TJ SUMMARIES

THE PAPERS SUMMARIZED HERE are from the *TAPPI Journal* July 2019 issue and August 2019 issue featuring special foam forming content. *TAPPI Journal* is an online publication of relevant and timely peer-reviewed research delivered via email and free to all TAPPI members. To receive *TAPPI Journal*, join TAPPI at www.tappi.org.

JULY

TISSUE

Measurement of the dynamics of fluid sorption for tissue papers

Konrad Olejnik, Jean-Francis Bloch, and Pawel Pelczynski

Liquid absorption ability is among the most important features of tissue papers. Due to non-homogeneous internal and superficial structures, precise and fast evaluation of this property is challenging.

The main aim of the presented research was to design an experimental device for measuring the kinetics of wetting phenomenon for tissue papers. The second aim was to evaluate whether it was possible to use image analysis for more precise characterization of liquid absorption properties of tissue paper.

The obtained results showed that the method used, based on image analysis supported by gravimetric methods, proved to efficiently and quantitatively characterize the dynamics of liquid absorption for tissue papers. Different experimental results were obtained for various tissue paper grades. Furthermore, water absorption capacity calculated from image analysis data correlated with results obtained according to the standard method EN ISO 12625-8:2010 "Tissue paper and tissue products—Part 8: Water-absorption time and water-absorption capacity, basket-immersion test method."

The presented method brings new information about sorption properties of tissue paper. Engineers and researchers can benefit from the new method in terms of better characterization and process optimization.

COATING

Citrus-based hydrocolloids: A water retention aid and rheology modifier for paper coatings

Preeti Tyagi, Michael Joyce, Sachin Agate, Martin A. Hubbe, and Lokendra Pal

This study describes the use of natural hydrocolloids derived from citrus peel fibers as a rheology modifier in paper coating applications. Researchers compared results with carboxymethyl cellulose (CMC) in a typical paper coating system. Water retention of the coating formulation was increased by 56 percent with citrus peel fibers compared to a default coating, and it also was higher than a CMC-containing coating. The Brookfield viscosity of paper coatings was found to increase with citrus peel fibers.

Compared to CMC, different citrus peel fibers containing coating recipes were able to achieve similar or higher water retention values, with no change or a slight increase in viscosity. Researchers measured all basic properties of paper to assess the impact of citrus peel fiber on the functional value of the coatings. Paper properties were improved with coated paper containing citrus peel fibers, including brightness, porosity, smoothness, surface bonding strength, and ink absorption.

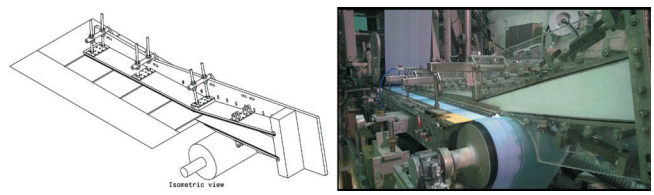
Due to their high content of pectin, citrus peel fibers have shown excellent control of rheology in a paper coating system. The industry impacts for this technology include introduction of a green chemical and upcycling of a waste byproduct from discarded citrus peel.

AUGUST

PAPERMAKING

Upscaling of foam forming technology for pilot scale

Jani Lehmonen, Timo Rantanen, and Karita Kinnunen-Raudaskoski



In VTT Technical Research Centre of Finland's pilot scale environment, modifications for foam forming included use a specially designed closed headbox geometry for stabilzation of foam recovery.

Changes in the global paper and board industry during past years have increased the need for more cost-efficient processes and production technologies. It is known that in paper and board production, foam typically leads to problems in the process rather than improvements in production efficiency. Foam forming technology, where foam is used as a carrier phase and a flowing medium, exploits the properties of dispersive foam.

In this study, the possibility of applying foam forming technology to paper applications was investigated using a pilot scale paper forming environment modified for foam forming from conventional water forming. According to the results, the shape of jet-to-wire ratios was the same in both forming methods, but in the case of foam forming, the achieved scale of jet-to-wire ratio and MD/CD-ratio were wider and

OTHER RESEARCH APPEARING IN TAPPI JOURNAL'S JULY 2019 ISSUE:

BLEACHING

Kraft pulp bleaching with a P-stage catalyzed by both bicarbonate and TAED
N. Das, S.K. Bose, and R.C. Francis

NONWOOD PULPING

Enhancement of processability, surface, and mechanical properties of paper based on rice straw pulp using biopolymers for packaging applications
Shubhang Bhardwaj, Nishi Kant Bhardwaj, and Yuvraj Singh Negi

not behaving sensitively to shear changes in the forming section as a water forming process would. This behavior would be beneficial when upscaling foam technology to the production scale.

The dryness results after the forming section indicated the improvement in dewatering, especially when foam density was at the lowest level (i.e., air content was at the highest level). In addition, the dryness results after the pressing section indicated a faster increase in the dryness level as a function of foam density. According to the study, the bonding level of water- and foam-laid structures were at the same level when the highest wet pressing value was applied. Wet pressing can compensate for the strength loss often associated with foam forming.

In summary, use of aqueous foam as a process fluid instead of conventional water permits enhancement to paper and board production and products. Enhancement in dewatering and increased dryness after wet pressing enable savings in drying energy consumption and offer improved formation, higher bulk of the web, and lightweighting of current products.

PAPERMAKING

Polyvinyl alcohol as foaming agent in foam formed paper
Jens-Mikael Gottberg, Timo Lappalainen, and Kristian Salminen

This work investigated the use of polyvinyl alcohol (PVOH or PVA) as a foaming agent in foam formed paper. Polyvinyl alcohol is a linear, nonionic water-soluble polymer. It has hydrophobic and hydrophilic parts that give it a surface-active character. PVOH is mainly characterized by degree of hydrolysis and molar mass. Degree of hydrolysis is given as mol-% hydroxyl groups on the polymer. Molar mass is measured indirectly by measuring the viscosity of a 4 percent PVOH solution.

The results showed that the degree of hydrolysis of PVOH had a strong effect on the foamability of PVOH. Foamability decreased strongly when the degree of hydrolysis increased from 88 to 98 mol-%. The effect of molar mass on foamability was weaker. The researchers saw an increase in foam stability and bubble size with increasing molar mass, but did not see any effect on maximum air content.

The best strength properties were achieved when using fully hydrolyzed PVOH as the foaming agent. Strength properties (both in- and out-of-plane) of samples made using PVOH were better than those made using an anionic foaming agent (sodium dodecyl sulfate). By adding PVOH binder fibers to the pulp, the researchers were able to further enhance the strength properties of paper and board. The results can be used to judge which type of PVOH should be used when looking for optimum strength and foaming properties.

PAPERMAKING

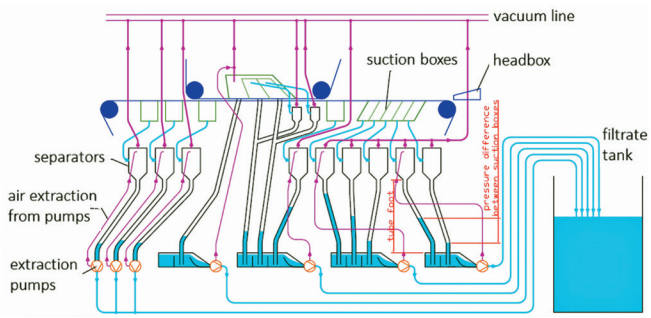
Real-time monitoring of bubble size distribution in a foam forming process
Antti Koponen, Hannu Eloranta, Ari Jäsberg, Markus Honkanen, and Harri Kiiskinen

Foam forming is an intricate option to lessen fiber flocculation and to get better energy and water efficiency when making fiber-based products. Developed during the 1970s, this approach has recently received renewed attention, mainly because it also offers possibilities to broaden the fiber-based product portfolios with novel and more valuable products.

In addition to air content, bubble size is the most important property of foam. Foam quality control is essential for building real-world foam forming processes. In this work, researchers show how bubble size can be monitored with direct optical imaging in real time under real process conditions, and how such analysis helps adjust foam quality and discover process faults in foam forming.

PAPERMAKING

Progress in foam forming technology
Harri Kiiskinen, Kristian Salminen, Timo Lappalainen, Jaakko Asikainen, Janne Keränen, and Erkki Hellén



To handle low-density foam, the vacuum system of VTT's pilot machine required modification in the form of four extraction pumps for extra dewatering capacity.

This review summarizes recent developments in foam forming that were mainly carried out in pilot scale. In addition to improving the efficiency of existing processes and allowing better uniformity in material, a wide variety of raw materials can be used in foam forming.

The focus of this review is thin webs—papers, boards, and foam-laid nonwovens, along with the pilot scale results obtained at VTT in Finland. For paper and board grades, the most direct advantage of foam forming is the potential to produce very uniform webs from longer and coarser fibers and obtain material savings through that. Another main point is increased solids content after a wet press, which may lead to significant energy savings in thermal drying. Finally, the potential to introduce "difficult" raw materials like long synthetic or manmade fibers into a papermaking process enables the manufacturing of novel products in an existing production line.

This paper also briefly discusses other interesting foam-based applications, including insulation and absorbing materials, foam-laid nonwovens, and materials for replacing plastics. With foam forming technology, it is possible to produce completely new products from wood fibers.