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Retention and functionalization of mechanisms of paper chemicals based on their interactions with cellulose fibers in papermaking process

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Alkyl ketene dimer (AKD), polyamine amide epichlorohydrin (PAE) resin, and aluminum sulfate have been used in practical papermaking process for more than 60 years, and many fundamental and applied technologies have been accumulated in papermaking mills. However, the actual papermaking process is complicated, and no adequate theory has been established for explanation of all the related phenomena and troubles owing to internal and external additions of paper chemicals without contradiction. In the case of addition of internal chemicals, it is necessary to analyze and determine the contents (or retention ratios) of the added chemicals in paper sheets for explanation of their functions and also troubles. This is because most of troubles of paper sheets are caused first by insufficient retention ratios of the internal paper additives, resulting in insufficient paper quality. Trace amounts of sizing components in paper sheets are determined by pyrolysis-gas chromatography. The amounts of cationic or anionic polymers containing nitrogen atoms (such as PAE and cationic/anionic polyacrylamide) are determined by a gas chromatography-type nitrogen content analyzer. Some elementals such as aluminum and sulfur originating from aluminum sulfate are determined for paper sheets by X-ray fluorescence analysis. When the contents of internal chemicals in paper sheets are sufficiently high but paper functionalities are unexpectedly insufficient, some interactions between paper chemicals and cellulose fibers and/or structural changes of the paper chemicals in the dried paper sheets should be considered and analyzed. Particularly, in the wet-end papermaking systems, small amounts of anionic carboxy groups in pulp fibers and fines play a significant role in electrostatic interactions with cationic paper chemicals such as sizes, polymers, and aluminum compounds and surface-anionic pulp fibers in water, their retention ratios in paper sheets, homogenous distributions of additives in paper sheets, and resultant efficient functionalization. These concepts of chemical modifications of pulp fibers using carboxy groups as scaffolds with paper chemicals in water may be extended to efficient surface modifications of charged groups-containing nanocellulose with cationic compounds in water to add water-resistance and hydrophobicity to hydrophilic nanocellulose. It is expected that efficient surface modifications of nanocellulose will be developed on the basis of the interaction and functionalization mechanisms of nanocellulose with cationic compounds in water.

Development of oil repellent for paper that doesn't rely on fluorine

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For more than half a century since 1968, "UNIDYNE" has been used as a water and oil repellent in various fields such as paper, nonwoven fabrics, textiles, and carpets. In recent years, the U.S. Food and Drug Administration (FDA) has expressed concern about impurities in fluorine materials and we are working on developing fluorine-free oil repellents for paper. Our goal is to be able to use fluorine-free oil repellent agents without compromising the paper's inherent properties, such as water vapor permeability and releasability that enables recycling.

We developed XP-8001, a fluorine-free oil-resistant agent for paper. By increasing the crystallinity of alkyl groups with low surface tension, we achieved oil resistance at high temperatures. Compared to other fluorine-free products, XP-8001 makes it possible to prevent oil penetrating while maintaining the paper's permeability. Since the product has demonstrated high performance in evaluations simulating actual applications, we believe that it meets market requirements.

Daikin Industries, Ltd will continue to provide valuable products in the future.

Determination of pH of aqueous extracts in neutral region

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This work sets out to investigate the determination of pH of aqueous extracts. Tokushu Tokai Paper Co., Ltd uses pH of aqueous extracts as one of the quality standards for paper products used for the conservation papers such as mounting board. The product is applied to the preservation of cultural properties and the storage of documents. The method for measuring the pH of aqueous extracts was updated in 2012 to the method for measuring by adding a potassium chloride solution. The determination of pH of aqueous extracts uses glass electrodes. Therefore, when we measured extract having a small electric conductivity, the deviation was increased. This phenomenon is unavoidable in terms of measurement principle. For many acid-free papers with calcium carbonate added, stable extraction pH measurement results can be obtained with a glass electrode.

ISO29681: 2009 has a method of extracting a paper sample with a 0.1 mol/L potassium chloride solution. For samples with a large amount of electrolyte, the deviation of the measured pH data will be decreased. On the other hand, in the case of acid free paper with a small amount of electrolyte, the deviation of the measured pH data was increased. And it is difficult in principle to measure pH accurately when the amount of electrolyte is low and the pH is around 7. Comparing the determination method with the same paper sample, the pH tended to be lower when the added amount of potassium chloride was large. In the case of the measurement method in which potassium chloride was not added, the deviation of the measured pH data became larger as the water purity was higher. We report that it is affected by the water used for extraction and the added potassium chloride solution.

Operating Experience of Canvas Cleaning Equipment

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Oji Materia Co., Ltd.'s Fuji Plant owns two paper machines: the N-1 machine for making corrugating medium and the N-2 machine for making white paperboard. Both machines are capable of making paper from 100% recycled paper, and play a role in Oji Materia as a resource-recycling plant.

The N-1 machine, which makes corrugating medium, is one of the leading high-speed paperboard machines in Japan, capable of making paper at speeds of 1,000m/min or more. Caused by dirty tools, As a result, defects are generated and paper breakage troubles are induced. In particular, dirt from sticky substances that accumulates on the dryer parts is a cause of trouble, so we have taken a variety of measures to strengthen cleaning with the existing high-pressure water canvas cleaner and regular cleaning of the blade-type cleaner, but we have struggled to cope with ensuring work safety.

As a countermeasure, we installed the "fabriKeeper" in the most dirty group in the dryer part in August 2021 and obtained good results. We report the consideration of introduction, our operating experience and results.

『Heat loss diagnosis and countermeasure for steam piping』 - 『Reduction of heat loss by the Aerogel Insulation Over-Wrapping Method』 -

Sho Suyama
NICHIAS Corporation

In industrial field, we can't ignore the heat loss from steam pipes that happens as the water absorption degrades a performance of insulation.

Here we introduce the countermeasure against this kind of heat loss, "The Aerogel Insulation Over-Wrapping Method".

We won the Grand Prize for Excellence in Energy Efficiency and Conservation in 2018 for the countermeasure method, which suggests ① Visualization of heat loss ② Improvement by strengthening heat retention ③ Verification of effect.

The latest fiber recovery filter applied for pressure screen

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The recent target of Stock Preparation System is to improve stock quality, to save energy and to save fiber loss. Also the importance of water saving is also getting higher as other target. This means that effluent treatment is also need to be improved to get better recycled water to reduce the usage of fresh water.

Typical effluent treatment has two steps as primary (with DAF: Dissolving Air Flotation) and secondary (with sedimentation). After water clarification, sludge comes out from the system. Sludge includes some short fibers which can be reused, and usually sludge is treated by landfilling finally. If short fibers are reused it would save the cost not only of fibers but also of landfill.

To recover the short fibers usually Disc Filter is applied, but a Disc Filter need big installation area and expensive cost of machine itself. Therefore it is not still applied for many customers yet, especially for the customers in small production.

To recover more short fibers at effluent treatment in relatively small flow ratio, smaller and easier machine is necessary. In this article, I introduce the latest fiber recovery technology with screen basket.

Attractive effect of long-life UV-LED lamp on flying insects

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There is a need to switch from fluorescent lamps to LEDs as the light source to attract insects. We have been selling UV-LED based light trap since 2017. In 2021, we have developed UV-LED lamp that have a longer lifespan and save more energy than conventional UV-LED lamp. In this study, we compared the attracting effect of old and new UV-LED lamp. There was no significant difference in the number of flying insects captured by the light trap with UV-LED lamp before and after the improvement. These results suggested that the new UV-LED lamp would be an energy-saving, long-life, and high insect attractiveness.