



TJ SUMMARIES

The papers summarized here are from the *TAPPI Journal* February 2019 issue, featuring special coating content; and the March 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.

FEBRUARY

BLADE COATING

Operational limits of blade coating associated with high aspect ratio pigments: Part I— Bench top blade coater

Lisa Weeks, Pat Gane, Tony Lyons, and Douglas W. Bousfield

Operational issues such as stalagmite formations, scratches, or spits develop during blade coating of high solids coatings at high web speeds. Coatings that contain high aspect ratio pigments exhibit these difficulties at lower solids concentrations and slower machine speeds than coatings comprised of more spherical pigments. There are a number of potential reasons behind this phenomenon, but a clear mechanism is not well established.

Using a bench top blade coater without a base sheet, the goal of this study is to understand the operational limits that occur due to the coating suspension interacting with the blade. Pigment suspensions are applied in excess in front of the blade. A camera mounted near the blade exit is used to detect defects and buildup on the backside of the blade. Researchers determined the machine speed at which deposits on the blade first appear for three pigments of different shape factors and at varying weight fractions. A runnability window based on shape factor and solids content was developed. Small changes in the solids concentration displayed changes in the speed at which blade deposits begin to appear. Presence of the particles at solids concentration nearing their immobilization solids must be contributing to the development of runnability issues.

CRACKING

Cracking at the fold in double layer coated paper: The influence of latex and starch composition

Seyyed Mohammad Hashemi Najafi, Douglas W. Bousfield, and Mehdi Tajvidi

Cracking at the fold of publication and packaging paper grades is a serious problem that can lead to rejection of product. In this study, researchers used coating layers with different and known mechanical properties to characterize crack formation during folding. The coating formulations were applied on two different basis weight papers, and the coated papers were folded. The binder systems in these formulations were different combinations of a styrene-butadiene latex and mixtures of latex and starch for two different pigment volume concentrations (PVC). Both types of papers were coated with single and double layers. The folded area was scanned with a high-resolution scanner while the samples were kept at their folded angle. The scanned images were analyzed within a constant area. The crack areas were reported for different types of papers, binder systems, and PVC values.

As PVC, starch content, and paper basis weight increased, the crack area increased. Double layer coated papers with high PVC and high starch content at the top layer had more cracks in comparison with a single layer coated paper, but when the PVC of the top layer was low, cracking area decreased. No measurable cracking was observed when the top layer was formulated with a 100 percent latex layer.

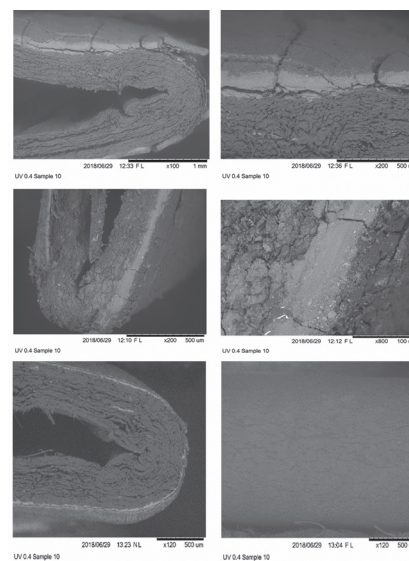
By understanding how the mechanical properties of two coating layers interact to generate cracking, coatings can be designed to minimize the cracking issue. This work suggests that cracking could also be minimized if, during converting, a latex-rich overcoat was applied to regions that are folded.

BOXBOARD

Improving the inkjet codability of folding boxboard

Peter Dahlvik and Georg Häusler

Good inkjet printability requires a coating layer with good water absorption properties. A properly designed open coating structure helps to efficiently remove the water phase of the printing ink while controlling the penetration of the ink. The absorptivity of the coating is primarily dependent on the pigment type, as well as the binder type and



SEM images of double-coated samples. The left image of each pair shows the cross-section of folded paper; the right image shows the cracking area. The bottom pair shows 62 percent PVC with a second layer of pure latex on top (left), and the scarfing layer cracking underneath (right).

amount. The pore volume of the coating layer can in principle be increased by introducing a structured pigment or a pigment with narrow particle size distribution. It is also important to optimize the binder type and level, with the aim to create a coating with higher void volume.

The objective of this study was to achieve the best possible combination of sheet-fed offset and inkjet printability (i.e., one-color codability) by modifying the top coating formulation with respect to the calcium carbonate pigment type and the ratio of styrene-acrylate/polyvinyl alcohol. For folding boxboard coating layers, mills can focus on optimizing pigment composition rather than the binder type or amount.

BARRIER COATING

Optimization of coating with water-based barriers

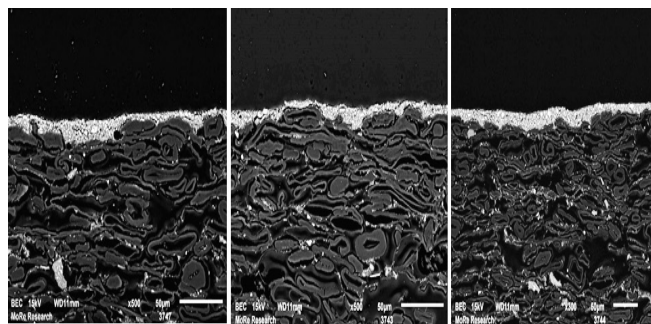
Tom Larsson and Per Emilsson

Interest in the development of renewable, sustainable fiber-based packaging products is growing. In recent years the paper industry has focused on finding substrates and the chemical suppliers have focused on developing different coating media to enhance properties. Sustainable paper and board barrier products are needed to create an alternative to the use of conventional packaging solutions containing plastics, perfluorocarbon, and wax.

Products with a water-based barrier coating are typically more expensive than conventional packaging solutions. Therefore, to make the new products with water-based barrier coatings cost-competitive, the best achievable performance with the lowest coat weight is important so that production costs can be kept as low as possible.

This study presents results from pilot trials that consider base stock (pretreated and non-pretreated), application methods by long- and short- (zero) dwell, and metering by rod and resilient tip. Laboratory evaluations of the coverage and barrier performance indicate the proper direction for obtaining a barrier.

Mills can benefit from a new way to apply and meter barrier coatings. Optimization of base stock, coating application, and metering will result in a barrier-coated stock that combines performance and economics.



SEM images show coating distribution with blade-, rod- (smooth), and resilient metering and how coat weight in peaks and valleys varies depending on the metering element used.

TISSUE

A study on the softness of household tissues using a tissue softness analyzer and hand-felt panels

Yuan-Shing Perng, Tser-Ying Teng, and Ching-Ho Chang

This study applied the reciprocal matrix approach to deduce the correlation between hand-felt (HF) and tissue softness analyzer (TSA) instrumental measurements of tissue softness. The research was conducted in three phases. In phase one, results indicated that systematic collection of samples and preparation of test specimens were the foundation of successful tests. TSA-HF and tensile strength exhibited a strong negative correlation. In the future, same-unit physical properties can provide a basis for discussing the commonality and complementary natures of hand-felt and TSA softness measurements.

In phase two, through the reciprocal matrix approach, subjective softness assessments performed by humans were reliably quantified. The quantified values were further applied to a statistical analysis using the *t*-test to distinguish and train professional panelists. In phase three of HF panel test results, all independent panels were compared to one another under a uniform scale established by four standard samples. The calibrated HF panel values were incorporated with TSA-HF results to establish technical curves between the softness and tensile strength, which were helpful for onsite workers to carry out process controls.

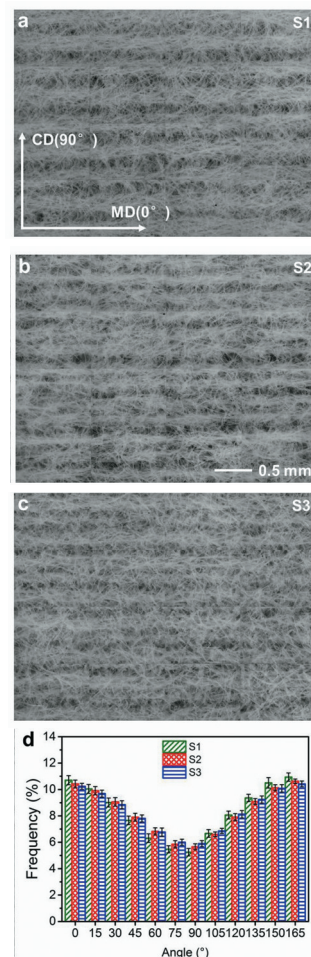
The HF panel and TSA methods can offer reliable research data that can be applied as a basis for production improvements, quality management, product development, and market surveys.

NONWOVENS

Controllable anisotropic properties of wet-laid hydroentangled nonwovens

Chao Deng, Jue Hou, Xing Zhang, R. Hugh Gong, and Xiangyu Jin

For nonwovens, fiber orientation distribution is an important structural characteristic that directly influences the anisotropic properties of the materials. Different $V_{\text{slurry}}/V_{\text{belt}}$ ratios were adopted to fabricate nonwovens during the wet-laid process. The results



Fiber orientation distribution of nonwoven samples S1–S3 with different $V_{\text{slurry}}/V_{\text{belt}}$ ratios: (a–c) microscopic images and (d) fiber orientation distributions.

indicated that fiber orientation distribution of nonwovens can be regulated by adopting different $V_{\text{slurry}}/V_{\text{belt}}$ ratios owing to the web-forming principle of wet-laid techniques.

Mechanical tests showed that both wet and dry tensile strength of nonwovens in different angle directions present anisotropy under different $V_{\text{slurry}}/V_{\text{belt}}$ ratio parameters. A liquid spreading distribution experiment proved that liquid spreading length and area

of nonwovens could be manipulated using different $V_{\text{slurry}}/V_{\text{belt}}$ ratios in the fabrication process. Consequently, specific anisotropic properties of wet-laid hydroentangled nonwovens can be realized by controlling the process parameters for particular end-use applications. Therefore, mills can adjust the slurry-to-belt ratios to control wet and dry tensile strengths of nonwovens for specific purposes. 

OTHER RESEARCH APPEARING IN TAPPI JOURNAL'S FEBRUARY 2019 COATING ISSUE:

BLADE COATING

Operational limits of blade coating associated with high aspect ratio pigments:

Part II—Cylindrical laboratory coater

Lisa Weeks, Pat Gane, Tony Lyons, and Douglas W. Bousfield

CRACKING

Discrete element method to model cracking for two layer systems

Daniel H. Varney and Douglas W. Bousfield

OTHER RESEARCH APPEARING IN TAPPI JOURNAL'S MARCH 2019 ISSUE:

CORRUGATED PACKAGING

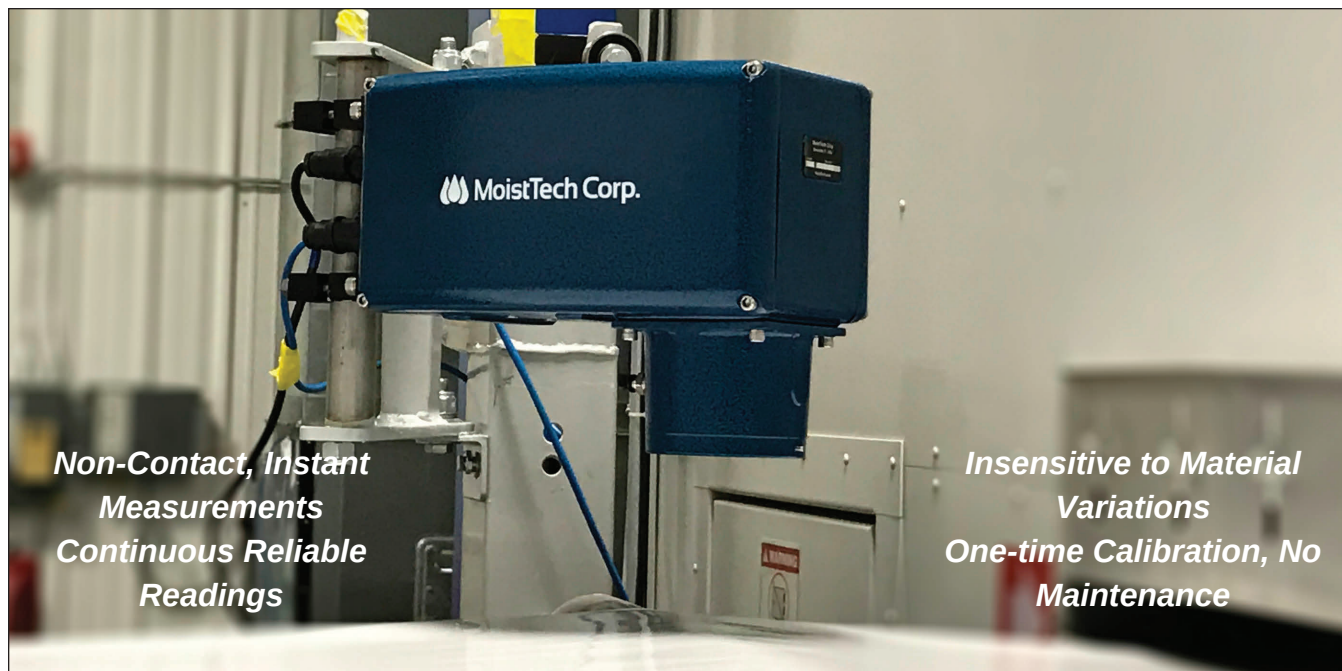
Evaluating hardness and the S-test

Doug Cash and Benjamin Frank

RECYCLING

Size distribution analysis of microstickies treated by enzyme mixtures in papermaking whitewater

Yanan Tang, Bo Li, Shengfang Geng, Carl Houtman, and Shubin Wu



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