TJ SUMMARIES

The papers summarized here are from the *TAPPI Journal* November 2019 issue, featuring peer-reviewed content from PaperCon 2019; and the January 2020 issue. *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*.

NOVEMBER

TISSUE

Rheological characterization of tack and viscoelasticity of compositions of crepe coating used in the Yankee dryer

Joshua Omambala and Carl Mcintyre

The vast majority of tissue production uses creping to achieve the required set of properties on the base sheet. The Yankee coating helps to develop the desired crepe that in turn determines properties such as bulk and softness. The adhesion of the sheet to the Yankee surface is a very important characteristic to consider in achieving the desired crepe. The coating mix usually consists of the adhesive, modifier, and release. A good combination of these components is essential to achieving the desired properties of the tissue or towel, which often are determined by machine trials that can be time consuming and lead to costly rejects.

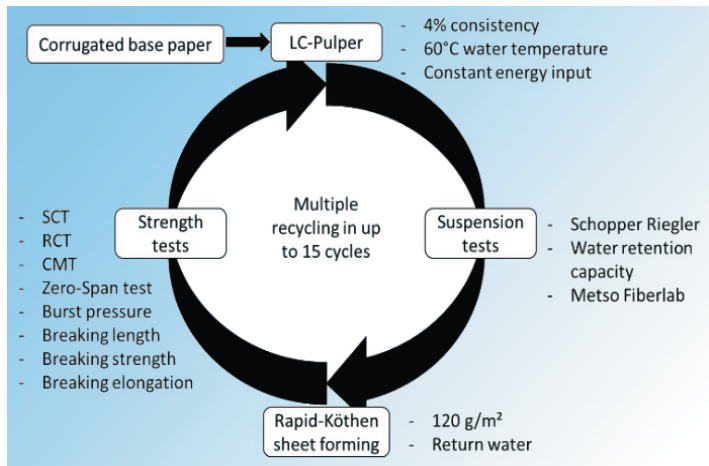
In this study, five compositions of an industrial Yankee coating adhesive, modifier, and release were examined rheologically. The weight ratio of the adhesive was kept constant at 30 percent in all five compositions, and the modifier and release ratios were varied.

From the results of this study, towel and tissue producing mills can predict the behavior of coating compositions before doing performance trials on the Yankee dryers. Manufacturers can test combinations of coatings for their rheological properties to determine which composition will give the best creping and quality performance, without the need for large-scale machine trials.

RECYCLING

Multiple recycling of paperboard: Paperboard characteristics and maximum number of recycling cycles—Part I: Multiple recycling of corrugated base paper

Frederic Kreplin, Hans-Joachim Putz, and Samuel Schabel



The goal of multiple recycling and testing procedures was to recycle the papers in up to 15 cycles and analyze changes in fiber material and in lab handsheets.

Paper for recycling is an important fiber source for the production of corrugated base paper. The change in production capacity toward more and more packaging papers affects the composition of paper for recycling and influences paper quality.

This research project investigated the influence of the multiple recycling of five different corrugated base papers (kraftliner, neutral sulfite semichemical [NSSC] fluting, corrugating medium, testliner 2, and testliner 3) on suspension and strength properties under laboratory conditions. The corrugated board base papers were repulped in a low consistency pulper and processed into Rapid Köthen laboratory sheets. The sheets were then recycled up to 15 times in the same process. In each cycle, the suspension and the paper properties were recorded. In particular, the focus was on corrugated board-specific parameters, such as short-span compression test, ring crush test, corrugating medium test, and burst. The study results indicate how multiple recycling under laboratory conditions affects fiber and paper properties.

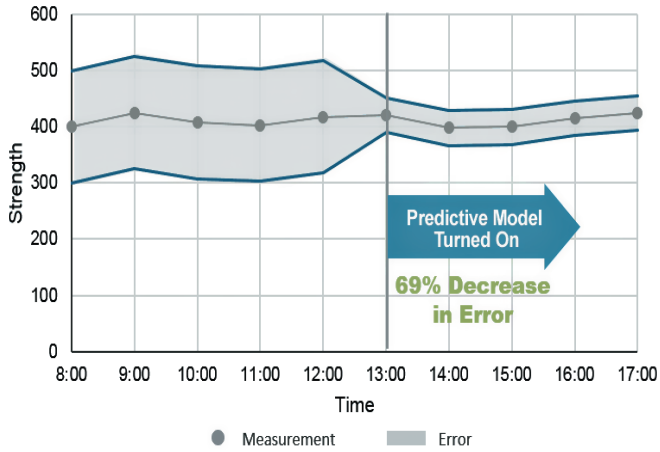
The results of this study show that paper fibers can be recycled more times than typically expected without significant loss of strength properties. This general information should support further efforts to extend paper recycling.

PROCESS CONTROL

Creating adaptive predictions for packaging-critical quality parameters using advanced analytics and machine learning

Cydney Rechtin, Chitta Ranjan, Anthony Lewis, and Beth Ann Zarko

With innovative instrumentation readily accessible, packaging manufacturers are collecting vast amounts of data that give them increasing visibility into their processes. Turning this visibility into actionable insight is key to successfully exceeding customer expectations and reducing costs.



Reduction in strength variability achieved using real-time prediction to make control decisions.

Predictive analytics supported by machine learning can provide real-time quality measures that remain robust and accurate in the face of changing machine conditions. These adaptive quality "soft sensors" allow for more informed, on-the-fly process changes; fast change detection; and process control optimization without requiring periodic model tuning.

The use of predictive modeling in the paper industry has increased in recent years; however, little attention has been given to packaging finished quality. The use of machine learning to maintain prediction relevancy under ever-changing machine conditions is novel. In this study, researchers demonstrate the process of establishing real-time, adaptive quality predictions in an industry focused on reel-to-reel quality control, and also discuss the value created through the availability and use of real-time critical quality.

This study emphasizes the importance of harnessing the data available to papermakers for the purpose of predicting, in real time, their most critical quality parameters. Papermakers can use this information to understand the value-added opportunities that advanced analytics can bring their manufacturing operation.

JANUARY

NONWOOD PULPING

Wheat straw as an alternative pulp fiber

Peter W. Hart

The desire to market sustainable packaging materials has led to an interest in the use of various fiber types as a raw material. It has been suggested that the use of annual crops for partial replacement of wood fiber would result in more sustainable products. Several life cycle analyses (LCA) have been performed to evaluate these claims. These LCAs provided conflicting and contradictory results because of the local conditions and the specific pulping processes investigated. In this study, researchers review selected LCAs and analyze the underlying reasons for these conflicting results.

Of all the agriculturally sourced annual fibers available other than wood, only straw pulp is currently available in commercial quantities. A careful review of the available data suggests that neither an annual crop nor wood are more sustainable in general. The use of straw fiber in place of wood fiber does not appear to present any advantages to either the environmental impact of production or to the final product quality.

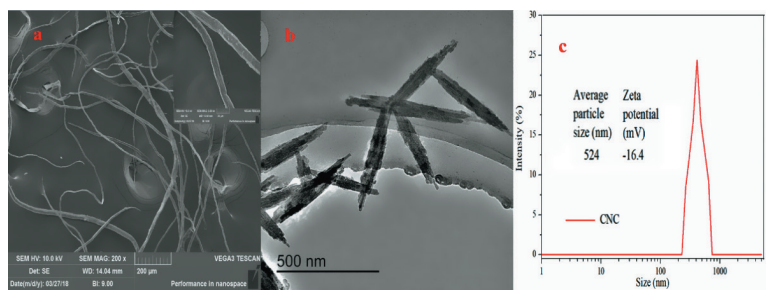
The impact of substitution of straw fiber for hardwood pulp in bleached board applications and for high yield pine in linerboard applications has been examined in handsheet studies. In general, the partial substitution of straw pulp for wood pulp does not improve the handsheet physical properties. These studies suggest that straw pulp should be used in low fiber strength requirement applications, such as tissue and molded fiber products.

As a routine part of sustainability and new product efforts, fiber from wheat straw was evaluated as a potential partial replacement for hardwood kraft fiber. Sufficient technical gaps in the areas of availability, pulping and bleaching, transportation and storage, and physical strength properties remain, making the use of this material suitable only for specialty niche markets at this time. No clear-cut sustainability advantage of using an annual fiber was determined for this product.

NANOCRYSTALS

A new approach for the preparation of cellulose nanocrystals from bamboo pulp through extremely low acid hydrolysis

Yongqi Zhang, Yongjian Xu, Xiaopeng Yue, Lei Dai, Minlan Gao, and Yun Zhi



Microscopic images show that bleached kraft bamboo fibers (a) turned into short, rod-like structures with high aspect ratio (b) after ELA hydrolysis.

As a renewable and biodegradable nanomaterial, cellulose nanocrystal (CNC) has a wide range of potential applications, but production of CNC faces significant challenges in capital investment and manufacturing cost. In this work, the one-step preparation of CNC from bleached kraft bamboo pulp by extremely low acid (concentration of acid ≤ 0.1 wt%) hydrolysis was demonstrated. The experimental data indicated that the yield of CNC was strongly affected by the operating pressure and concentration of hydrochloric acid (HCl), as well as temperature.

Rod-like CNC with a mean particle size of 524 nm was obtained through an extremely low acid (ELA) hydrolysis process. The yield of CNC can reach to 37.1 percent by an ELA hydrolysis process at 180°C for 60 min with 0.08 wt% HCl and 20 MPa operating pressure. The Fourier transform-infrared spectroscopy (FTIR) measurements show

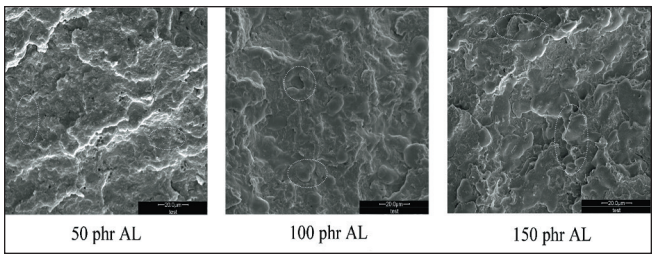
that the as-prepared CNC maintained cellulose structure. Compared with a conventional CNC prepared by strong sulfuric acid (H_2SO_4) hydrolysis, the CNC prepared by ELA hydrolysis process exhibited much higher thermal stability.

This ELA hydrolysis process may provide a new, efficient, and environmentally benign way to produce CNC from bleached kraft bamboo pulp.

LIGNIN

Effects of different ammonium lignosulfonate contents on the crystallization, rheological behaviors, and thermal and mechanical properties of ethylene propylene diene monomer/polypropylene/ammonium lignosulfonate composites

Rui Gou and Minghui Guo



Scanning electron microscope images of EPDM/PP/AL composites with different AL contents show the composite interface condition worsened and the phase interface became clearer with increasing lignin content.

Thermoplastic elastomer (TPE), made from ethylene propylene diene monomer (EPDM) and polypropylene (PP) based on reactive blending, has an excellent processing performance and characteristics and a wide range of applications. However, there are currently no reports in the literature regarding the use of TPE in making composite boards. In this paper, EPDM, PP, and ammonium lignosulfonate (AL) were used as the raw materials, polyethylene wax was used as the plasticizer, and a dicumyl peroxide vulcanization system with dynamic vulcanization was used to make a new kind of composite material. This research studied the influences of the AL contents on the crystallization behaviors, rheological properties, thermal properties, and mechanical properties of the composites.

Researchers extracted AL from papermaking wastewater and applied it to an EPDM/PP blending system to develop a new kind of composite. The results showed that the AL content had a noticeable impact on the performance of the composite board. Accordingly, this kind of composite material can be used as an elastomer material for the core layer of laminated flooring. The study broadens the application field for industrial lignin.

OTHER RESEARCH APPEARING IN *TAPPI JOURNAL'S* NOVEMBER 2019 ISSUE:

BIOREFINERY

Lignin-based resins for kraft paper applications

Prajakta Dongre and Biljana Bujanovic

CELLULOSE MICROFIBRILS

A novel predictive method for filler coflocculation with cellulose microfibrils

Ignacio De San Pio, Klas G. Johansson, and Paul Krochak

OTHER RESEARCH APPEARING IN *TAPPI JOURNAL'S* JANUARY 2020 ISSUE:

PAPERMAKING

Root cause analysis of cationic polymer additive efficiency decline in virgin and recycle containerboard mills

Davit E. Sharoyan and Cory W. Ross