JAPAN TAPPI JOURNAL
2
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CONTENTS

CNF, Household and Functional Paper

Introduction of Research Laboratories (155)

2024 February JAPAN TAPPI JOURNAL
Vol.78, No.2 Abstracts

Food Applications of Cellulose Nano Fiber "Cellenpia ®"

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

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

Features and Developments of Phosphorylated Cellulose Nanofibers

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

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

Development status of CNF reinforced plastics (cellenpia® PLAS)

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

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

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

Novel Agricultural Materials Utilizing Cellulose Nanofibers Produced by Aqueous Counter Collision

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

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

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

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

Development of CNF reinforced plastics manufacturing process.

Takaaki Imai
Advanced Materials R&D Center, Daio Paper Corporation

In domestic, the development of CNF production process and CNF application are advanced, but there are still not a lot of commercial productions with CNF. In order to expand commercialization of CNF, it is important to reduce the production cost of CNF and to promote the development of technologies for expanding product applications. And reducing CO_2 emissions will realize social implementation and market expansion at early stage because of motivation for decarbonized society.

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

Introduction of eco-friendly chemicals for household paper

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

Under the PRTR Law, a number of chemical substances have been added to the list of substances subject to PRTR since 2023. In order to be environmentally friendly, it is preferable to avoid the use of PRTR substances as much as possible, and we have succeeded in developing coating and release agents that contain no PRTR substances as environmentally friendly household paper chemicals.
In addition, with the revision of the Safety and Health Law, businesses are increasingly required to pay attention to the health of their employees, for example by strengthening risk assessments.

The paper manufacturing process is a key source of paper dust. The household paper manufacturing process is characterised by its tendency to generate paper dust, which, if inhaled, could have a negative impact on employee health. Furthermore, paper dust is also a potential source of fire.
Therefore, in order to reduce the risk of health hazards and fires, we have developed paper dust inhibitors, which are agents that reduce the amount of paper dust.

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

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

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

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

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

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

Wire and Felt cleaner for Tissue Machines - CleanLine Excell -

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

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

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

Example of energy saving and improvement of operation with wire

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

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

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

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

Ryo Inamatsu
Maintech Co., Ltd. Fuji Office

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

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

Saving Fiber Cost for Tissue

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

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

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

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

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

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

Evaluating to functional paper by Imaging software
and LIBS technology

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

It has various way to industrial paper analysis depending various demanding like production, development of new or better functions, and others.
Even focusing impurities analysis, it has also several different needs like the size, distribution, source of contamination, material of impurities.
In this report, explaining several latest methods of functional paper analysis that new generation imaging analysis software and elements distribution imaging using laser irradiation (LIBS) with actual examples.
From these methods, we propose to reach more valuable information for R&D and more reasonable QC possibility.