

CONTENTS

Pulp and Paper Research Conference/Patent

- 1 Report on the 92nd Pulp and Paper Research Conference
.....Wood Science Committee, JAPAN TAPPI
 - 10 Composite Materials of Marine Biodegradable Plastics and Cellulose Fiber
.....Yuna Ikuno and Atsushi Koyanagi
 - 13 Efficacy of Yeast Products Derived from Spent Sulfite Liquor in Aquatic and
Livestock Products.....Masaru Kouno, Shinji Sugiyama and Tadafumi Hashimoto
 - 16 Application of CNF to Cosmetic Products
.....Sonoka Masuda, Yusuke Tada and Shinji Sato
 - 19 The Effect of Suppressing Heat-Induced Yellowing of Phosphorylated-CNF by
Removing Phosphate Groups After Nanofibrillation
.....Kohei Yamada, Yusuke Matsubara, Taiga Koga and Hayato Fushimi
 - 22 Acquisition of Transmission Electron Microscopic Images Enabling Visualization
of All Fibers in a Droplet.....Kai Okubo, Takuma Kozono and Ryota Kose
 - 26 The Use of Generative AI in Intellectual Property Operations is Already in the
Practical Stage.....Hidenori Yorozu
-

Topics & Information

- 37 Numerical Based Color Communication.....Eiji Okamatsu
 - 43 Laboratory Pulp Molding Machine.....Katsuhiko Yokoyama
 - 47 Carbon Sequestration by Forests and Carbon Stocks in Harvested Wood
Products.....Keiichi Nakamata
-

Technical Report

- 52 An Environmental Awareness Enhancement Program Using the AI-Based
Waste Sorting App “ECOPON” for Mixed Paper Sorting.....Takao Ando
-

- 03 Committee report
 - 69 Papyrus
 - 73 Industry News (Domestic and International)
 - 77 List of Patents issued and Laid-open Publication
 - 86 Price list of Domestic Logs and Wood Chips by District
 - 87 Other Monthly Statistics
 - 89 News from the Association
-

Composite Materials of Marine Biodegradable plastics and Cellulose Fiber

Yuna Ikuno, Atsushi Koyanagi
Oji Holdings Corporation

It is estimated that there are 150 million tons of marine debris, making it essential to address this issue to protect the global environment. One approach to tackling marine debris is the development of marine biodegradable plastics. These include Polyhydroxyalkanoates (PHA), Polybutylene succinate adipate (PBSA), and Polycaprolactone (PCL), with the use of PHA, a biomass material, particularly expanding globally. However, PHA has the challenge of a long solidification time and poor molding efficiency during injection molding. We have developed a composite material by combining PHA with cellulose, utilizing abundant forest resources and compounding technology. Compared to conventional marine biodegradable plastics, our composite material shows improved strength and molding efficiency. We found that increasing the cellulose content enhances the strength. However, higher cellulose concentrations present the challenge of reduced fluidity during molding. To address this, we examined the use of lubricants and resolved the fluidity issue by incorporating two types of lubricants. Additionally, we confirmed that talc further improved the crystallization speed. In summary, we developed a plastic that is easier to handle and stronger than PHA alone. The developed plastic is expected to be applied to fishing gear, agricultural materials that are difficult to recover in the ocean.

Efficacy of Yeast Products Derived from Spent Sulfite Liquor in Aquatic and Livestock Products

Masaru Kouno, Shinji Sugiyama, Tadafumi Hashimoto
Nippon Paper Industries Co., Ltd.,

Nippon Paper Group operates under the philosophy of "A biomass company that opens up the future with trees," highly utilizing wood, a sustainable resource, to manufacture chemical products and expand into various fields. For example, we have cultivated yeast using hemicellulose, a wood component, to produce the biopolymer ribonucleic acid (RNA), which has been used as an additive in infant formula and other products. Recently, as part of our application development towards realizing a circular society, we have conducted joint research with academic institutions and found that RNA exhibits effects on aquatic and livestock products due to its antioxidant properties. In infection tests with yellowtail and cold stress tests with *Litopenaeus vannamei* shrimp, a significant increase in survival rate was observed in the groups fed RNA. Furthermore, it was also found that a sample re-mixed with the extraction residue (cell wall components) after RNA extraction showed an increased preventive effect against Hemorrhagic Bowel Syndrome (HBS) in cattle. This paper clarifies that RNA purified from yeast has an immune-enhancing effect on aquatic and livestock products, and that this effect shows a synergistic effect with cell wall components. The antioxidant properties of RNA are expected to help livestock cope with environmental stress, making it a promising feed that can improve production in clinical settings.

Application of CNF to cosmetic products

Sonoka Masuda, Yusuke Tada and Shinji Sato
NIPPON PAPER INDUSTRIES Co., Ltd.*²

To realize a sustainable circular society, the effective utilization of biomass resources is essential. Cellulose derived from woody biomass has attracted attention as a carbon-neutral material, and among its various applications, cellulose nanofibers (CNF) are particularly promising.

CNF possesses excellent properties such as thixotropy, low stringiness, and stability in dispersion, emulsification, and foaming. These characteristics distinguish CNF from conventional water-soluble polymers, making it a novel type of thickener, emulsifier, and dispersant. Its potential applications in the cosmetics field have also been gaining attention. This report examines the effects of CNF's fundamental functions in cosmetic formulations and discusses its effectiveness in this field.

The effect of suppressing heat-induced yellowing of phosphorylated-CNF by removing phosphate groups after nanofabrication

Kohei Yamada, Yusuke Matsubara, Taiga Koga, and Hayato Fushimi
Oji Holdings Corporation

We are working on development of materials using phosphorylated cellulose nanofibers (CNF). Specifically, we are focusing on transparent sheets. CNF sheets made from phosphorylated CNF as a raw material exhibit outstanding mechanical strength, dimensional stability, and high transparency. However, the CNF sheets have the problem of turning yellow when heated. This yellowing is assumed to be mainly caused by the phosphate groups, so we attempted to remove some of the groups through hydrolysis by applying a heating process.

To remove the phosphate groups, we heated water dispersion of phosphorylated CNF in a pressure vessel at temperatures of 140-160°C. The results showed phosphate groups in the CNF were removed over time with heating. Although the haze of the CNF dispersion tended to increase as the phosphate groups decreased, it remained around 1% even when the phosphate groups were below 0.1 mmol/g.

Thus, we obtained CNF sheets using de-phosphorylated CNF containing phosphate groups at 0.05-0.10 mmol/g. The de-phosphorylated CNF sheets showed a significant decrease in ΔYI , indicating improved resistance to heat-induced yellowing compared to phosphorylated CNF sheets containing more than 1.0 mmol/g of phosphate groups. Additionally, the inherent properties of CNF, such as high elastic modulus and transparency, were still maintained.

Acquisition of Transmission Electron Microscopic Images Enabling Visualization of All Fibers in a Droplet

Kai Okubo, Takuma Kozono and Ryota Kose
Faculty of Agriculture, Tokyo University of Agriculture and Technology

Fine fibers such as cellulose nanofibers (CNFs) and microfibrillated cellulose (MFC) are attracting attention as sustainable alternatives to petroleum-based materials. For effective utilization, quantitative evaluation of these fiber morphology is essential. Transmission electron microscopy (TEM) enables direct observation of individual fibers. These fibers are typically obtained as aqueous suspensions and drop-cast onto a TEM grid, followed by drying to remove the water. However, capturing all fine fibers in a droplet within a single image has been challenging due to the difficulty of dropping a small amount of droplet within the observation area of the grid.

In this study, we developed a sample preparation method that allows all fine fibers in a droplet to remain within the observable area of the grid by optimizing the droplet volume and deposition location on the grid. To obtain wide-area, high-resolution observation images, we used a TEM equipped with an automated montage system that captures and stitches multiple high-resolution images. Over 1500 images were stitched into a single image covering approximately 600 $\mu\text{m} \times 600 \mu\text{m}$, succeeding to obtain the single TEM image visualizing all fine fibers in the drop .

Numerical Based Color Communication

Eiji Okamatsu
X-Rite

This paper will introduce user-friendly tools for color measurement and communication that are used as the standard spectrophotometer in the printing & packaging industry for quality evaluation and color matching, and provide the information necessary for numerical-based color communication.

Laboratory Pulp Molding Machine

Katsuhiko Yokoyama
MATSUBO Corporation

During the development of a new pulp mold product and a quality problem in an existing product occurs it is often necessary to produce containers for verification under modified conditions. Generally, production of containers, even in small quantities, requires the operation of production machines. This is costly and time-consuming if it is required for each small change of conditions during the development of a new product. This introduces a Laboratory pulp molding machine for small-lot production that contributes to improving this problem.

By using this Laboratory pulp molding machine, samples for verification can be easily produced at low cost. This machine is applicable not only for R&D, but also for quality control, quality assurance, production control, chemicals, pulp raw material evaluation, and optimization of production conditions. The system consists of three modules: a pulp molding module, a support module, and a heat press module. Thus, this machine has the same equipment configuration as the production machine, and small-lot production can be performed without running the production machine. This Laboratory machine can be used to perform a production under the same production recipes as ones of a production machine, allowing for quick investigation of the causes of quality problems and improvements. Production recipes used with this Laboratory machine can be easily transferred to the production machine. This describes the principle, functions, and handling of the machine. properties.

Carbon Sequestration by Forests and Carbon Stocks in Harvested Wood Products

Keiichi Nakamata
Hokuetsu Corporation

This paper explains the international rules regarding at which stage carbon, fixed in wood, is considered to be released during the processes of harvesting, product manufacturing, use, and disposal.

During the Kyoto Protocol's first commitment period (2008-2012), CO₂ within timber was considered to be emitted into the atmosphere the moment it was harvested and removed from the forest. This rule is known as the "instantaneous oxidation approach". In the Kyoto Protocol's second commitment period (2013-2020), wood products were recognized as a carbon stock. Consequently, for developed countries, CO₂ emissions from domestically produced wood are now accounted for at the point when the wood product is disposed of.

An Environmental Awareness Enhancement Program Using the AI-Based Waste Sorting App “ECOPON” for Mixed Paper Sorting

Takao Ando
Faculty of Management, Atomi University

This study introduces ECOPON, an AI-based application developed to assist with the separation of mixed paper from other household waste. Gamification elements were incorporated to sustain the participants' motivation and participation, and environmental education activities were conducted in elementary schools. Features such as quizzes with point-based rewards have extended the educational impact of ECOPON and made the separation of mixed paper from other household waste an enjoyable experience for children. Although there is room for improvement, such as refining the interface and category labels, the participants were able to operate ECOPON easily and to consistently bring mixed paper from home to school. The ECOPON system was designed to first teach participants the local waste sorting categories, after which they *teach* ECOPON through repeated use, effectively training the artificial intelligence (AI). As a result, the participants came to understand that AI can make mistakes and developed a sense of familiarity with the AI technology. The accumulation of mixed paper image data collected from the participants will contribute to the development of future user-oriented sorting support systems and ensure high-quality recyclable resources domestically. As a circular economy advances, restrictions on imported raw materials may become more prevalent. Therefore, Community Design for the Environment (CDfE), defined as community planning in which consumers take responsibility for the sorting and collection of waste, is essential for realizing an advanced sound material-cycle society.