JAPAN TAPPI JOURNAL
8
August 2022
Vol. 76, No. 8

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Pulp

2022 August JAPAN TAPPI JOURNAL
Vol.76, No.8 Abstracts

Conversion from paper pulp to cellulose nanofibers (CNFs)

Structures and characteristics of diverse CNFs, and their current R&D and challenges

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In this century, various methods have been found to separate “cellulose microfibrils” from plant cellulose fibers and to convert them into nanocellulose materials. Research and development of nanocellulose-containing organic and inorganic composites has been investigated for preparation of new functionalized materials in the world. If the production mass of nanocellulose is increased, the price of nanocellulose is expected to be reduced when paper pulps are used as the resources. The mass of production and consumption of nanocellulose materials will increase, if nanocellulose-containing polymer composites are achieved to have high strength, elastic modulus, and toughness even at small mass ratios of nanocellulose in the composites, resulting in a decrease in nanocellulose price. Partial substitution from metallic materials, reductions of the mass of fossil resources-based polymers and marine microplastics, and creation of a sustainable society based on biomass resources may be contributed by the quantitative and qualitative expansions of nanocellulose application and utilization. This is because nanocellulose materials are biosynthesized from atmospheric CO_2, and abundantly accumulated as cellulose microfibrils in plant bodies. The use of nanocellulose may also partly prevent and reduce the global environmental and resource issues. In the process of research and development for efficient preparation methods of new nanocellulose materials, various chemical pretreatments have been developed. These chemistry fields of plant cellulose fibers are categorized to new position-selective surface chemical modifications of crystalline cellulose microfibrils. These fields may open new technology of paper-like functional materials using chemically modified wood cellulose fibers containing abundant scaffolds for efficient counterion-exchanges with diverse cationic metal ions and alkylammonium ions under aqueous conditions.

Recent trends of biorefinery in Scandinavia

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The Japanese Government announced in 2020 the goal of making Greenhouse Gas(GHG) emissions net- zero（carbon neutrality） by 2050. In response to this, the Japan Paper Association has developed a similar long-term vision. The association has cited the following three technologies necessary for its realization; ①saving energy, fuel conversion ②CO2 absorption by forest improvement, ③development of CNF and chemicals from wood based material, which is referred to biorefinery . As for the biorefinery technology using wood and wood derivatives , Sweden and Finland have been active in this field for long time.

In this report, I introduce the biorefinery R&D trend and systems in both countries briefly.

Global Market Pulp Demand & Supply

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In most cases, pulp is integratedly consumed by paper producers. However, pulp is traded in market globally with approx. 70 million tons in 2020. Market pulp is a globally trading commodity and there are many factors to form its price. Among those factors, the balance of the market pulp demand & supply is one of the most important factors.

Looking at supply side, the production capacity gets increased every year and it is expected to be increased further. Especially the growth in South America is significant. Although South America has already become the biggest supply area, there are lots of additional expansion plans there. South America would keep leading supply side. For supply growth by grade, BSKP has some expansion plan, however, majority of the expansion is for BHKP because it has cost competitiveness in raw wood materials with fast growth.

Looking at demand side, the biggest demand area is China. Since 3% demand growth is expected in China through 2020 to 2025, it is necessary to keep monitoring the situation of China. Also, in Asia except for China, Japan and Korea, market pulp demand is expected to increase. On the other hand, in the matured markets, such as North America, West Europe and Japan, the demand is expected to be stable or decreased.

Both supply and demand are expected to be increased. Although demand is gradually increased, supply tends to jump up when the expansion projects start. The demand & supply balance on BSKP is expected to be tightened because of the limited expansion plan. However, that of BHKP is expected to be softened because of the lots of expansion plan. That balance is important when we consider the market pulp price trend.

Lates trend about new Pulp mill projects in the world

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The investment about a pulp mill has been very active recently. Since 2010, 30 mega pulp mills have been built or being built all over the world. Most of them are located in South America or South East Asia where it is rather easy to procure raw material. On the other hand, some investments about a mega pulp mill have been done in Europe, especially Northern Europe. This is very much interesting because the situation of pulp and paper demand in Norther Europe is similar to that in Japan. Printing paper demand has been decreasing in both regions. Although the pulp and paper market in Northern Europe is not growing as rapidly as in South America or South East Asia, the investment about a pulp mill has been rather active. Recent investment about a pulp mill has interesting features. CO_2 emission and new revenue from a pulp mill could be a key factor. Some mills in Europe target to be a bio refinery plant.

Kiln Fuel Conversion Toward Carbon Neutrality

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In Europe, including the Republic of Finland, an environmentally advanced country, the fuel for combustion in lime kilns has already been converted from heavy oil to natural gas since around 1995. Furthermore, in recent years, they have been reusing the side streams discharged from the pulp production process, aiming to completely closed mill. In addition, in response to recent climate change, each company is working to reduce CO_2 emissions in order to meet the CO_2 emission limit targets set at COP26 held last year. Pulp and Paper mills require a vast amount of fuel for chemical recovery processes, power generation and steam production. The process that consumes the largest amount of fossil fuels is the Lime Kiln. Kraft pulp mills around the world have already begun to switch from fossil fuels such as heavy oil and natural gas to biomass fuels to achieve carbon neutral. For example, bark and sawdust, which would normally be discarded, are being effectively used. These can be realized through gasification of biomass waste.

Typical delivery examples include belt dryers, gasification plants in combination with multi-fuel burners for Lime Kilns. The belt dryer uses the low-temperature waste heat available at the mill, and the gasification uses a gasifier based on circulating fluidized bed (CFB) technology. ANDRITZ has already installed four CFB gasification plants for pulp and paper mill (for Lime kilns) in the Republic of Finland, the People's Republic of China, and the Federative Republic of Brazil. The following is an overview of the advanced gasification technology.

Advanced technology to counter the increasing foreign matter

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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 I will introduce the process that focuses on the pulping system, together with some case studies.

Operational Experience of MaxiTrasher and MaxiSeparator

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The domestic newspaper production has been declining due to the development of digital technology in recent years. Furthermore, waste paper market is expected to decrease and hard to get waste newspaper because the export of used paper has expanded. On the other hand, the recovery rate of overall used paper is high in recent years due to increase in environmental awareness and the recycling rate of waste paperboard. Considering the current situation of collecting wastepaper, there is an urgent need to increase the use of low-grade wastepaper.

For the above reasons, Iwanuma Mill DIP-2 installed Aikawa Iron Works MaxiTrasher and MaxiSeparator to use more low-grade wastepaper in November 2019. This report describes the experience of operating the new system.

Development of online pulp color dirt observation equipment

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The method of measuring dirt in pulp is performed which are visually confirmed and measured by humans. However, with this method, there is a large time lag when managing dirt on a production line and continuous measurement is difficult. Therefore, OMRON has started manufacturing system that can monitor dirt in pulp in real time. After that, OMRON discontinued the product, and we developed the system as a successor to the product, released the product as a monochrome version of the online dirt meter.

On the other hand, the ratio of DIP used has increased due to the increasing recycling momentum and environmental measures, the operation department needs to manage color dirt that are difficult to detect with monochrome versions such as UV ink and color impurities.

Therefore, we worked on colorization of the online dirt meter in collaboration with Nippon Paper Industries Iwanuma Mill, and started developing system that "visualizes" color dirt in pulp in real time. This paper introduces the development of product and functions of this system.

Stabilizing of Stock preparation LC-refining by using Valmet online analyzer

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Paper properties are determined by the fiber properties. Fiber dimensions are changed by refining. The refining result is affected by many factors such as fiber species, process conditions, refining system, refiner geometry, refiner fillings, amount of refining and intensity of refining. Traditionally, refining has been controlled based on freeness (drainage rate) with either manual or feedback control.

Freeness is the result of the treatment of the fibers and the same freeness can be achieved with very different fiber properties. Advanced fiber imaging techniques have now provided a better understanding of the freeness quality.

Controlling refining by freeness alone may not produce a homogeneous mass on the machine, even if the refiners themselves are at their setpoint. Paper machines can experience unexpected web breaks due to changes in fiber properties even though Freeness (CSF) or Schopper-Riegler are firmly on
target.

The quality of the freeness must be known in order to optimize the refining to produce a better end product.

Introduction of sulfuric acid dilution system with pump control

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IWAKI CO.,LTD

In the pulp and paper plants, various chemicals including strongly acidic/alkaline substances, are utilized in manufacturing processes and waste treatment. For instance, sulfuric acid is used for pH adjustment in the bleaching process, neutralization of alkaline waste. Because of its large amount of usage and low-cost perspective, concentrated sulfuric acid is generally used with dilution. However, dilution of sulfuric acid is a highly exothermic reaction, which involves the potential risk of a serious accident. It is critical to select optimal control systems, corrosion-resistant pumps, and cooling systems in order to achieve safe, reliable dilution of concentrated sulfuric acid.

Defoamer for craft pulp manufacturing process

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In this lecture, the basics of defoamers and defoamers for kraft pulp production process will be explained, and the evaluation methods and applications in actual process will be described.

Black liquor contains various surfactants and is prone to foaming. This can lead to a decrease in productivity and quality in the kraft pulp manufacturing process. There are two ways to prevent foaming problems: mechanical and chemical methods that use defoamers.

Optimization of Liquor Recycling System

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There are a lot of impurities in wood, such as Iron, Silica, Magnesium, Aluminum. As a result, they go into the pulping manufacturing process. The existence of plenty of impurities in green liquor occurs poor sedimentation and impurities leak to the next step. The next steps are slaker and causticizing tank. Impurities disturb causticizing reaction, Causticizing Efficiency (CE) is down, and calcium carbonate particle size becomes smaller. These cause poor dehydration at white liquor filter and lime mud filter, and Lime Availability (LA) decrease. Lower LA means that causticizing reaction needs more new purchased calcium carbonate. Lower CE means that Dead load chemicals (Dead load) increase. Dead load does not participate in pulping reactions in the digester and is circulating through the pulping and recovery cycle. Here Dead load is sodium carbonate. Dead load moves with water in the pulping and recovery cycle. It means that more energy needs at digester, evaporator, and recovery boiler.

In this report, we first describe the problems caused by changes in the raw materials used. Next, we will introduce effective liquor recycling control methods that use a combination of liquor recycling control agents and S.sensing® system. Then, we will report the case where the water quality control of the green liquor clarifier process contributes to the stable operation of the kraft chemical recovery process.

The latest Pulper detrash system.“ S-PAL ”

Kazuma Hagiwara
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 contribute to establishing a resource recycling society as well as sustaining a consistent paper recycling activity, we need to propose 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.

First step for Smart Factory , Operational experience and effectiveness of SKF Condition Monitoring System

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In the manufacturing industry, labor shortages are becoming more serious due to the declining birthrate and aging population. In addition, sudden failures are increasing due to aging equipment and machines, and it is necessary to consider the safety of maintenance work.
Therefore, this time, we introduced SKF (Global bearing manufacturer headquartered in Sweden) bearing condition monitoring system to the Rengo Kanazu Mill No. 2 paper machine and remotely monitored it 24 hours a day to detect abnormalities at an early stage and verify their effectiveness.

Since January 2020, SKF condition monitoring system has been introduced and started operation for the rolls to be monitored, and it was found that the number of unplanned accident stops was reduced after the implementation of the system. This is because sensors make it now possible to check the status of bearings that cannot normally be inspected and early detection of abnormalities has made it possible to take early maintenance actions on bearings. It is considered that it is possible to predict and maintain abnormalities of mechanical factors such as roll unbalance and loosening of housing mounting bolts.

In future, we will continue to introduce a condition monitoring system for the bearings of all rolls of the No. 2 paper machine to further strengthen maintenance, and by repeating vibration analysis, we will improve the accuracy of the threshold and make it a system suitable for the No. 2 paper machine.
Because of the success of this trial, Rengo plan to make all of our factories Smart Factories, and the SKF condition monitoring system will be installed at all Rengo factories in the future.