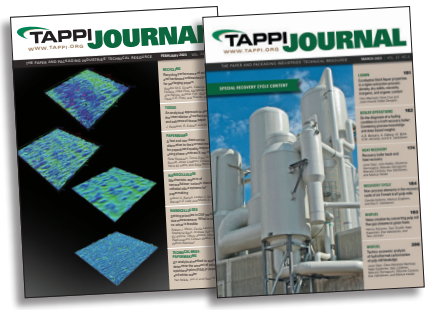


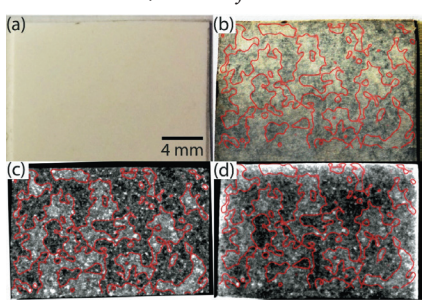
The papers summarized here are from *TAPPI Journal*'s February 2023 issue and March 2023 special Recovery Cycle issue. *TAPPI Journal* is an online, open access publication of relevant and timely peer-reviewed research. To receive *TAPPI Journal*, visit tappi.org/subscribe or search the archive of previously published papers at tappi.org/tj. Authors can submit research for publication in *TAPPI Journal* at tappi.org/tjsubmit. There is no fee to publish and copyright remains with the authors.

FEBRUARY

PAPERBOARD

A fast and non-destructive alternative to the burnout method for paperboard quality inspections using phase-contrast X-ray imaging

Reza Rezasson, Tunhe Zhou, Anna Burvall, Johan Lindgren, Christer Fröjdh, Hans M. Hertz, and Börje Norlin



(a), (b): Photos of the paperboard before and after burning. (c), (d): Phase retrieved X-ray images of the unburnt and burnt sample. Contour lines generated from (c) were superimposed on (b) and (d). The conclusion was that X-ray and burnout images give similar results.

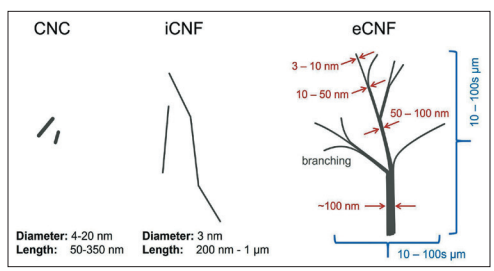
An X-ray based quality inspection method for paperboard was implemented and tested as a fast, non-destructive alternative to the burnout method. An argument against X-ray imaging for inspection of paper and paperboard has been that X-ray absorption is low in paper. To overcome this limitation, the researchers used phase-contrast X-ray imaging (PCXI), which gives higher contrast than conventional attenuation-based imaging for low-absorbing materials such as paper.

Researchers observed strong similarity between the burnout images and the PCXI images. In conclusion, further development of the phase-contrast X-ray method would provide an interesting option for replacing or complementing the standard burnout method. Phase-contrast X-ray imaging could be directly applied on paperboard to produce "burnout-like" images, skipping the burning procedure.

NANOCELLULOSE

Setting priorities in CNF particle size measurement: What is needed vs. what is feasible

Robert J. Moon, Cecilia Land Hensdal, Stephanie Beck, Andreas Fall, Julio Costa, Eiji Kojima, Tiffany Abitbol, Vikram Raghuwanshi, Colleen Walker, and Warren Batchelor



Schematics of cellulose nanocrystals (CNCs), individualized cellulose nanofibrils (iCNFs), and the more complex entangled cellulose nanofibrils (eCNFs), illustrating their generalized particle morphology.

Measuring the size of cellulose nanomaterials can be challenging, especially in the case of branched and entangled cellulose nanofibrils (CNFs). The International Organization for Standardization (ISO), Technical Committee 6, Task Group 1—Cellulosic Nanomaterials, is exploring opportunities to develop standard methods for measurement of CNF particle size and particle size distribution. This work is a summary of the available measuring techniques, responses from a survey on the measurement needs of CNF companies and researchers, and outcomes from an international workshop on cellulose nanofibril measurement and standardization.

The recommendation of these authors within ISO is to start work to revise the definition of CNFs and develop sample preparation and measurement guidelines. Other recommendations include further research to reproducibly prepare hierarchical branched CNF structures and characterize them and develop automated image analysis for hierarchical branched CNF structures.

MARCH

LIGNIN

Eucalyptus black liquor properties in a lignin extraction process: density, dry solids, viscosity, inorganic, and organic content

Vitor Machado Viana Cruz and José Vicente Hallak Dangelo

Illustrated schematic of samples of the analyzed streams: diluted eucalyptus black liquor (DBL); acidified black liquor (ABL) at five different pHs; and lignin lean black liquor (LLBL) taken from the first filtrate after acidification at pH 8.5.

Extracting lignin from black liquor is becoming more common, although only a few research papers discuss the impact of the process on the liquor's primary properties. This work aims to determine the changes in black liquor properties as it undergoes a lignin extraction process using carbon dioxide (CO_2).

A diluted eucalyptus black liquor sample (DBL) was acidified with CO_2 to a final pH of 8.5. After filtration, the kraft lignin was removed, and the filtrated lignin lean black liquor (LLBL) was collected. Researchers collected five acidified black liquors (ABL) samples during acidification; samples were analyzed regarding lignin content in solution, sodium carbonate (Na_2CO_3), sodium sulfate (Na_2SO_4), density, dry solids content, and viscosity.

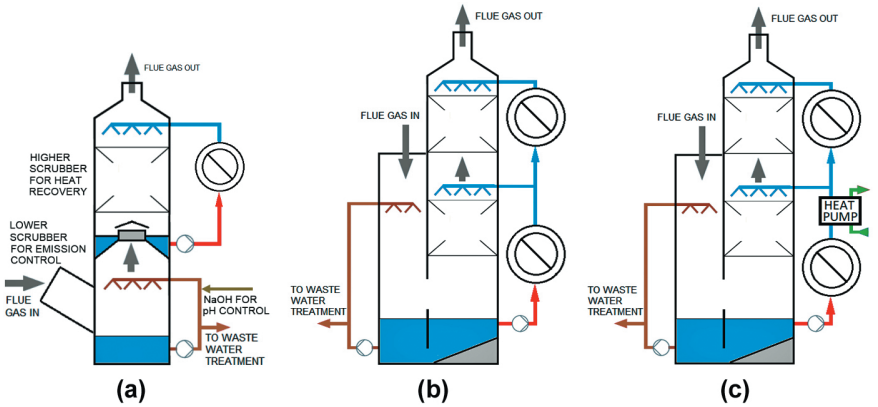
The results showed similar behavior for dry solids, density, and viscosity of the supernatant, but an increase in density was observed around pH 9.00. In light of this, the density of LLBL turns out to be closer to the one in the initial DBL.

Eucalyptus black liquor properties are presented to help pulp mills better understand how the liquor behaves in a lignin extraction process and evaluate the potential correlations for these properties that are hard to measure, especially viscosity.

HEAT RECOVERY

Recovery boiler back-end heat recovery

Jussi Saari, Juha Kaikko, Ekaterina Sermyagina, Marcelo Hamaguchi, Marcelo Cardoso, Esa Vakkilainen, and Markus Haider



Three possible low-temperature heat recovery scrubber configurations: a) 1-stage heat recovery scrubber; b) 2-stage heat recovery; and c) 2-stage with heat pump.

Recently, some biomass-fired boilers have been equipped with increasingly complex condensing back-end heat recovery solutions, sometimes also using heat pumps to upgrade the low-grade heat. In kraft recovery boilers, however, scrubbers are still mainly for gas cleaning, with only simple heat recovery solutions.

In this study, researchers use process simulation software to study the potential to improve the power generation and energy efficiency by applying condensing back-end heat recovery on a recovery boiler. Different configurations are considered, including heat pumps. Potential streams to serve as heat sinks are considered and evaluated. Lowering the recovery boiler flue gas temperature to approximately 65°C significantly decreases the flue gas losses. The heat can be recovered as hot water, which is used to partially replace low-pressure (LP) steam, making more steam available for the condensing steam turbine portion for increased power generation. The results indicate that in a simple condensing plant, some 1-4 percent additional electricity could be generated. In a Nordic mill that provides district heating, even more additional electricity generation, up to 6 percent, could be achieved.

Other Research Appearing in *TAPPI Journal*'s February and March Issues

TISSUE (February)
An analytical approach to assess the interrelation of surface properties and softness of tissue paper
J. Reitbauer, R. Eckhart, and W. Bauer

NANOCELLULOSE (February)
Mechanistic aspects of nanocellulose—cationic starch—colloidal silica systems for papermaking
Nelson A. Barrios, Larden J. Garland, Brandon D. Leib, and Martin A. Hubbe

PAPERMAKING (February)
An analytical method to quantitatively determine the amount of polyamide epichlorohydrin (PAE) in paperboard and white water
Yao Ntifafa, Yun Ji, and Peter W. Hart

RECYCLING (February)
Recycling performance of softwood and hardwood unbleached kraft pulps for packaging papers
Rogério M.S. Simões, Catarina I.A. Ferreira, Filipa Pires, Margarida Martins, Ana Ramos, António P.M. Sousa, Paula C.R. Pinto, and Ricardo Jorge

RECOVERY CYCLE (March)
Non-process elements in the recovery cycle of six Finnish kraft pulp mills
Camilla Karlemo, Markus Engblom, and Esa K. Vakkilainen

BIOFUEL (March)
Value creation by converting pulp mill flue gas streams to green fuels
Hannu Karjunen, Tero Tynjälä, Katja Kuparinen, Esa Vakkilainen, and Tero Joronen

BIOFUEL (March)
Techno-economic analysis of hydrothermal carbonization of pulp mill biosludge
Jussi Saari, Clara Mendoza Martinez, Katja Kuparinen, Satu Lipiäinen, Marcelo Hamaguchi, Marcelo Cardoso, Esa Vakkilainen, and Markus Haider

BOILER OPERATIONS (March)
On the diagnosis of a fouling condition in a kraft recovery boiler: combining process knowledge and data-based insights
A.B. Belisário, A. Edberg, M. Björk, G.M. Almeida, and E.K. Vakkilainen