

TJ Summaries

The papers summarized here comprise this month's issue of TAPPI JOURNAL, a monthly publication of relevant and timely peer-reviewed research.

INK MILEAGE

A method for evaluating ink mileage in gravure printing

By Renmei Xu, Alexandra Pekarovicova, Paul D. Fleming, Yu Ju Wu, and Michelle X. Wang

APPLICATION: Differences in paper properties affect the consumption of printing inks. An ink mileage curve is a plot of an ink's printed optical density on a substrate, as a function of ink film thickness. Ink film thickness is tough to measure, so ink film coat weight, the amount of ink in gram per square meter (gsm) of substrate, has been used instead.

Various researchers have fitted ink mileage curves to experimental data from IGT and Prufbau printability testers using offset inks. The quantity of ink on paper was determined by the weight difference of the printing disc before and after printing. These models have not been tested on other ink types or on commercial printing presses. The challenge was the difficulty of accurately measuring ink film coat weight.

In this study, researchers calculated ink film coat

weights from copper (Cu) concentrations in both liquid ink and printed paper samples, and analyzed them by Atomic Absorption (AA) Spectrometer after digestion. Both Oittinen and Calabro-Savagnone models were found to fit the experimental data equally well. Paper mills can use the method developed in this research to evaluate the ink mileage of their papers and to modify their papers to achieve higher ink mileages.

LIME KILNS

Flame length in lime kilns with a separate non-condensable gas burner

By Arafat Aloqaily, David C. S. Kuhn, Pierre Sullivan and Honghi Tran

APPLICATION: Using an acid-alkali visualization technique, researchers studied the flame length in a lime kiln with a separate non-condensable gas (NCG) burner, as a function of the combined Craya-Curtet number (Ct) and excess air. They found that flame length increases with an increase in the combined Ct and a decrease in excess air,

FEATURED PAPER:

COATING LAYERS

A study of in-plane and Z-direction strength of coating layers with varying latex content

By J.C. Husband, J.S. Preston, L.F. Gate, A. Storer and P. Creaton

Coating properties are critical for helping papermakers deliver the qualities that end users demand. In this research, the authors have developed a way of subjecting a coating layer to tensile deformation in the z-direction. Their research provides insights into important properties of coated papers, especially stiffness and strength, and how these might be influenced by the shape of the kaolin particles used.

"We chose to study the strength properties of coating layers



J.C. Husband



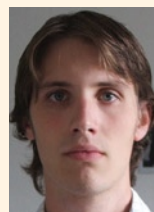
J.S. Preston



L.F. Gate



A. Storer



P. Creaton

because, surprisingly, there is relatively little recently published work in the open literature," writes lead author John Husband, an associate in the Department of Chemistry at the University of Edinburgh. "Shape-engineered kaolins have recently entered the market and we were interested to see if there were any advantages such pigments could offer in conferring stiffness or resistance to cracking, for example. In the current economic climate, the

move to lower basis weights and the need to optimize binder use are important, and the availability of a further control tool such as kaolin morphology is a valuable asset for the papermaker."

Previously, these researchers had studied the in-plane tensile strength properties of coating layers based on kaolin and latex; but they knew that in-plane tensile is not the only stress vector to which the coating is subjected in use. There are also

and developed an empirical equation for calculating the flame length.

New criteria for predicting the length of the flame in the lime kiln and how it changes with combined Ct and excess air will allow operators and engineers to monitor and continuously control fluctuations in flame length. This can stabilize and enhance the efficiency of kiln operation.

MULTIVARIATE ANALYSIS

Impact of TMP refining line interruptions and reject refiner operations on pulp and paper variability

By Robert P. Harrison, Alain A. Roche and Paul R. Stuart

APPLICATION: Modern thermomechanical pulp (TMP) newsprint mills face a double challenge: varying chip quality and an increasingly demanding clientele. This situation only exacerbates other economic factors that are making it increasingly difficult for North American newsprint mills to compete internationally.

One approach for smoothing out quality inconsistencies is to reduce the variability in the intermediate pulp.

However, many mills today operate at or above nominal capacity virtually all the time, leaving little or no “wiggle” room to compensate for outside disturbances. At the same time, mills are faced with yet another new challenge: a glut of process data captured by millwide data historians.

Earlier work explored various data pre-treatment techniques to see which ones yielded the best models of TMP pulp quality. Here we have delved further into the process fundamentals in an effort to improve these models, focusing on refining energy and consistency, most notably in the reject refining section. This led to a surprising amount of improvement in the “black box” models.

Within the mill, there are rich and poor data sources, which somehow must be combined into a coherent model. We addressed this by using as short a timescale as possible, then applying filtering to bridge the gap between the faster (process) measurements and slower (product quality) measurements.

Each mill will use these results in a different way, because each mill is different, and they do not always measure the same parameters. However, the fundamental refining process is the same everywhere. By taking

likely to be z-directional stresses operating at right angles to the in-plane stresses; for example, during supercalendering or printing with high tack inks.

This new study attempted to measure the tensile strength of coating layers using a similar technique in both directions, so that the anisotropy in the coating layer strength properties can be quantified.

RESULTS

This work shows that the morphology of kaolin has a major effect on the strength of the coating layer. By developing a way to measure the tensile strength of the coating in the z-direction using the same principle as the in-plane test, researchers were able to show that coatings based on platy kaolin are

weaker in the z- than the in-plane (x-y) direction. Reported results also show some interesting parallels with the strength properties of uncoated papers.

Overall, this research shows that:

a) Coating layers based on kaolin particles possess anisotropic strength properties. Depending on the particle size and shape factor, the in-plane tensile strength of the layer is greater than the z-direction strength by factors of between four (in the case of coarse and blocky particles) and 22 (using fine and platy particles).

b) When researchers compared a series of coatings based on kaolins of varying size and shape, there was an inverse relationship between in-plane and z-direction strengths. High shape factor particles resulted

in coating layers having the highest in-plane but lowest z-direction strength.

c) Coatings based on blocky GCC particles showed similar z-direction and in-plane strength, confirming that this pigment gives isotropic coating structures.

d) High latex levels using coatings based on the same clay type increase both strength parameters.

“There have been previous attempts to measure z-direction strength of paper coatings, but these have used a different technique from that used in the x-y direction. We believe that our work is the first to obtain measurements of the anisotropy in tensile strength using comparable methods and correlating the results with the shape factor of the particles,” Husband says.

process fundamentals into account, it should be possible to extract more useful knowledge from the large amounts of operating data now available at most mills.

BLENDING POLYACRYLAMIDES

Blended amphoteric PAMs:

High performance as retention aids

By Yoshio Mori

APPLICATION: A recent rise in pulp fineness has reduced the efficiency of currently used retention aids. Moreover, high-speed paper production processes require high performance retention aids that do not degrade paper formation.

In this study, researchers synthesized anionic- and cationic-unit rich amphoteric polyacrylamides (PAMs) and evaluated a blend of the two as a retention aid. "I chose this topic because it presents a new approach to achieving an ideal balance between one-pass retention and formation," says author Yoshio Mori, deputy research manager in the macromolecular material research laboratory of Toagosei Co., Ltd. in Nagoya, Japan. "Our goal was to find a new, one-pack chemical system that would save labor with as little process control as possible. Our research suggests that our new retention system, which differs from the usual microparticle system, meets our goal."

Analyses of stress changes in the floc generation process and the water solution characteristics of each PAM and blend suggest that this blend system has effectively assisted proper floc generation and resulted in enhanced performance, Mori reports. 

Subscribe to TAPPI JOURNAL

TAPPI JOURNAL publishes full-text, peer-reviewed research in 11 issues per year, and is available by subscription only. The print edition is delivered via mail, and the electronic edition is delivered via e-mail. Subscribe to both the print and electronic TJ, or to the electronic edition only.

■ **TAPPI Members—1 year (11 issues):** Print + electronic, US\$132; electronic only, US\$29.

■ **Non-members:** Print + electronic, US\$376; electronic only, US\$262.

International mailing charge for print edition: US\$14. To subscribe, visit www.tappi.org or contact TAPPI's Member Connection Center at +1 800-332-8686 (U.S.); +1 800-446-9431 (Canada); or +1 770-446-1400.