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Basic Principles of Wood Chemistry and Proposal for Future Research

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In this paper, the basic principles of wood chemistry were briefly described with some proposals for the future research. Wood chemistry basically deals with a part of living tree as wood samples, not with wood chips of the raw material of the industry. It is important to note that each tree may have different characteristics dependent on the environmental conditions, in which the tree has grown up, even in the same species. This is one of the reasons why the most careful sample preparation is needed for the reliable discussion.

As far as the topics for the future research of wood chemistry, bio-ethanol production from softwood chips, advanced utilization of lignin, and new chemical pulping method were raised.

History of Continuous Cooking Technology and State-of-the-Art Development by Andritz

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Andritz K.K.

Kamyr continuous digester was invented and developed by Johan Richter during 1940’s. The first commercial digester was started up in Fengersfors in Sweden in 1950, of which capacity was only 50 tons/day. In 1953, the first continuous digester in Japan started up at Oji Paper Kasugai mill. Then, more than 50 digesters have been installed in japan and probably more than 500 digesters are introduced globally to date. The original technology concept invented by Johan Richter has been further evolved continuously. Today the single vessel digester system has been developed capable of producing more than 5000 tons a day. This paper summarizes major development history of continuous cooking system.

Development of Continuous Digester, Washing and Bleaching Equipment

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The technologies for making kraft pulp were progressed together with development of the continuous digester, the washing machines, and the equipment for bleaching plant, etc.. The latest kraft pulping plant for hardwood which developed by Valmet normally contents COMPACT COOKINGTM system, a number of TwinRoll™ presses as washing machine, an extend oxygen delignification system (OxyTrac™), and a high consistency ozone bleaching system(ZeTrac™) etc.. On the other hand, most of the kraft pulping plants in Japan were built before 1990. It is a great challenge to increase the efficiency of these mills in order to be competitive to the latest kraft pulping plant. And it is a good way to take the latest technologies or the concept into the existing plant in order to optimize the system further.

Introduction of Advanced Process Control (APC) on the Kraft Pulp Bleaching Process

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At Akita mill, fuel cost reduction in the kiln process has been achieved by use of oil cokes that started in 2013, there is more room for the energy saving because the operation of the kiln still depends on the experience of the operator. Also in the bleaching process, there is room for chemical saving because the process is always operated conservatively to keep the final brightness in the upper part of target range. For the above reasons, we introduced process optimization system to both the kiln and bleaching process in expectations of steady operation and cost reduction. Now, we are working on an early realization of the process improvement.

In this report, the background of the introduction of the system and future effort are explained. Although this system has many installation records overseas, it is first installation in Japan.

Current Situation and Problem of Japanese-Style Paper Recycling

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In this article Japan's current situations of collection, distribution, and utilization of the recovered paper as well as the system and characteristics of Japanese-style paper recycling are

introduced. The high utilization rate of recovered paper in Japan has been supported by this Japanese-style paper recycling, that is the securement of cheap and high quality recovered paper.

Next the influence of the consumption decrease in the newsprint and the printing and communication paper in progress and globalization of the recovered paper to the supply-demand balance in the world and Japan is analyzed. Then problems and corresponding direction (reinforcement for recycling) of the utilization of the recovered paper in each product category are reviewed.

DIP Technologies for Lower Grade Raw Material

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Recently, the positive signs are little by little seen in the domestic economy. However, because of the consideration of the environmental protection and the influence of well-developed digital devices, paper consumption has been kept still with a lower level. Furthermore, exporting of the recycled paper to China has kept still a higher level, even though the Chinese economy development shows a slowdown. With this background, it becomes more and more difficult to get the better quality recycled paper in the domestic market. On the other hand, in order to adapt the lower basis weight production as well as the higher speed paper machine, the quality standard of the DIP line can be more demanding.

Under these circumstances, the domestic paper manufacturing field now needs more and more the suitable technologies and facilities that can improve the quality with the minimum energy consumption, keeping the reasonable yield with using the lower grade recycled paper. In this section, we would like to introduce the basic technologies and the latest challenges for major equipment of DIP line.

Development of “Catalyzer Type De-Inking Agent”
—Development of the De-Inking Agent for UV Curable Inks—

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Recycling of waste paper is an important issue for environmental protection. As the paper

industry is committed to improve the utilization rate of waste paper, more and more the recovery of pulp from low grade waste paper is required to consider.

In comparison with normal printing inks, UV curable inks give strong fixed film which is hard to miniaturize in the de-inking process even at higher process temperature due to its high melting point. As a result, UV curable inks are hardly removed during flotation process because the ink particles are unable to floated by adsorbing on bubbles. Therefore the paper industry is facing serious quality problems of de-inking papers like big residual ink spots.

To avoid such unfavorable problems, printed materials with UV curable inks is contraindicated at waste paper recycling plants who are struggling to conduct the selection of waste paper. In such situation, the development of more powerful and superior de-inking agent and de-inking process for UV curable inks printed waste paper has been demanded. Therefore we have developed the world first “Catalyzer type de-inking agent” by which UV curable inks can be decomposed and miniaturized, by adopting new approach to combine surface science and catalysis science.

Basic Technologies of Pitch Control and New Developments
―NISSIN-Pitch Control Method―

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Recently, the quality of the wastepaper is lower than before, because the good wastepaper circulation volume shrinkage by influence of progress of information digitalization, and the other hand, improvement of paper quality and weight saving are desired from paper and board user, therefore deposit trouble is one of a serious problem for papermaking engineers.

The pitch included in the wastepaper will be adhered at various papermaking process, and the deposit causes web-breaks and defects. Therefore taking measures to the pitch in the pulping process is one of the methods to resolve a pitch problem fundamentally.

This report describes an important factor of pitch troubleshooting and introduces the primary and the newest pitch control technology.

Basic Lecture and Recent Development of Scale Control Technologies in Pulp Making Process

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Slightly soluble deposits called “SCALE” are experienced in pulp and paper industry which use plenty of water. Although this “SCALE” problem occurs in every process, “SCALE” is especially easy to form in kraft pulp making process due to its water quality, pH, and temperature.

If “SCALE” foams in process, it affects bad influences like bad heating performance in digester and bad washing performance in washer. Therefore, “SCALE CONTROL” is very important issue.

In this paper, we show the characteristics of scale deposits, the mechanism of their formation, and scale control technologies.

In addition, we introduce the next generation digester scale control agents “DEPONAX P-78” .

Biomass Researches in the FFPRI

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In this seminar, recent project studies on the biorefinery are mentioned. Cellulose nanofiber (CNF) is one of the hottest studies in biorefinary. CNF and lignin bench scale plant were constructed in FFPRI respectively. CNF from woody biomass is produced using alkali cooking technology followed by physical and enzymatic treatment. Lignin from sugi is produced by new technology. The lignin can be used in fabrication of nanocomposite films, sealing materials and automotive components.

Possibilities and Limits of Wood Resources as Energy Sources

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The biomass power plants based on the FIT (Feed-in Tariffs) system are under operation and many projects are scheduled to start operation in Japan. Although this has the power to revitalization of the Japanese forestry business, overemphasis of the fuel use might inhibit the sound growth of the forest industry. For the fuel utilization of wood resources, it should be

considered that the amount of usable woods, the efficiency of the power generation, and working conditions of forest workers.

Operational Experience by Modifying Kraft Pulp Production

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Fiber lines in Mishima mill have been modified and extended step by step along with new installations of paper machines. The total energy cost was pushed up due to increased number of equipment and distance of pulp traffic line.

Two of softwood fiber lines were unified to one. Hardwood fiber line was also retrofitted to get more production and to reduce energy. We decided to modify our softwood fiber line to get more production and energy efficiency improvement, making the most of equipment that had been idle after the retrofit of hardwood fiber line to reduce capital investment. After this modification, the production has been increased from 650 t/day to 950 t/day, which is the highest in Japan.

Our concept of the modification of new softwood fiber line was as follows;

- Operational improvement by modifying the existing cooking system
- Improvement of energy efficiency by enhancing the much more heat recovery
- Reduction of bleaching chemicals by the improvement of washing performance
- Upsizing the equipment by using larger one that had been idle

To increase the production rate, continuous digester has been modified to the Compact Cooking G1TM, which could accelerate the downflow of the chip column in the digester, and the capacity of screening and bleaching process has been upgraded.

We stabilized the operation by adjusting multi charges feeding ratio of white liquor, liquor-to-wood ratio and chip compaction in digester.

Practices for Specific Energy Reduction in TMP Process

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In 1970's the strength on newsprint paper manufactured in Tomakomai mill, Oji Paper Co., Ltd. depended mainly on mechanical pulp such as TMP（thermo-mechanical pulp）.

TMP contributed greatly to lighter grade of newsprint paper through established production system; however, the required pulp quality as well as production ratio has become less dependent on TMP after KP plant started and the production of DIP(deinked pulp) has been increasing along with the rise in environmental awareness.

Once oil-saving production system was implemented in 2008 at Tomakomai due to higher fuel price, we needed to improve operating conditions such as refining system or new type of refiner plates to reduce energy cost in TMP accompanied with high energy consumption.

In a series of several practices, we have continued to optimize conditions and introduce new technology while carefully considering required pulp quality, and finally achieved 30% specific energy reduction in the refiner process of TMP production.

－Peer Reviewed－

Characterization of Compressive Strength for Containerboard Using Short-Span Test

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Recent decrease in basis weight of containerboard raises some quality problems, one of which is decrease in ring crush compressive strength in spite of adding enough dry strength additives. As a result, this can lead to an error in calculating box compressive strength using Kellicutt's equation. In this paper, short-span test, which is widely recognized as the superior compression test to ring crush test, is reviewed from the analytical point of view as follows.

FEM simulation showed that ring crush compressive strength decreases with lower thickness due to buckling of the specimen, and that when thickness is extremely low, significant strength loss is caused by the buckling mode change.

Correlation between box and containerboard compressive strength suggested that short-span compressive strength could estimate the box compressive strength with more accuracy.