboo pulp:  
bacterial reverse mutation test, mouse lymphoma thymidine kinase assay, micronucleus test,  
and repeated dose 90-day oral toxicity study in rats**

Tomoko Shimokawa, Kengo Magara, Tsutomu Ikeda, Noriko Hayashi  
Department of Forest Resource Chemistry, Forestry and Forest Products Research Institute  
Mutsumi Ogawa, Tetsuya Takao, Eiko Nakayama  
Graduate School of Life Sciences, Showa Woman's University

Bamboo plants, especially Moso bamboo (*Phyllostachys edulis*), grow rapidly and are suitable resources for reuse loop. With the aim of utilizing Moso bamboo for future application in food materials, cellulose nanofibers (CNFs) were prepared from bamboo pulp via alkaline cooking with wet milling after an enzymatic pretreatment. The certification test revealed that bamboo CNFs were more nano-sized than microfibrinous cellulose which is a recognized food additive. Accordingly, the CNFs cannot be classified into the microfibrinous cellulose category. Therefore, we conducted bacterial reverse mutation test, *in vitro* mouse lymphoma TK (thymidine kinase) assay, and *in vitro* cell micronucleus test on the Chinese hamster lung cell line and confirmed that the bamboo CNFs exhibited no mutagenicity. Furthermore, a repeated dose 90-day oral toxicity study was conducted on rats using 1 wt% bamboo CNFs suspension, which revealed no abnormality on long-term ingestion. No deaths were observed in any of the administration groups throughout the test period and no effects of the test substance were observed on rats under general conditions, urinalysis, and ophthalmologic examination. In addition, hematological examinations, blood biochemical examinations, organ weight measurements, necropsy findings, and histopathological examinations performed after the administration period showed no effects of the test substance on the rats. Since no toxicity due to the test substance was observed in either the male or female administration group, the no observed adverse effect level (NOAEL) under the test conditions was determined to be 200 mg/kg/day or more for both males and females.

## CONTENTS

### Environment

- 1 A Report of the 28<sup>th</sup> Environmental Conference  
.....Environmental Technical Committee, JAPAN TAPPI
- 2 From Paper Manufacturing Process to Wastewater Treatment Process Kurita's  
Comprehensive Method of Reducing Environmental Load.....Chise Fukuda
- 8 Precautions for Outsourcing Waste Treatment in COVID-19 Infection  
.....Hironao Sakamoto
- 19 Fundamentals Knowledge and Visualization of Noise  
—Visualization with Acoustic Camera and Simulation——.....Takeshi Hirata
- 26 Ammonia Co-firing in Coal-fired Power.....Tadashi Sumida
- 30 CCUS Initiatives and Future Policy Direction.....Kotaro Hirano
- 42 Internal and External Situations Surrounding the Global Warming Issues and  
Challenges for Japan.....Jun Arima
- 54 Towards 2030  
—Study Results of the Working Group on SDGs——.....Akihiro Aikawa

### Topics & Information

- 59 Revolutions in the History of Civilization Induced by Paper  
Part 11 : Innovations and Revolutions in Europe Induced by Paper.....Kiyooki Iida
- 65 An Essay on Methodology for Innovating “JAPAN TAPPI JOURNAL”  
Part 17 : On the Ethics as Related to the Freedom of Editing Journals.....Fumihiko Onabe
- 68 The Oldest Extant Paper in Japan and the Oldest Extant Paper Written in Japan  
.....Naohiko Tsujimoto

### Introduction of Research Laboratories (142)

- 78 Laboratory of Composite Materials, Division of Forest and Biomaterials Science,  
Graduate School of Agriculture, Kyoto University

- 03 Committee report
- 77 Essay on Intellectual Property
- 80 Coffee break
- 81 Papyrus
- 84 Industry News (Domestic and International)
- 89 List of Titles in Foreign Journals Received by JAPAN TAPPI
- 92 List of Patents issued and Laid-open Publication
- 103 Price list of Domestic Logs and Wood Chips by District
- 104 Other Monthly Statistics
- 106 News from the Association

### **From paper manufacturing process to wastewater treatment process Kurita's comprehensive method of reducing environmental load**

Chise Fukuda  
Kurita Water Industries, Ltd.

In recent years, the environment surrounding the paper industry has been changing day by day due to changes in water quality and operating conditions. Above all, fluctuations in the raw materials for used paper are expected to affect the environmental load of the entire factory from the manufacturing process to the wastewater treatment process. In other words, in order to solve the environmental load issue, it is necessary to take a comprehensive approach that captures changes in the water quality of the entire factory. From the perspective of improving productivity and reducing the environmental load, we are focusing on "water", which is often used in the paper manufacturing process.

This report first describes the challenges posed by changes in the raw materials used. Next, as a method of solving the environmental load problem, the first is an effective microbial control method combining a slime control agent and aeration, and the second is the application of an optimum flocculant and coagulant suitable for water quality. Third, we will introduce a water quality management method using S.sensing® that responds to changes in water quality and operations.

### **Precautions for outsourcing waste treatment in COVID-19 infection**

Hironao Sakamoto  
ENVIPRO HOLDINGS Inc.

The processor is in an environment where improper processing is likely to occur, and in the past there have been cases of "cross-flow" by the processor.

Against the background of the case where food waste commissioned by food manufacturers was sold as food by an industrial waste disposal company in Aichi Prefecture, penalties for false statements in the manifest were strengthened.

The main problems of the case are: (1) Since the industrial waste treatment flow is unclear, the discharger and the administrative agency cannot notice the reason for violating the Waste Disposal Law such as the forged description of the electronic manifest. , (2) Insufficient information on industrial waste treatment companies makes it difficult for waste generators to identify good industrial waste treatment companies , (3) Improvement of treatment companies after revocation of permission It is not subject to orders, etc.

Violations that are likely to be made by disposal companies include permission of waste type, who is the discharger, whether they are processing, linking after the secondary contractor, and returning the manifest.

As a measure to minimize the risk of improper processing by the processor in COVID-19 infection, it explains the points to note when using the preliminary survey sheet and performing remote audits.

### **Fundamentals Knowledge and Visualization of Noise -Visualization with acoustic camera and simulation-**

Takeshi Hirata  
Nihon Onkyo Engineering Co.,Ltd.  
Noise Improvement Div.

There has always been a noise problem for the outside and in recent years there has been a growing concern about the noise of working environments. The fundamentals of acoustics in solving the problem can provide some pathway to countermeasures. Moreover, by visualizing sounds that can only be judged by the ears, it is possible to share information about noise problems. In this paper, we introduce the visualization method and the simulation flow.

## **Ammonia co-firing in coal-fired power**

Tadashi Sumida

mitsubishi heavy industries, Ltd.

For realization of low-carbon society, coal-fired power plant transformation can be categorized into 3 categories, i.e., "Modification to apply lower carbon technology", "Modification to increase flexibility" and "Scrap and Build to IGCC or GTCC".

The expansion of ammonia utilization promotes the popularization of the hydrogen energy in Japan, and the ammonia is also being studied as a CO<sub>2</sub> free fuel.

Merits of ammonia utilization are high hydrogen content, comparatively easy liquefaction (suitable for transportation) unlike hydrogen, utilization of existing infrastructure technology of production, transportation and storage, direct combustion or hydrogenation, and utilization for boiler, gas turbine, fuel, etc.

Challenges are as follows: (1) establishment of safety of ammonia facilities (improvement of laws and regulations), (2) current manufacturing method for reforming and synthesizing natural gas, which is not CO<sub>2</sub>-free, (3) relatively more expensive than fossil fuel, (4) current condition of, utilization as fertilizer is main, and trade volume is small.

Combustion speed of ammonia is almost equal to coal (pulverized coal), and modification of the heat transfer area is not required by the ammonia co-firing. Only the burner modification is required for ammonia co-firing of the boiler. On NO<sub>x</sub> control for ammonia co-firing, we can present optimum economical plan by retention time security of denitration in the furnace and strengthening of SCR.

We will promote decarbonization of energy by focusing on the expansion and diffusion of high-efficiency, environmentally friendly power generation systems.

## **CCUS Initiatives and future policy direction**

Kotaro Hirano

Former Ministry of Economy, Trade and Industry

Global Environmental Affairs Office

Assistant to the director

Climate change since Prime Minister Suga's statement in October last year, "Aiming for carbon neutrality in 2050," and "Aiming to reduce greenhouse gases by 46% in 2030 compared to 2013," at the Climate Change Summit in April this year. There is growing interest both inside and outside the country on "CCUS" as a countermeasure technology.

In November 2019, Japan achieved a cumulative CO<sub>2</sub> injection amount of 300,000 tons at the Tomakomai CCS Demonstration Center, and demonstrated a consistent CCS system from CO<sub>2</sub> separation / recovery to storage / injection. The injected CO<sub>2</sub> is continuously monitored based on the Ocean Pollution Control Law, and no signs of CO<sub>2</sub> leakage to the ocean have been observed so far.

Regarding CCS, in the "Long-term strategy as a growth strategy based on the Paris Agreement" decided by the Cabinet in June 2019, "We will consider introducing CCS by 2030 on the premise of commercialization." Based on the provisions of this "long-term strategy" and the issues obtained from the CCS verification test at Tomakomai, the Ministry of Economy, Trade and Industry's Global Environmental Measures Office has (1) CCS cost reduction and (2) CO<sub>2</sub> transportation means for commercialization of CCS in 2030. We are working on various policies such as establishment, (3) making a base by combining CCS and carbon recycling, (4) securing suitable storage land, and (5) improving the business environment for the introduction of CCS.

In this lecture, we will report on the results of the CCS large-scale demonstration test in Tomakomai and the direction of policy development regarding CCUS. We hope that it will help the pulp and paper industry when considering climate change countermeasures.



## **Internal and external situations surrounding the global warming issues and challenges for Japan**

Jun Arima  
The 21st Century Public Policy Institute.  
Associate Director for Research

Despite strong push from the US and the EU, emerging countries such as China, India and Russia are opposed to the global carbon-neutrality in 2050 for achieving the goal of limiting the global average temperature rise to 1.5 degrees Celsius since the industrial revolution, and the phase-out of coal-fired power by 2030. This is reflected in a divergence in the messages of G7 and G20. The priorities on climate actions in the 17 SDGs vary from country to country.

China is shrewdly capitalizing on the global trends towards carbon neutrality. While announcing carbon neutrality in 2060, it is expanding the market for PV panels, batteries, wind turbines, and electric vehicles. It is benefiting from retreat of developed countries from fossil fuel sectors and clean coal technology exports.

Under that situation, Prime Minister Suga announced 2050 carbon neutrality goal last October and substantially raised Japan's NDC in 2030 compared with 2013 level from 26% reduction to 46% reduction. He argued that Japan should pursue a virtuous cycle of economy and environment and METI published the Green Growth Strategy specifying 14 industries and technology areas which could contribute to Japan's green growth and therefore should receive policy resources in a prioritized manner. However, we should also face the reality that decarbonization is not cost free and there could be a trade-off between economic growth and environmental protection. It is particularly so in Japan where energy cost is the highest among major countries.

Japan's 46% target was set back-casting from 2050 carbon neutrality goal without thorough examination of its feasibility and economic cost. In its pursuit of 46% target, the government should regularly monitor energy cost and compare it with major trading partners.

Given the bulk of incremental CO2 emissions will come from developing countries in the Asian region, Japanese government and industries develop innovative technologies such as fuel ammonia, hydrogen, CCUS and carbon recycling which are crucial for decarbonization of the region and disseminate them by improving their cost competitiveness. This is the most fundamental contribution of Japan to the prevention of global warming.

### **Towards 2030 -Study Results of the Working Group on SDGs-**

Akihiro Aikawa  
General Affairs & Public Relations Division, Japan Paper Association

Paper industry's initiatives are highly aligned with Sustainable Development Goals (SDGs) as forest resources are the core of the business. Thus, Japan Paper Association set up a working group to improve the industry's presence on SDGs. The Working Group extracted 13 materiality of paper industry with related SDGs by the survey to the member companies, then identified eight SDGs to which the industry is contributing, four SDGs the industry can contribute further and two challenges the industry needs to address to make further contribution to SDGs, through SDGs mapping per each materiality. The Working Group also showed the action policies and the strategic initiatives to address the challenges.

### **Revolutions in the history of civilization induced by paper Part 11: Innovations and revolutions in Europe induced by paper**

Kiyoaki Iida

In the 14th century, Europe started to manufacture paper, and in almost the same time, its society began to change dynamically.

In the Renaissance which was initiated in Italy in the 14th century, huge volumes of books were translated and studied. The movement asked a large volume of paper which the Italian paper manufacturers supplied, improving its productivity and quality.

The Italian technology was transferred to the Protestant in the northern France, which became the largest paper supplier in Europe. The thought of believing in one's reason that had come up in the Renaissance led to the Reformation (1517). New ideas were printed and published in large numbers, and the Reformation was called as a new media revolution. Paper manufactured in France supported the movement. The French technology, then, spread in Europe, due to the abolition of the Edict of Nantes

The Age of Enlightenment followed, that started in the middle of the 17th century. France was the center of the movement, and books became quite common in daily life. Dutch which succeeded in cost-down by inventing Hollander beater became the largest supplier in Europe, being in replace to France.

The intellectual activities that paper had helped to grow yielded the Industrial Revolution (1760-1840) in Britain. Technologies were generalized and information was effectively exchanged by abundant supply of paper that British paper industry afforded, which had grown to be a leading producer in Europe.

The rise of paper making in some district seemed to be well related to the economic growth and resulting social revolution in that district. The simple work of paper making was a significant presence in a big wave of social developments.

## **An Essay on Methodology for Innovating “JAPAN TAPPI JOURNAL”**

### **Part 17: On the Ethics as related to the Freedom of Editing Journals**

Fumihiko Onabe

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Human beings have free wills. However, human actions and behaviors without codes of conducts will lead to instability, confusion and anarchy of the organization and society.

The seventeenth article of this series will analyze the journals in terms of “ethics as constraining codes” in editing journals. The overall contents are described as below.

1. Introduction
2. The meaning of ethics
3. Codes of ethics as human conduct codes
4. Codes of ethics as constraining conditions of human behaviors
5. Publication ethics
6. Journal's ethics
7. General ethics codes of academic journals
8. Corporate or business ethics
9. Ethics required for the “JAPAN TAPPI JOURNAL”
10. Epilogue

## **The Oldest Extant Paper in Japan and the Oldest Extant Paper Written in Japan**

Naohiko Tsujimoto

The “oldest paper” that exists in Japan, that is, the “Li Bai Document (Draft of a letter by Li Bai)” written in China in 328, and the “oldest paper written in Japan (615)”, that is, Prince Shotoku's autograph “Hokke gisho (Commentary on The Lotus Sutra)”, those two cultural heritages are explained in this paper.

The raw material of the paper of “Li Bai Document” is apparent, because a part of linen cloth can be seen on the paper. On the other hand, the content of the document was extremely difficult to decipher, but at the end of the Meiji era, a Japanese researcher succeeded in the identification of Li Bai and also the deciphering the content, and the value of the “Li Bai Document” became known to the world.

Regarding “Hokke gisho”, it was reported by Nara National Museum in 1921 that the paper was dyed yellow. Until recently, the opinion that “Hokke gisho” was not written by Prince Shotoku was supported by the academic circles of Japanese History. In this article, it is explained in six items that “Hokke gisho” was written by Prince Shotoku, and one of the items is a research result by using a search system that digitizes almost all Buddhist texts (about 100 volumes). I will clarify the validity that “Hokke gisho” was written by Prince Shotoku.