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Basics of headbox from former theory and transition, latest trend

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Valmet K.K

Focusing on the historical development of papermaking machines, this paper introduces the basics and latest technologies of the wet part, especially the headbox and wire part. Headboxes evolved from open type, closed pressurized type, and hydraulic type, and the introduction of edge flow control and dilution control improved the control performance of fiber orientation and cross direction BD profile, and paper quality improved dramatically. Meanwhile, the wire part was designed to increase speed and improve formation, with the Fourdrinier and twin wire as its cores, and hybrid formers and gap formers were developed. The twin wire former, which simultaneously dewaterers from the top and bottom, reduces the two-sidedness, contributing to improved quality. In recent years, layering headboxes, vacuum assist shoes, sleeve rolls, and other devices that realize multi-layering have appeared, making it possible to save energy and reduce space. In particular, the latest sleeve roll technology has improved dewatering performance while significantly reducing vacuum energy, bringing about great benefits in terms of both production costs and environmental impact. Learning about the development of papermaking technology based on the efforts, setbacks, and inquisitiveness of our predecessors leads to an understanding of the essence of papermaking and will enable new developments in the future.

Operating Experience of the Latest Headbox from Valmet at Corrugated Medium Machine

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The headbox of PM7 at Rengo Yashio mill had been used since its start up in 1991. In 2023, Valmet's OptiFlo Gap headbox was installed to enhance the paper quality and run the machine at higher speed for better productivity. Both the bone dry basis weight R and 2 σ in the cross direction improved about 50 % after that. In addition, through trial and error, sheet breaks at paper machine and winder were reduced and an average of machine speed achieved about 4.2% increase. Greenhouse gas emission was also reduced because of these high production efficiency. This paper will introduce our experience of operating this new headbox.

Basics and latest trends of forming fabric (Energy saving)

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A forming fabric is an integral component in the forming section of the paper machine. It has 3 functions: ①Dewatering pulp slurry, ②Creating the sheet formation, and ③Carrying to next press section. The origins of forming fabric are very ancient, it has been used before Louis Robert from France invented the world's first continuous paper machine in 1798. Early forming fabrics were made of metal and had been used until around 1975. Later, as paper machines have become larger and faster for the requirement of high-quality paper and increasing productivity, plastic fabrics are the main material used. Forming fabrics are one of the important components that not only determine paper quality, but also influence the operability of the next process, the demands on it are high and forming fabrics have been constantly evolving to keep up with changing trends.

In today's world situation, the global goal, as set out including the SDGs, is to aim for sustainable development that achieves a balance between the environment, economy, and society and this has become an urgent issue that must be achieved. In Japan, the Energy Conservation Law requires the promotion of sustainable production and consumption through the efficient use of energy and the spread of energy-saving products. The pulp and paper industry are a sector that consumes a relatively large amount of energy, and active efforts are being made to reduce the environmental impact. The drive power of the forming part is estimated to be several million to several hundred million yen per year, so reducing the drive load will help reduce energy consumption.

In this session, introduce the history of forming fabrics briefly, and describe the latest lineup, the N series and eco series, and introduce a case study of reduced drive load as an example of an energy-saving product.

De-watering unit at wire part: Functions and Maintenance

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There are different kind of de-watering units at wire part, such as Forming Board, Multi Hydro Foils, Wet Vacuum Foils and Suction Box etc.

Good sheet formation can be achieved by optimum application of those units and periodical maintenance. In this article, we would like to review functions of different kind of de-watering units, focusing on Fourdrinier machine, and required scheduled maintenance cycles through our over 50-year experiences.

Wet-end Optimization with Camera Monitor System and Dewatering Elements

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IBS Paper Performance Group (IBS-PPG) propose a new approach to wet-end optimization by combining its existing wet-end optimization technology of iTABLE® system with newly developed high-speed camera monitoring system for wet-end activity control. iTABLE® consists of 1) Flexible forming board in MD position, 2) Height and angle adjustable blades in dewatering boxes, 3) Vacuum control valves, 4) Control Unit, and 5) On-line dryness sensor. These are all targeted to improve sheet formation and operational flexibility in sheet forming zone of wet-end. IBS has delivered over 200 systems of iTABLE® all over the world with benefits of improved sheet formation, reduction in basis weight, machine speed-up, refining energy saving, sheet strength improvement, and reduction in chemical usage.

IBS has also recently developed a high-speed camera monitoring system for various wet-end activities. TableVision® system involves different sets of camera and software to monitor and control important aspects of wet-end activities. JetVision monitors jet impingement point by measuring the length of jet cut-through of stock to maintain a proper position of forming board. ActivityVision monitors and quantifies fiber activity with cameras set along forming table. FlocVision monitors and quantifies sheet formation by measuring the size of fiber flocs. With two different set of LED lighting, it can observe both topography and sheet formation. LineVision monitors dry-line position to control proper vacuum level.

This new approach for wet-end optimization with a combination of flexible iTABLE® system and visual online-controllable TableVision® would provide paper makers with competitive advantages, operational flexibility and means to overcome human resource shortages. This combined system has been delivered to over 50 customers with significant benefits such as improved sheet formation, conversion from fresh pulp to recycled pulp and reduction of B-grade products and rejects.

Introduction to Linear Turbine Vacuum Pump

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Currently, carbon neutrality efforts are being actively carried out around the world. In addition, the global situation continues to be unstable, and various factors such as soaring prices of raw material and fuel continue to increase the demand for improved production efficiency and energy conservation.

Paper mills consume a lot of electricity in the equipment of stock preparation process, fan pump, drive devices for paper machine, vacuum line, etc. Among them, the vacuum line could not replace conventional equipment such as roots blower and turbo blower, and the development of energy-saving vacuum equipment would be desired.

Among them, applying the technology of linear motor which had been researched and developed in Japan and Germany, China Yisheng Linear Technology Co., Ltd developed the rotating linear turbine vacuum pump with magnetic bearings in 2018.

Since magnetic bearings are used to support the shaft non-contact, energy loss such as friction is very small, and high-speed rotation is possible. In addition, by being directly connected to motor, there is little mechanical loss such as belt and gearbox, and transmission efficiency is very high. On the other hand, its low noise can greatly contribute to reducing environmental impact and workload.

While many paper mills in China are using linear turbine vacuum pump, with the introduction of linear turbine vacuum pump at paper mills in Japan, this equipment can greatly contribute to energy conservation.

Operational Monitoring with MillONE

Rei Nagaoka

IHI Voith paper technology. Co. ltd. Digital group

In the factories of major paper manufacturing clients, 24-hour operations are conducted to maintain maximum operational efficiency. One of the many requirements for sustaining 24-hour operations is the development of an operational screen (GUI) that allows operators to easily check the operational status and perform detailed actions. An excellent GUI is intuitive to use, enabling workers to quickly obtain necessary information, thus improving work efficiency and creating time for decision-making based on operational data. The usability of the GUI is directly linked to the job satisfaction of the operators.

Voith Paper is focusing on the quality of this GUI and operational efficiency, advancing the development of a GUI software called MillONE. This document will detail the features and benefits of using this software.

New technologies to improve paper machine operability

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SOMAR Corporation

In many cases, recent paper defects and paper breakage problems are caused by complex substances. The multifunctional coagulant “REALIZER A Series” which is being developed to solve these problems, is a highly dispersible polymer that is easy to add and helps improve the operation of papermaking machines. The application of “Reactive Polymer” a new polymer design technology, to this multifunctional coagulant has led to further improvement of its effectiveness. As shown in Figure 1, recent years have seen a decline in the quality of pulp raw materials, which has led to a decline in wet end properties such as yield and paper quality such as paper strength. This has also increased the white water load and made the paper machine more susceptible to contamination. The number of problems such as paper breakage and defects, which have a significant negative impact on the operability of paper machines, has been increasing year by year, and countermeasures are required.

In last year's report, we introduced the improvement of fixability and reduction of defects of the internal paper strength agent by applying the oxidation type slime control agent “CURESIDE Series” and the multifunctional coagulant “REALIZER A Series” that introduces reactive polymer technology. We are studying the possibility of applying these technologies that can improve paper strength to reduce paper-breaking problems in paper and paperboard machines. In the paperboard field, paper breakage is often caused by filler components, and paper breakage is particularly likely to occur in high-ash grades. In the paperboard field, adhesive substances brought in from recovered paper materials often cause stains on dryers and other equipment, leading to paper-breaking problems.

Here, we will explain our new approach, “SOMAR Optimal Wet End Management” by introducing examples of how tool contamination in paper machines can be reduced by improving the fixation of fillers and additives to pulp fibers.

Responding to Increasing Waste Paper Processing

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There will be more needs of recovering applicable fibers from high wet strength, hard-to-defiber recycle paper and paper broke that have been incinerated as general waste due to difficulty of recycling.

This paper introduces efficient and stable processing of such hard-to-defiber recycle paper, presenting recommended workflows with our equipment for various waste paper grades.

Case Study of HYMO Wet End System Using Coagulants

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In recent years, induced by the SDGs, reduced impact on the environment became more and more important. Therefore, paper mills are promoting the use of low-grade wastepaper and closed systems in the papermaking process. Among these, the use of low-grade wastepaper leads to an increase in short fibers and fillers and to increased amounts of pitch components. As a result, a rising amount of pitch components causes an increase in web breaking and other trouble in the papermaking process. In addition to this, closed systems result in larger pitch particles through hydrophobic interactions among pitch components. When we analyze detrimental substances caused by pitch trouble and resulting in web breaking, short fibers, stickies, calcium carbonate and pitch components are identified in many cases. In this situation, coagulants, retention and drainage aids are getting more and more important. Along with their roles, coagulants, retention and drainage aids provide various functions that contribute to the SDGs and result in a considerable reduction of the environmental impact. As for the specific functions of these chemicals, they shall enhance an effective use of fibers and fillers, as well as other paper chemicals, improvement of wastewater treatment, reduction of energy consumption, and improvement of the paper quality.

In this report, we introduce our characteristic coagulants, named NR-883 and the MT series. We show as well, field results using characteristic coagulants and our combination system of coagulants and retention aids. In further detail about our characteristic coagulants, NR-883 has a special structure of hydrophilic and hydrophobic segments, adjusting molecular weight properly. The MT series consists of multi-compound polymers, having a very wide range of molecular weight and charge density. These characteristic coagulants are very effective in preventing pitch trouble.

We are aiming at contributing to the SDGs and the reduction of environmental impact by applying coagulants, retention and drainage aids and by making effective use of the HYMO Wet End System.

Solution for operation stabilization by analysis of wet end monitoring sensor and defect information

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Maintech Co., Ltd. Fuji Office

The number of problems caused by machine deposits has been increasing due to the worsening of the raw material of pulp situation. In addition, it is becoming increasingly difficult to respond to machine dirt deposits in a timely and appropriate manner due to the decrease in the working population at production sites and the retirement of experienced employees. To address this issue, we are developing "SmartPapyrus®", a system to prevent defects and sheet breaks by visualizing machine dirt deposits using IoT, analyzing it using artificial intelligence, and using machine dirt deposit prevention technology.

In addition, we are currently installing sensors at multiple locations in the stock preparation line and conducting continuous online measurements to identify the causes of defects classified by SmartPapyrus® 1.0.

In this report, we will introduce on the analysis results using sensor data from the stock preparation line for the defects that have been classified by SmartPapyrus® 1.0, as well as changes in sensor data and defect trends due to switch in retention agents.

A Report on Participation in the 22nd International Symposium on Wood, Fiber, and Pulp Chemistry (ISWFPC)2025, Raleigh

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The ISWFPC is an important international symposium that encompasses researchers in the field of wood chemistry, chemistry of fibers related to wood components, and chemistry of pulping and bleaching, as it covers a wide range of topics from basic to applied chemistry. Since the first symposium was held in Stockholm, Sweden in 1981 as the “Ekman Days”, it has been held every other year except for 2021, when it was cancelled due to a pandemic. The name of the 2nd–12th symposia was “ISWPC” because pulping and bleaching chemistry and chemical structure of lignin were the main themes in the 20th century. Cellulose nanofibers and biorefineries have become important themes in the 21st century, resulting in changing the name to “ISWFPC from the 13th symposium. The 23rd and 24th ISWFPC will be held in Pekanbaru, Indonesia in 2027 and in Nanjing, China in 2029, respectively.

The 22nd symposium was held at North Carolina State University (NSCU) in Raleigh, the capital of North Carolina State, USA, from June 2nd to 6th (with a pre-symposium on June 2nd and a tour of facilities in the university on June 6th). Profs. Hasan Jameel and Sunkyu Park of the Department of Forest Biomaterials, College of Natural Resources, NSCU chaired the organizing committee. A total of 192 participants (128 general (21 Japanese) and 64 students (4 Japanese)) from 21 countries attended the symposium, which consisted of 5 plenary lectures, 98 oral presentations (including cancelled), and 83 poster presentations (including cancelled).

This article introduces the contents of several plenary lectures, oral, and poster presentations.