

## CONTENTS

### Biorefinery and Plastics substitution

- 1 Pine-based Resin Use in Paper for Sustainability.....Asuka Okumura
- 8 Valmet's Biorefinery Technologies for Products from Wood-resources towards Decarbonization.....Masaharu Menjo and Tomonori Miyako
- 14 Effective Treatment of Organic Liquid Waste Such as Shochu Liquid Waste —Introduction of Miyazaki Model—.....Yutaka Isu
- 19 Development of the Bio-Asphalt Mixture Utilizing Kraft Lignin.....Takuto Shakuno
- 23 Development of Cellophane Recycling Technology .....Shumpei Ishikawa and Noriaki Tsukida
- 26 Paper Packaging Materials to Substitute for Film.....Keisuke Takemoto

### Topics & Information

- 33 Valmet's New Recovery Boiler and Effective Utilization of Existing Boilers After New Recovery Boiler Construction.....Kazuya Hirakawa
- 38 Our Efforts to the Energy Plants in the Pulp and Paper Industry.....Yuji Fujiwara
- 41 Anti-Scaling Technique of Black Liquor Evaporator Using High Power Ultrasonic Technology.....Masato Tatematsu
- 46 Confront the Surge in Energy Prices !  
An Organizational Approach to Maximize the Value of Factory Energy Management Systems.....Yasuyuki Horiuchi
- 51 Application of Superheated Steam Drying to Pulp and Paper Industries .....Akira Nakasuka
- 55 Research Projects of Universities and Government Research Institutes .....Wood Science Committee, JAPAN TAPPI

### Research Report

- 65 Safety Assessment of Bamboo-derived Cellulose Nanofibers in Food for Healthy Adults : A Long-term, Open-label Ingestion Trial .....Tomoko Shimokawa, Noriko Hayashi and Tetsuya Takao

### Pulp and Paper Mills in Japan (106)

- 86 Mishima Mill, Tokushu Tokai Paper Co., Ltd.

03 Committee report

64 Coffee break

92 Papyrus

97 Industry News (Domestic and International)

101 List of Patents issued and Laid-open Publication

108 Price list of Domestic Logs and Wood Chips by District

109 Other Monthly Statistics

111 News from the Association

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

Asuka Okumura

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

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

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

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

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

Masaharu Menjo and Tomonori Miyako

Valmet K. K.

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

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

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

Yutaka Isu

Nichinan Mill, Oji Paper Co., Ltd

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

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

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

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Nippon Paper Industries Co., Ltd

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

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

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

## **Development of Cellophane Recycling Technology**

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

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

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

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

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

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

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

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

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

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

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

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

Yuji Fujiwara  
TAKUMA CO., LTD.

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

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

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

## **Operating experience of Biomass boiler**

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

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

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

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

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

Masato Tatematsu  
Mitsubishi Paper Mills Limited Kitakami mill

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

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

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

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

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

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

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

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

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

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