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Paper physics and the ways of thinking as the basis of papermaking technology

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Paper physics is decisively related to its structure from macro to micro level, and the structure is made by paper-making and converting technologies. Thus, paper physics is the basic science which covers paper-making, printing, converting, and its final use with logistics, recycling, and further the basis of some paper standards and testing methods including JIS depends on paper physics. In this article the relation between paper physics and the structure is illustrated with some examples and several important points on carrying paper physics study are explained. Considering its excellent environmental and recycling properties, paper would also be widely used from now on, and thus more studies of the physical properties related to paper converting and the use are expected in future as well as extension of a conventional study on paper physics.

Technology transition of Coater
—Technology Transition of Blade Coater applicator—

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Blade Coater consist backing roll, applicator and blade. Blade coater produce level coated product. And blade was main player and applicator was not main player. When Wide paper width and high speed operating production is required, level coated product could not produce by blade only. Blade metering, together with uniform application, achieve the requested coated product. Jet type applicator was research and developed as uniform applicator in Japan. Jet applicator is blade coater world standard now. Based on this jet type applicator technology, ideal contour coating head for paper product named curtain coater, was developed in

Japan. Curtain coater produce special product, for example, pressure sensitive paper, thermo-sensitive paper and inkjet paper.
Curtain coater achieves easy operation and excellent coverage. These feature make green light to produce coated pigment paper and board now.

Rheological Behavior of Coating Color and Effects of Rheology Modifier

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Coating color suffers the high-shear rate by coating speed and the blade after applied to base paper. In this time, coating color carries the elastic behavior by the high-speed coating. Therefore, we pay attention to this phenomenon and investigated rheological behavior of coating color by dynamic viscoelastic measurement.
As the result, we have found some correlation between the loss tangent that is a ratio of the storage modulus to the loss modulus of coating color and especially bleeding trouble. Also we have considered the mechanism of bleeding occurring by this.

We could change the rheological behavior of coating color by rheology modifier "SOMAREX" developed based on this viscoelastic data and get the knowledge to be able to improve the runnability of paper coating.

Basic Knowledge of Starch and Starch Products for Coated Paper

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Starch is produced by green plants for energy storage. Starches are isolated from botanical sources. Corn and tapioca starch are familiar to Japanese market. Starches show characteristic property by varying from plant to plant. In addition to its property, Starches that modified physically and chemically are appropriate for wide range application; food to industrial fields. As to paper industry especially, starch is utilized for wet-end, surface-sizing, coating and spraying. The utilization of starch in regard to paper coating is role as adhesion. So, starch mainly adheres between pigment and coating base. On the one hand it is necessary to gelatinized starch to exert enormous effect on paper, but at the same time the gelatinization

leads to expression of starch retrogradation. On the grounds of retrogradation, any modified starches are not only placed on the market but also controlled on their temperature et.al in the process necessarily. Talking of modified starch for coated paper, highly modified Starches are usually used like starch urea phosphated and hydroxyethyl starch. In late years, as for coated paper manufacturing, high speed coating and high concentrated coating color are required. So, it is difficult to handle starch urea phosphated under foregoing conditions. Therefore, starch carbamate have been released and used as coating binder to provide high fluidity to coating color. At one point in time, the usage rate of starch trended toward a decrease in evaluation about coating performance. Because of the quality improvement of starch and a trend of cost reduction, existential value of starch is reappraised and a usage rate of starch increases recently.

Evolution of Pigment Use in Coating Applications

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In this paper we review the properties and performance of the main pigments (carbonates and kaolins) used in coated paper and board applications. We then go on to look at how pigment use and formulation practice has has changed in recent years, how this is influenced by regional differences and what this means for the role of kaolin in paper. We finish by looking more closely at some of the recent developments for kaolin which focus on how structured kaolin-based coatings can bring value in paper and board applications and how the functionality of kaolin can be used in speciality applications such as barrier coatings.

Recent Latex Technology Trends

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In order to increase the printing strength of coated paper, it is preferable to increase wettability between polymer particles and the adherend ,polymer cohesion force ， and interfacial adhesion.

Generally, the polymer particle design for improving backing roll dirt and increasing printing strength of coated paper is trade-off. With polymer particle morphology controlled and particle surface modified by water-based polymer, we have been able to improve backing roll dirt and increase printing strength of coated paper at the same time.
On the other hand, blister issue happened during off-set rotary printing process could be solved by increasing the calcium carbonate dosage during high-speed coating and double coating process. Therefore, the use of high gel type latex with strong printing strength which was generally used in off-set rotary printing for coated paper has become possible.

How to Improve Tissue Making
－Improvement and Achievement of Release Agent for Creping －

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Improving production and sheet quality have been one of the top priorities for tissue manufacturers. As press felt deposits due to recycled paper causes sheet web moisture profile uneven, coating on Yankee dryer tends to be unstable, which also leads to sheet spot and chattering mark on the dryer surface. Many kinds of Creping control agents especially polymer based coating agents have been used to solve the problems, however they have not succeeded in forming stable coating layer under the recycled furnish condition.
Maintech has developed innovative release agents “MRA series“ which protect the coating layer from the uneven moisture of the sheet web.
This report describes the concept and mechanism of MRA and its field testing cases in which MRA have been able to improve productivity and sheet quality.

Visualization of contract work

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Presently, the contract work is indispensable in many manufacturing. However,

in many manufacturing, proper management of contract work isn't done.
To improve this situation, it is important to do “visualization” of contract work and build the true form. The step which builds the true form is introduced here. Necessary to the purpose, a way of an actual condition survey and a way of thinking are also introduced.
The step which builds the true form is as follows.
(1) Finding problem by an actual condition survey
(2) Planning of the important problem
(3) Making of an improvement plan
(4) Execution of an improvement plan
It's an actual condition survey to become important first among these. If you can grasp the current state by conducting surveys on it, you can establish abstraction of a problem, building of the true form and proper price of contract work.
That step is below.
1) Grasp of details of work
2) Clarification of the work scope
3) Investigation of working time
4) Investigation of operational hardness or ease
5) Building of the true form / Reduction of working time
6) Calculation of proper price of contract work
When it's being advanced by this step, the indefinite contract work you're managing is probably becoming clear.
As the step which builds the true form, this time is the introduction until planning to settle problem, making of an improvement plan and execution of an improvement plan are omitted.
However, when a problem becomes clear, you will be easier to do making and execution of an improvement plan.

Company where expenses of contract work are big and that evidence is ambiguous, are better to do “visualization” of contract.

The History of Technological Developments of the Paper Industry in Japan after World War II

Part4　Chips Import and Integrated Mills of the Japanese Model（2）

Kiyoaki Iida

As discussed in the preceding issue, the paper industry of Japan developed a unique mill design model based on imported chips. Chips from abroad were carried to their existing coastal mills where they newly installed big kraft pulp plants and resulting pulp were integrally sheeted in the mills. The model found following advantages.

1. By installing big kraft plants, the mills increased their outputs, improved their productivity and became competitive internationally.

2. Though the yield of kraft process is about 50%, the residual organic matter is

a useful energy source, burned in the recovery plant to generate electricity and steam necessary in mill operation. The energy produced at recovery plant was as much as that of heavy oil purchased by the whole paper industry (1993)

3. As logging cost in Japan was very expensive, it was understood that the cost of shipping chips from abroad would be paying.

4. As chip import business became successful in the 1970s, the price of chips overseas started to rise drastically. The deficit was offset with the sharp rise of yen rate from 1970 to 1990.

5. As the volume of imported chips became larger than that of domestic chips, the price of domestic chips were controlled, the domestic forest was maintained and the wood supply to the industry was steadily secured.

6. Though the yen got stronger and imported products became oppressive to the industry for several decades, it favored imported chip prices and worked as a hedge in currency change.

Pilot plant operations in Kita-Akita city for producing bioethanol from lignocellulosic biomass

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Since June 2009, we have been operating a pilot plant to valuate a process for producing bio-ethanol from lignocellulosic biomass, wherein lignin is removed using soda-anthraquinone (soda-AQ) cooking as a pretreatment for enzymatic saccharification. By the end of September 2012, we completed all pilot plant operations and obtained the following results. Using a semi-batch cooking method, Sugi (*Cryptomeria japonica*) soda-AQ pulp was produced at an yield of 44%. The Sugi pulp was hydrolyzed using a commercial cellulase to obtain a sugar yield of 97%. The produced sugar solution was concentrated from 3.1% to 7.4% using a reverse osmosis membrane and then fermented using a yeast to obtain an ethanol yield of 96.5%. The volume of ethanol produced was then calculated to be 216 L from 1 BDT of Sugi chips.

Based on these operational data, we estimated the energy balance and manufacturing costs at a chip consumption rate of 250 t/day. In the entire process from pretreatment to ethanol distillation, the steam and electric energy consumption was 824.6 eT/day and 118.7 MWh/day, respectively. However, the

energy generated was calculated to be 1102.2 eT/day of steam and 189.8 MWh/day of electricity from the discharged black liquor, which exceeds the energy consumed. From these calculations of operating costs, we estimated the variable and total costs associated with producing 1 L of ethanol to be 98 yen and 263 yen, respectively. These estimations suggest that the cost of Sugi chips and depreciation expense would be substantially reduced to use this process.