Summaries from *TAPPI Journal* June and July 2023

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JUNE

PULPING

External fibrillation of wood pulp

Richard J. Kerekes, J. David Mcdonald, and Frank P. Meltzer

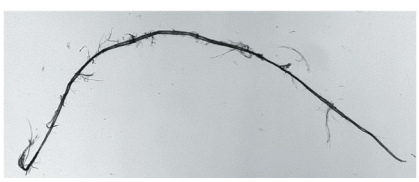


Image of a pulp fiber showing external fibrillation.

Pulp refining produces external fibrillation consisting of fibrils tethered to fiber surfaces, in addition to loose fibrils and fines. Both contribute to a larger bonding area that increases paper strength, but tethered fibrils have less likelihood of being washed out during papermaking. This study postulates the mechanism by which refining produces external fibrillation and the optimum conditions for doing so.

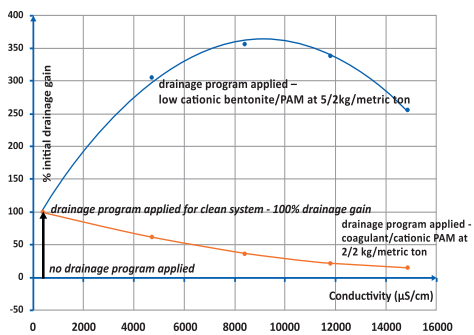
The postulated mechanism is surface abrasion during sliding of fibers in refiner gaps. External fibrillation occurs when forces are great enough to partially dislodge fibrils from fiber surfaces, but not great enough to break the fibrils. Researchers determined the refining intensities to achieve these forces by using a mathematical model and experiments using a laboratory disc refiner. This study provides guidelines to maximize the external fibrillation of fibers in low consistency refining.

An extension of this study suggested that abrasion may also account for most of the energy consumed in the mechanical pulping process.

PAPERMAKING

Water chemistry challenges in pulping and papermaking—fundamentals and practical insights, Part 2: Conductivity, charge, and hardness

Przemyslaw Pruszynski, Lebo Xu, and Peter W. Hart



Impact of conductivity on performance of retention programs in TMP-based furnish (PAM = polyacrylamide).

Although water is essential to the papermaking process, papermakers often overlook its importance. A better understanding of water properties and chemical interactions associated with water at the wet end leads to a sound foundation for high-quality paper production and smooth operation.

Water is an excellent solvent for ionic substances, both organic and inorganic. These substances contribute to system conductivity, charge, and hardness and significantly impact the papermaking process. Part 1 of this paper, published in *TAPPI J.* 21(6): 313(2022), discussed fundamental water properties, water chemistry, and the impact of pH on pulping and papermaking operations. In this paper, the authors review definitions, sources, and the typical symptoms of the effect of conductivity, charge, and hardness on the productivity of the papermaking process.

By gaining understanding on how conductivity, charge, and hardness affect wet end chemistry, mills can better address water challenges on a PM for more efficient operation.

Other Research Appearing in *TAPPI Journal*'s June and July Issues

NONWOOD PULPING (June)
Co-pulping of Trewia nudiflora and Trema orientalis
Md. Jahurul Islam, M. Mostafizur Rahman, Taslima Ferdous, Jannatun Nayeem, Razia Sultana Popy, Chao Tian, and M. Sarwar Jahan

ADDITIVES (June)
Understanding alkenyl succinic anhydride (ASA) size reversion due to autooxidation
Yao Ntifafa, Yun Ji, and Peter W. Hart

FLEXIBLE PACKAGING (June)
Pareto-based design of experiments for identifying and comparing optimum sealing parameters of heat sealing applications in packaging machines
Peter A. Gellerich and Jens-Peter Majschak

RECOVERY BOILER (June)
Evaluating the effect of recovery boiler operation on green liquor dregs concentration using multivariate analysis
Elizabeth Maggs, Andrew K. Jones, and Honghi Tran

RECYCLING (July)
Effects of metal surface morphology on deposition behavior of microstickies from papermaking white water
Yuting Xu, Xiaoli Cao, Carl Houtman, Bo Li, Wenxuan Mo, and Xiaohong Li

PAPERMAKING (July)
Effect of fly ash-based calcium silicate on physical properties of cardboard paper
Puqi Zhao, Peng Xu, Sheng Xu, and Yuting Du

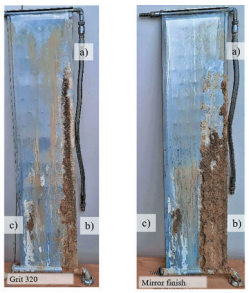
PAPERMAKING (July)
Experimental study and prediction of two-phase flow pattern distribution diagrams in multi-channel cylinder dryer
Haozeng Guo, Jixian Dong, Sha Wang, Lijie Qiao, Bo Wang, Huan Liu, and Biao Wang

JULY

RECYCLING

Evaporation of process water from recycled containerboard mills

Stefan Bürgmayr, Joanne Tanner, Warren Batchelor, and Andrew A.F. Hoadley



Deposits formed on evaporator heating surfaces after 50 days of continuous operation. Formation occurred regardless of surface finish, rough or mirror.

The reduction of the specific effluent discharge volumes of paper mills leads to concentrated process waters that are difficult to treat. Evaporation is an effective water reclamation technology; however, its feasibility largely depends on the fouling behavior of the calcium-rich process water.

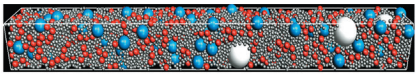
Researchers conducted a pilot plant study to investigate fouling of an evaporator processing the production water from a recycled containerboard mill. The evaporator was operated continuously for five weeks at an evaporation temperature of 55°C and a differential temperature of 5°C, and with a recovery rate of approximately 90 percent. The calcium ion concentration of the circulating liquor exceeded 7,000 mg/L with a pH of 6. Despite the high fouling potential of the circulating liquor, the heat transfer coefficient did not decline over the investigated trial. The absence of deposits on large areas of the heating surfaces demonstrate that the process water does not generally form deposits under the conditions investigated.

This work demonstrates, for the first time in a long-duration pilot plant study, the successful use of evaporation to reclaim water from the process water of a recycle containerboard mill without negative impact on its energy balance.

COATING

A discrete element method to model coating layer mechanical properties with bimodal and pseudo-full particle size distributions

Daniel Varney, Martti Toivakka, and Douglas W. Bousfield



Representation of full distribution of spherical particles approximating a broad particle size GCC (60 w/w% < 2.0 µm; particle size range 0.75—6.0 µm; simulated with 4 particle size bins; packing density 65.7%).

The mechanical properties of paper coating layers are important in converting operations such as calendering, printing, and folding. While several experimental and theoretical studies have advanced our knowledge of these systems, we lack a particle level understanding of issues like crack-at-the-fold.

In this study, we use a discrete element method (DEM) model to describe bending and tension deformations of a coating layer. We also report the impact of particle size distribution on the predicted mechanical properties of the coating layer. Inputs to the model include properties of the binder film and the binder concentration. The model predicts crack formation as a function of these parameters and also calculates the modulus, the maximum stress, and the strain-to-failure.

By comparing simulation results to previous experimental results, we obtained reasonable predictions for both tensile and bending for a range of latex-starch ratios and at various binder concentrations.