TJ SUMMARIES

The papers summarized here are from the *TAPPI Journal* April 2019 issue, featuring special nanocellulose content; and the May 2019 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.

APRIL

NANOMATERIALS

Priorities for development of standard test methods to support the commercialization of cellulose nanomaterials

Stephanie Beck, Colleen C. Walker, and Warren Batchelor

With the growing number of producers and users of cellulose nanomaterials (CNMs), there is an increasing need to develop standard test methods to control production and quality of CNMs. In 2014, a task group was formed within ISO Technical Committee 6, *Paper, board and pulps*, to begin addressing the need for standards. This task group, TG 1, was tasked with reviewing existing standards and identifying the need for additional standards to characterize CNMs.

In March 2018, TG 1 launched a survey to ask CNM producers around the world about the importance of having standard procedures to measure and quantify a variety of CNM properties, both physical and chemical. Producers were asked to identify the type(s) of CNM they produced and their scale of production, and to rank the properties for which they felt standard test methods were most important.

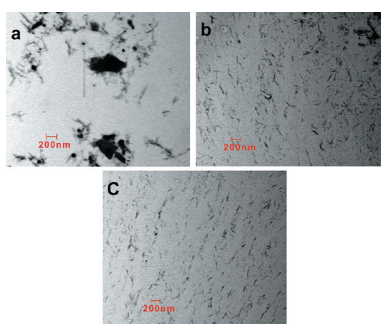
In this study, the authors summarize the survey responses and identify those properties of highest interest for producers of both cellulose nanocrystals and cellulose nano- and microfibril-based materials (CNFs/CMFs). The authors also examine the challenges of developing new standard methods for some of the key properties—as well as the feasibility and limitations of adapting existing standards—to CNMs.

The information in this study will serve to guide the development of practical and industry-relevant measurement techniques and standard test methods to support the global commercialization of cellulose nanomaterials.

NANOCRYSTALS

Characterization of the redispersibility of cellulose nanocrystals by particle size analysis using dynamic light scattering

Guomin Wu, Qian Li, Can Jin, Zhenwu Kong, and Siqun Wang



TEM images of CNC dispersion with different shearing times (a:1 min, b: 2 min, c: 5 min) shows almost all particles undergo nanoscale dispersion when shearing time is longer than two minutes.

Cellulose nanocrystals (CNCs), which are derived from the most abundant and inexhaustible natural polymer, cellulose, have received significant interest owing to their mechanical, optical, chemical, and rheological properties. In order to transport CNC products conveniently and efficiently, they are ideally dried and stored as powders using freeze-drying or spray-drying technologies. The redispersibility of CNC powders is quite important for their end use; hence, a convenient method is required to characterize the redispersibility of CNC powders.

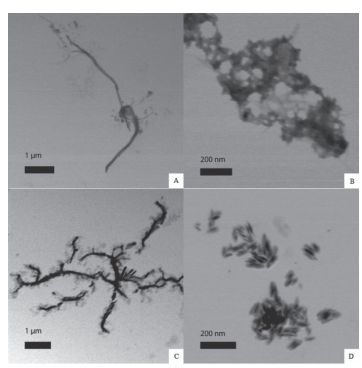
In this study, the possibility of characterizing the redispersibility of CNC powders by particle size analysis using dynamic light scattering (DLS) was investigated by comparing the results from transmission electron microscopy (TEM) and DLS. The particle size obtained with DLS approximately matched that obtained with TEM. Compared with TEM, DLS is a quick and convenient method to measure the particle size distribution of CNCs in water. Two kinds of dispersing methods, sonication and high-speed shearing, and two kinds of CNCs prepared by different methods, sulfuric acid hydrolysis and the TEMPO (2,2,6,6-tetramethylpiperidine-1-oxyl) oxidization method, were used to study the redispersibility of CNCs. Sonication was more efficient than the high-speed shearing method for nanoscale dispersion of CNC powders in water. CNCs prepared by sulfuric acid hydrolysis could be more easily redispersed in water than those prepared by TEMPO oxidation.

Understanding the feasibility of measuring the particle size distribution of CNCs with DLS should provide an easy method for online quality control of CNCs production.

NANOFIBERS

From biorefineries to bioproducts: conversion of pretreated pulp from biorefining streams to lignocellulose nanofibers

Chenggui Sun, Yang Gao, Richard Chandra, and Yaman Boluk



Typical scanning transmission electron micrographs of softwood-lignocellulose nanofibers (SW-LCNF).

This study investigates the use of pretreatment and enzymatic hydrolysis side streams and conversion to lignocellulose nanofibers. The authors used a steam-exploded and partial enzymatic hydrolyzed hardwood pulp and an organosolv pretreated softwood pulp to prepare lignocellulose nanofibers (LCNF)

via microfluidization. The energies applied on fibrillation were estimated to examine the energy consumption levels of LCNF production. The energy consumptions of the fibrillation processes of the hardwood LCNF production and the softwood LCNF production were about 7040-14080 kWh/ton and 4640 kWh/ton on a dry material basis, respectively. The morphology and dimension of developed hardwood and softwood LCNFs and the stability and rheological behavior of their suspensions were investigated and are discussed.

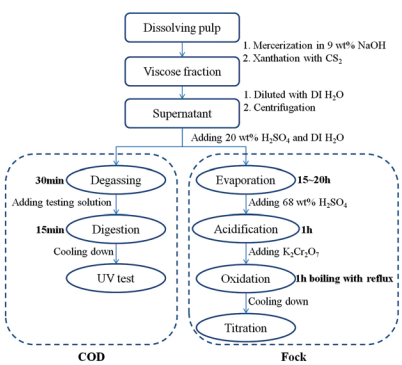
The development of LCNF as a high value coproduct from lignocellulosic biomass from side streams of biorefining processes could increase the economic feasibility of biorefining processes.

MAY

DISSOLVING PULP

A novel approach for determining the reactivity of dissolving pulp based on the COD method

Chen Gong, Shi Yu, Liu Yan-Zhao, Ni Jian-Ping, Yang Xiao-Bo, and Tian Chao



Experimental scheme of the novel COD method compared with the Fock test.

This study discusses a novel approach for determining the reactivity of dissolving pulp according to the chemical oxygen demand (COD) of water. First, a sample of dissolving pulp was subjected to mercerization and xanthation in order to obtain dissolved cellulose fractions. Next, the fractions were digested with a testing solution as applied in COD procedures. Finally, the resulting liquid was rapidly tested by ultraviolet-visible spectrophotometry (UV-Vis). By quantifying the absorbance of Cr^{3+} at a wavelength of 600 nm, researchers indirectly calculated the reactivity of dissolving pulp. The results measured by this novel COD method correlated well with the most accepted Fock test results with less than 10 percent relative difference. Also, this newly developed COD method is less time-consuming than the Fock test.

This novel COD method presents an alternative approach for determining the reactivity of dissolving pulp in laboratory or industrial applications.

EMISSIONS

Sources, collection, and handling of noncondensible gases in modern kraft pulp mills

Kirsi S. Hovikorpi and Esa K. Vakkilainen

This work describes and discusses sources of noncondensible gases (NCG) in modern kraft pulp mills and modern NCG collection from process units where odor emissions can occur if these gases are released to the surroundings. A mill-wide overview of NCG sources and collection in modern pulp mills is provided.

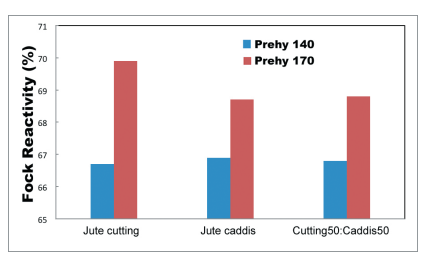
Using modern practices, malodorous gases can be collected to the extent that a pulp mill is essentially odor free. The key to limiting complaint-causing odors is prevention of these emissions during process disturbances, equipment malfunctions, operator errors, and other unforeseen occurrences.

This work presents a comprehensive overview of NCG sources, collection, and handling systems in modern kraft pulp mills. The authors hope the information will motivate industry to further reduce sulfuric odor nuisance emissions from kraft processes and examine possible pretreatment of gases in process units where these gases are generated.

NONWOOD PULPING

Prehydrolysis kraft pulping of jute cutting and caddis mixture for rayon production

Jannatun Nayeem, M. Sarwar Jahan, Razia Sultana Popy, M. Nashir Uddin, and M.A. Quaiyyu



Effect of prehydrolysis conditions on Fock reactivity of dissolving pulp.

Jute cutting, jute caddis, and cutting-caddis mixtures were prehydrolyzed by varying time and temperature to get about 90 percent prehydrolyzed yield. At the conditions of 170°C for 60 min of prehydrolysis, the yield for 100 percent jute cutting was 76.3 percent, while the same for jute caddis was only 67.9 percent. But with prehydrolysis at 150°C for 60 min, the yield was 90 percent for jute cutting, where 49.94 percent of original pentosan was dissolved and prehydrolysis of jute caddis at 140°C in 60 min yielded 86.4 percent solid residue. Jute cutting-caddis mixed prehydrolysis was done at 140°C for 30 min and yielded 92 percent solid residue for 50:50 cutting-caddis mixtures, where pentosan dissolution was only 29 percent.

Researchers then kraft cooked prehydrolyzed jute cutting, jute caddis, and cutting-caddis mixtures. Pulp yield was only 40.9 percent for 100 percent jute cutting prehydrolyzed at 170°C for 60 min, which was 10.9 percent lower than the prehydrolysis at 140°C. For jute cutting-caddis mixed prehydrolysis at 140°C for 45 min followed by kraft cooking, pulp yield decreased by 3.3 percent with 50 perent caddis in the mixture, but by 6.7 percent with 75 percent caddis in the mixture. Pulp bleachability improved with increasing jute cutting proportion in the cutting-caddis mixture pulp.

OTHER CONTENT APPEARING IN *TAPPI JOURNAL'S* APRIL 2019 ISSUE:

SPECIAL FEATURE

Nanocellulose in Japan: An industrial perspective
Takanori Miyanishi

OTHER CONTENT APPEARING IN *TAPPI JOURNAL'S* MAY 2019 ISSUE:

CORRUGATED BOARD

Effects of preincubation on the gelatinization of cassava and corn starch suspensions containing sodium hydroxide as a main component of corrugating adhesives
Takatoshi Koyakumaru and Hirofumi Nakano

TECHNICAL BRIEF

Commercialization and nanocellulose applications and some of their research needs
Tom Lindström