2022 AIMCAL R2R Europe Conference ▪ June 7-9 ▪ Valencia, Spain

# CONVERTING QUARTERLY

Web Processing & Finishing Technologies

## Automation speeds changeovers for rotary perforation

2022 Quarter 2:

- 2022 AIMCAL Awards
- Special Market Report: Medical & Pharmaceutical
- Achieving highest-quality battery-electrode coating
- Naming & classifying web-handling defects

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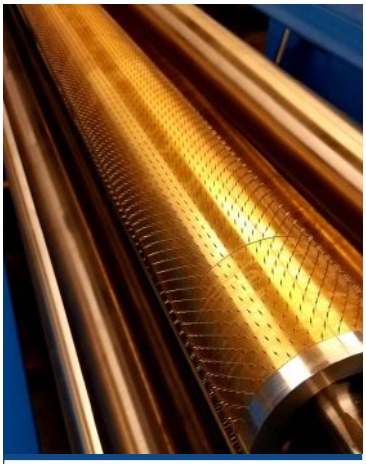
2022 Quarter 2
Vol. 12, No. 2



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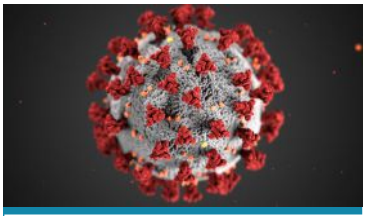

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## SPECIAL MARKET REPORT: MEDICAL & PHARMACEUTICAL



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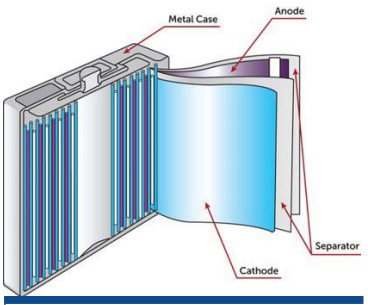
**ON THE COVER:** A Stewarts of America precision-pinned, microperforating roller is pushed up against a high-density, bristle-brush roller. Any pin pattern is possible with designs up to 4,000 pins per sq. in. (Courtesy of Finzer Roller [*www.finzerroller.com*])

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# Making tomorrow's flexible, sustainable medical package

By any product-demand or sales forecast, the opportunities for R2R web processors and converters are wide open in the burgeoning medical and pharmaceuticals end-use market. Our Special Market Report makes that clear with projections like medical flexible packaging reaching sales of $26.3 billion worldwide by 2028, "green" pharmaceutical packaging climbing 9.1% CAGR to 2027, and printed electronics for healthcare applications growing 20.6% CAGR to 2026. These three key trends will impact medical/pharma products despite the COVID-19 pandemic-induced, supply-chain disruptions expected to plague manufacturing for the foreseeable future.

We hope you benefit from the report's technical-paper offerings as well as the other technical content in this issue. These topics address four areas that should interest our audience of web converters, whether you're looking for information on breakthrough technology or assistance with challenges that have affected R2R processing for decades.

- ***R2R Battery Manufacturing*** – How slot-die coating can help you achieve the highest quality anodes and cathodes as battery tech advances.
- ***Gravure Printing*** – Along with continued coverage on ink viscosity-control automation, we present electrothermal drying and how it both saves energy and reduces CO2 emissions.
- ***Rolls & Rollers*** – Learn how new automation helps speed otherwise costly, time-consuming changeovers for rotary perforation.
- ***Web Handling*** – One paper covers applying smart technology to splicing on coating & laminating lines, followed by a discussion on naming and classifying web-handling defects.

**AIMCAL R2R Europe Conference 2022:** Continue your learning opportunities in all things web-processing as the biennial program returns in-person at the AIMPLAS Plastics Technology Centre in Valencia, Spain. The three-day program, June 7-9, includes sessions on solution, extrusion & vacuum web coating; web handling; and gravure printing. Meet old friends and make new ones at several networking events, including tabletop receptions and a tour of Valencia. ■

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## PRESIDENT'S Message

Greetings AIMCAL members and *CQ* subscribers, and a warm spring welcome to the 2022 Q2 issue.

Please let me introduce myself. My name is Andrew Jack of Emerson & Renwick, Ltd. (E+R Group) UK, and I will be taking over the reins as AIMCAL President from our now-Past President Dante Ferrari. Dante will be a hard act to follow as he continued the work of other presidents in growing and making our great organization even better. I believe I'm the first European to hold this position, and I do consider myself as European even though I'm British. Hopefully, I will be only the second of many international presidents of AIMCAL, as we continue to expand the association globally. I've worked in the flexible-material R2R industry for both suppliers and converters for almost 30 years now and have been actively involved with AIMCAL for over 15 years.

As usual, this *CQ* is packed with great information about the latest technical and market developments in the web-converting industry, with a special focus this quarter on the Medical & Pharmaceutical market.

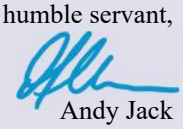
As I write this message, COVID-19 seems to be in retreat and the global economy continues to grow, despite the ongoing "chip" shortage and the seemingly senseless Russian invasion of Ukraine. I hope I speak for everyone when praying for a de-escalation of hostilities and a rapid return to peace in this area. As a consequence of the invasion, oil and gas prices have reached record highs over the last quarter and are another reason why energy costs have soared. Supply-chain disruptions seem to be the topic of the day in many a meeting, with lead times suffering. Raw materials, such as steel and nickel, are achieving record price increases, with many suppliers guaranteeing quoted prices for only 24 hours or less. These increases and extended deliveries are making for very challenging positions for converters and OEMs alike. Current growth opportunities in R2R seem to surround the energy sector, with battery, solar and fuel cell all taking center stage as countries around the globe seek to cement their position in this competitive field.

AIMCAL can help. Economics reports, such as those published in *CQ* by Dr. Robert Fry and those available in the Member Area of the AIMCAL Website, help to make sense of where the world and major economies are headed, and what it means for our industry. AIMCAL Jobs allows companies to advertise job postings and people in the industry to post their resumes. Members can raise their profile to attract both new customers and suppliers by advertising, posting Member News and posing *"Ask AIMCAL"* questions. And, of course, there are an almost limitless number of technical resources to draw on in the AIMCAL TV and conference proceedings libraries in the Member Area. Members can increase employee engagement while raising skill levels by participating in online, hybrid or in-person Converting School classes or having employees take the online GAA gravure training and certification program.

AIMCAL also continues to offer great networking, and in-person events are back. It feels great to announce that after a two-year hiatus due to COVID-19, we will welcome attendees to the 2022 AIMCAL R2R Europe Conference in Valencia, Spain, June 7-9. Please join us for this prestigious event, collaboratively produced with AIMPLAS, as we have both technical presenting and tabletop-exhibiting opportunities available.

To conclude my first message, it is my honor to serve as President. AIMCAL always has been close to my heart, and I've enjoyed each and every event I've attended. AIMCAL is my "go to" source of information and guidance. I am very open to dialog (and the odd beer) so please feel free to seek me out at any of the up-and-coming events for a chat. I lead an incredibly talented board, all of whom have unique attributes that help bring the ideas required to grow. Add to this the incredible team Executive Director Chris Kerscher has assembled, and we have a perfect formula. I hope you and many others will join me on this exciting journey. I'm looking forward to the next two years.

Your humble servant,



Andy Jack
President of the Board – AIMCAL

## AIMCAL R2R Europe Conference to return to an in-person format

Anticipation is building for an in-person AIMCAL R2R (roll-to-roll) Europe Conference. Scheduled for June 7–9, 2022, at the AIMPLAS Plastics Technology Centre in Valencia, Spain, the event's agenda includes sessions on Web Coating, Vacuum Web Coating, Gravure Coating & Printing, and Web Handling. Leading consultants and experts from academia and original equipment manufacturers will present best practices and advances related to coating process technology, oriented films, barrier, R2R vacuum technology, system developments,

printed electronics, sustainability, strategies for improving productivity, converting technology, new materials and processing developments, monitoring and measurement, coating materials for key market applications, and flexible packaging and materials.

The schedule will include tabletop exhibits during evening receptions and other networking opportunities, such as an AIMPLAS facility tour and a guided tour of Valencia.

Registration information and conference details may be found on the AIMCAL Website, *www.aimcal.org* (click on Conference & Events). Prospective exhibitors should contact AIMCAL Member Outreach Director Tim Janes at 803-948-9469, *Tim@aimcal.org*.

## Roisum to reprise hybrid Converting School courses on web handling, winding

Dr. David R. Roisum of Finishing Technologies serves as the instructor for the next editions of *Web Handling Month* and *Web Winding Month*. The online courses are accessed on-demand each week and conclude each Friday with a two-hour live Zoom session with the instructor. On the final Friday, each participant can schedule a 15-minute private meeting with the instructor.

August 2022 – *Web Handling Month* participants learn how to: Eliminate wrinkles, baggy webs and apply effective spreading; eliminate winding defects; design and maintain web machinery and control systems; and design web products and processes for more reliable manufacturing.

September 2022 – *Web Winding Month* participants learn how to: Eliminate winding defects; know whether a defect is manufacturing- or winding-related or both; match winder and settings to product; and design and maintain winding machinery and control systems.

Students who meet all course requirements receive a Certificate of Completion. The cost per course is $699 for members and $899 for nonmembers. Visit *www.aimcal.org*, click on Education and then Courses.

## Plan to participate in AIMCAL R2R Conference USA Sept. 25-29 in Orlando

Proposals for presentations at the annual AIMCAL R2R (roll-to-roll) USA Conference (Sept. 25-29, 2022, in Orlando, FL) may be made on the AIMCAL Website, *www.aimcal.org.* Registration materials also are available. Click on Conference & Events and select 2022 R2R Conference USA from the drop-down menu.

The multi-track agenda includes sessions on Coating & Laminating, Vacuum Web Coating, Web Handling, Adhesives & Coatings, Flexible Packaging, Battery Manufacturing, Printed Electronics, Sustainability, Market Forecasts, Gravure Coating and Printing.

The traditional tabletop exhibit area has been expanded to include 10-by-10-ft exhibits. There also are additional sponsorship opportunities. For more information, contact AIMCAL Member Outreach Director Tim Janes at 803-948-9469, *Tim@aimcal.org.*

## AIMCAL Member Referral Program offers perks and discounts

Referring a new member generates benefits beyond regular AIMCAL membership. Under AIMCAL's Member Referral Program, a member company that refers another firm receives recognition in a member spotlight, e.g., "AIMCAL welcomes ABC Converting as a new member this month – recommended by John Doe at XYZ Films."

For each company referred that joins, the person making the referral earns a $100 discount on AIMCAL events (conference, training program, etc.), which can be gifted to a customer.

Credits will be available in individual AIMCAL accounts once a company joins and pays for membership. To ensure credit is received, email any referral to AIMCAL Member Outreach Director Tim Janes at 803-948-9469, *Tim@aimcal.org,* before the referred company joins.

## Registration opens for ISCST Symposium

The 21st International Coating Science and Technology (ISCST) Symposium will be held Sept. 11-14, 2022, in Minneapolis, MN. Organized by the International Society of Coating Science & Technology and facilitated by AIMCAL, the meeting provides a forum for scientists and engineers to discuss the latest developments and discoveries in the application and solidification of thin liquid films.

A special session on Flexible Electronics will explore continuous and semi-continuous processing of electronic, optoelectronic and energy-storage components on flexible substrates. Other technical sessions will focus on Coating Process Fundamentals, Drying and Curing Fundamentals,

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Flow and Solidification of Particulate Coatings, Wetting & Adhesion, Coating Technology & Applications, Printing and Discrete Coating and Analytics/Big Data in the Coating Industry.

A tabletop exhibit area will offer opportunities to learn about coating products and services from equipment suppliers, coating services, coating and drying modeling software and instrumentation providers.

## Apply online for WISE scholarship

Applications for the new AIMCAL Women in Industry Scholarship for Excellence (WISE) now are available online. The first WISE winners will be announced at the AIMCAL R2R USA Conference (Sept. 25–29 in Orlando, FL).

Intended to help pay down student debt for women employed in the R2R sector, the scholarship recognizes honorees who have overcome significant challenges, invested in STEM degrees and are contributing to the industry.

To support the scholarship program long-term, AIMCAL continues to seek donations from member and nonmember companies and individuals to fund a $100,000 endowment. To donate or apply for a scholarship, click on *www.aimcal.org/AIMCAL/AIMCAL-News/WISE-Scholarship.aspx*. For more information about WISE or the AIMCAL Women's Leadership Committee, contact 803-948-9470 or *aimcal@aimcal.org*.

## Nine new members enjoy array of benefits

Nine newcomers are enjoying the perks of AIMCAL membership. With membership in AIMCAL, all personnel

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## AIMCAL Women's Leadership Committee Member Profile:

*Ana Lyra, R&D Engineer, Terphane (Bloomfield, NY)*

**Describe your current line of work and what interests you the most about it.** As an R&D engineer, I work with quite a wide range of activities, from raw materials and machine suppliers to understanding the requirements for each application. Having a clear view of customer needs and working in partnership with the customer from the beginning of the project is a successful recipe. This approach guides us to make the improvements to products and processes and to reach the desired final properties. Interacting with diverse areas is what makes my eyes shine. I'm always learning something new and meeting new people.

**What areas of the R2R processing field are the most exciting now and into the future?** Convenience, innovation and sustainability. We are all in a rush to keep up with our professional and personal lives, so a convenient package that saves us time and makes the daily routine easier is a must-have. Lidded trays used for fresh fruits, salads and snacks in individual portions are good examples. The combination of convenience with innovative and sustainable ideas is what the environment needs. An example would be reduced plastic consumption by downgauging, replacing rigid lids with flexible options or using post-consumer recycled resin (PCR).

**Did/do you have a female role model or mentor in your career, and what was this experience like?** I was one of the first female engineers to be hired to work in close contact with the operations floor. And I'm very proud to say that our company has been changing in this respect. For a few years now, we already have had a stronger female presence, not only at the lab or at the office, but also with crucial holes in the PET lines and metallizer and coating machines.

*Ana Lyra*

In my eight years at Terphane, my mentors always have been male. They have never treated me differently because I'm female and always have encouraged me to do my best, to be curious, to use my technical background to make technical decisions and to use common sense to complete analyses. Valuing people is one of Terphane's values. Not only my leaders, but all Terphane team members treat each other (regardless of gender, religion or color) with the respect a human being deserves.

**What career advice can you give to women coming into the field to help assure their success?** Study, work hard and be kind. Study will provide the technical background you need to solve technical problems. It will take time, but if you work hard, people will notice you. If they don't, make yourself visible, take risks and build from there. Treating people with respect is the minimum, but if you can give a little bit of kindness (maybe a smile, maybe "good morning"), then you will have partners for your projects. Maybe partners for a lifetime.

# Innovation and Industry

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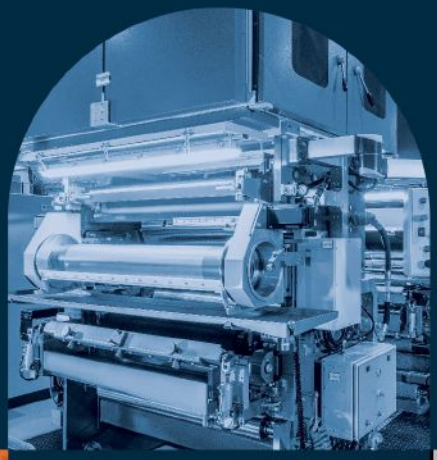

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in the organization receive access to member benefits, such as an individual profile for each employee and access to the online member Community forum, Ask AIMCAL business leads, AIMCAL TV network (more than 225 technical presentations), 10+ years of Conference Proceedings and global market research reports. Other benefits include opportunities for committee involvement, technical training, networking and discounted fees for events. Member companies also are listed in the *AIMCAL SourceBook* directory and have the opportunity to present live Webinars to the industry.

**Heat Technologies, Inc.** (Atlanta, GA): Patented Spectra HE™ Ultra technology emphasizes "mass transfer" rather than "heat" in the removal of liquids by "charging the air" with ultrasonic oscillations. This transfers more moisture-defusing energy to the material to evaporate liquids or increase heating or cooling rates. *(404-272-9006)*

**Infinity Tapes** (Lawrence, MA): US manufacturer produces double-coated tapes, adhesive-transfer tapes, tamper-evident films and tapes and silicone-coated papers and films, which often serve as release liners. Custom formulations and converting can address any application requirement. *(937-765-3951)*

**J. Josephson, Inc.** (South Hackensack, NJ): Commercial wallcovering manufacturer, led by the third generation of the Goodman family, sells to more than 50 countries. A large portfolio of print and emboss rollers offers virtually limitless capability in terms of color and design. *(201-440-7000)*

**Kohli Industries** (Thane, India): Manufacturer and exporter of printing and converting machines for the flexible packaging industry has installed 1,600 machines in 36 countries since its founding in 1972. Options include gravure presses, laminators, extrusion laminators and slitter/rewinders. (+91-98-2002-9050)

**Munich University of Applied Sciences** (Munich, Germany): At one of the largest universities of applied sciences in Germany, students can choose from more than 88 Bachelor and Master degree programs including Paper and Packaging Technology, Print and Media Technology and various engineering disciplines. *(+49-89-12650)*

**Nordson Extrusion Dies LLC** (Chippewa Falls, WI): Premier™ and Ultracoat™ slot-die systems dispense singular or multiple thin and uniform coatings in one pass. Proprietary design software adapts the slot die's flow channel to ensure uniform distribution of fluids within the required thickness tolerance. *(715-726-1201)*

**OCS Optical Control Systems GmbH** (Houston, TX): Headquartered in Germany, the company provides optical inspection equipment for quality control and assurance for plastic products. Services include raw-material inspection, surface testing, system integration and turnkey laboratory solutions. *(281-723-4275)*

**Precision AirConvey Corporation** (Newark, DE): Trim and matrix removal systems for the label, paper, film and sheet and other industries use high-quality cutters and pneumatic conveying systems to effectively remove trim materials and eliminate costly clogs or breakdowns. *(302-999-8000)*

**Toppan USA, Inc.** (Griffin, GA): First plant outside Japan to produce GL Film started up in March 2016 and relies on Toppan's coating and vapor-deposition technologies to produce the transparent barrier film. Operation serves Europe as well as North and South America. *(770-467-5938)*

Learn about member benefits at *www.aimcal.org* (click Membership) or contact AIMCAL Member Outreach Director Tim Janes at 803-948-9469, *Tim@aimcal.org.* ■

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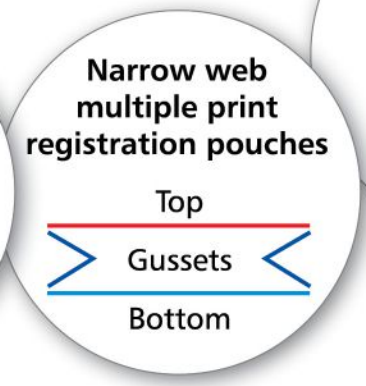


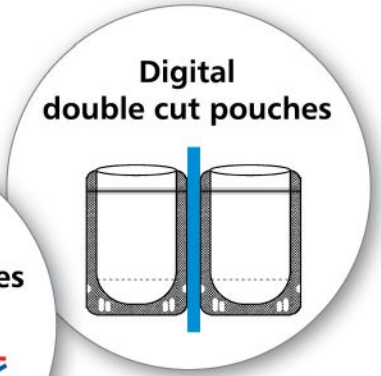


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# Shelf impact, user experience are key aspects of winners in 2022 FPA Achievement Awards

## Vonco Products takes lead honor for flexible-pouch enteral-feeding system.

*Edited by Editor-in-Chief Mark Spaulding*

Shelf impact and a focus on the user experience for packaging were seen as increasing trends among the winners of this year's Flexible Packaging Assn.'s Achievement Awards Competition. The winning entries in the 66th annual event were recognized March 23 during the 2022 FPA Annual Meeting at the Hyatt Regency Coconut Point Resort and Spa in Bonita Springs, FL.

For this year's competition, FPA received a historic number of entries—100 packages were submitted for the competition, with a total of 325 entries (some packages were entered into multiple categories). Twenty-seven packages were honored with 43 different Achievement Awards. Thirteen packages won various Gold Awards, and 13 took home Silver Awards.

Judges for the 2022 competition included Martin Golden of MHGolden Packaging, packaging development consulting and adjunct professor, Rutgers University Packaging Program; Brian Ludwick, vp, publisher and brand director, *Packaging Impressions*; and Jim Peters, packaging-industry marketing communications consultant and author.

"One of the things that was a big part of my consulting practice was shelf impact, and I realize that today, the thinking goes beyond just the shelf. So, I started using the term 'point of perception.' If you get into the medical field, if you get into the industrial field—it's not just the packages on the shelf—but how does it help the end-users at the point when they first perceive the package," notes Peters. "For example, color coding in medical packaging is a way to enhance patient safety."

Technical innovation and sustainability continue to be a focus of the competition. "The sustainability aspect was an outstanding area to focus on among our discussions and review of the entries. It led to several excellent thought discussions on what was presented by the entries and how that floated into technical innovations," says Golden. Peters adds, "The sustainability aspect and the way that it permeated so many of the entries, and what I particularly liked, is the way it was a total process—looking from the technical angle all the way to how it is used in its final-use environment to be sustainable – that's what I found most impressive about the competition."

The printing quality of the entries this year also elicited plenty of admiration from the judges. Ludwick notes, "Printing was a critical category for this year's competition for the vast majority of the entries reviewed, and it was fantastic. The printing quality, the graphics, the use of colors, and the matte and gloss combinations were just outstanding."

### Highest Achievement Award

Vonco Products LLC (Trevor, WI) took the competition's 2022 Highest Achievement Award for its EnteraLoc™ medical-fluid device intended for tube-fed patients. The package is reportedly the first seamless, closed-loop solution that combines nutritious meals with a flexible pouch, leak-proof seal, custom-designed spout and direct-connect ENFit® device in one complete enteral-feeding system. Unlike traditional solutions, EnteraLoc™ uniquely delivers nutrition

directly into the patient's feeding tube. It is designed to improve the nutrition/hydration of tube-fed patients by providing a convenient method of nutrient delivery that is simple, safe, no mess and can be consumed "on-the-go."

Judges evaluated the Highest Achievement Award winner for overall excellence, significant attributes in all award categories, and contributing most to the advancement of the flexible-packaging industry. Converted for end-user customer Medtrition, Inc., the EnteraLoc also won Gold Awards for Expanding the Use of Flexible Packaging, Packaging Excellence, Sustainability and Technical Innovation. More info: *www.vonco.com*

## Thirteen Gold Achievement Awards

For the 2022 competition, judges bestowed 13 packages with Gold Achievement Awards. They include:

**Ahmad Cardamom Tea Bag:** Winning a Gold Award for Printing, Emirates Printing Press's 200-gm Ahmad Tea Bag is designed with Cast and Cure™ technology to boost anti-counterfeiting measures. The technique printed on the front panel gives a holographic effect and provides security to the package as Cast and Cure is not easy to copy, thus helping to prevent duplication. Printed with 8-color reverse printing and, after the lamination process is completed, the surface Cast and Cure is added with a separate process at EPP's Dubai (UAE) plant. The bag uses a high-barrier, metalized-PET film to retain product aroma and increase its shelf life. More info: *www.eppdubai.com*


**Recycle-Ready Meal Kit:** Converted for Tyson® Instant Pot Family, the meal kit won Amcor Flexibles (Oshkosh, WI) a Gold Award for Expanding the Use of Flexible Packaging. The AmPrima™ recycle-ready pouch is a technology that addresses Tyson's goal of incorporating better, more sustainable plastics in its brand packaging. It streamlines three components (a rigid APET tray, a PVC overwrap and a label) into one high-barrier, flexible carrier pouch eligible for consumer recycling. The efficient design results in an 80% reduction in carbon footprint; a 75% reduction in packaging weight; and elimination of chloride-based materials. More info: *www.amcor.com*



**Beachbody® Standup Pouch:** Customer Beachbody LLC partnered with American Packaging Corp. (Story City, IA) to launch its new Cookies & Cream-flavored Shakeology® brand standup pouch. Incorporating 45% post-consumer recycled (PCR) content at a minimum, the pouch is a flexographically printed, multi-material lamination of PET, met-PET and LLDPE. It won Gold for Sustainability and Silver for Packaging Excellence and Shelf Impact. More info: *www.americanpackaging.com*

**Celebratory Overwrap:** Created to celebrate International Women's Day, the new HerSHEy's chocolate-bar overwrap supports an initiative important to the company and its consumers – honoring the women in their lives. Converted by Printpack's Villa Rica, GA, plant, the Celebrate HerSHEy's bar resulted in considerable media attention with hundreds of posts, reposts and likes on social-media platforms. In addition, the story was covered by local and national news outlets for additional earned media. The wrapper won Gold for Shelf Impact. More info: *www.printpack.com*


**3D Recyclable Pouch:** Winning Gold for Shelf Impact for converter Emirates Printing Press (Dubai), the KITKAT® Mini Moments 3D recyclable standup pouch is designed with a registered matte coating to create a striking brand block on the shelf. As the full laminate is OPP- and PE-based, the pouching parameters were set carefully for good sealing quality and finish of the pouch. OPP non-heat-sealable and metallized-BOPP films on both sides of the treated material are used instead of PET and metalized-PET to make the laminate recyclable. The pouch also has laser scoring for easy tearing by the consumer. More info: *www.eppdubai.com*


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**Paper-Based Packaging Tube:** Produced by the Noida, India, plant of Uflex Packaging, Inc., the new KRAFTIKA tube was developed on the concept of reducing the plastics at the source, thereby reducing overall environmental impact vs. a traditional tube. KRAFTIKA replaces plastic with an FSC-certified, virgin kraft paper that helps lighten the tube's weight by up to 45%. The tubes have strong barrier properties with a low moisture-absorption rate and high bursting strength. Winning Gold for Packaging Excellence and Silver for Expanding the Use of Flexible Packaging, as well as Technical Innovation, KRAFTIKA is best suited to package products such as cosmetics that are produced using natural or organic ingredients. More info: *www.flexxfilm.com*

**Bio-Based Bags:** Converter American Packaging Corp. (Story City, IA) and its customer Lamb Weston were proud to present a truly circular, sustainable-packaging scenario for the Alexia Organic line of frozen potato products. The film used is partially made from plant-based starches, 16% by weight, including processing by-product from the manufacturing of french fries. Not only does this packaging replace plastic with bio-based content, it also finds a new home for french-fry byproduct. The bags won a Gold Award for Sustainability and a Silver for Packaging Excellence. More info: *www.americanpackaging.com*


**Mackintosh's® Quality Street® Standup Pouch:** Winning a second Gold Award for Printing for Emirates Printing Press (Dubai), the recyclable pouch was developed with customer Nestlé as a sustainability initiative. Key features include rich, vibrant colors and appealing visual effects achieved with 8-color gravure printing that makes the pouch distinctive. The printing with surface-matte finish with a very high-resolution product image gives the pouch an unusual look. The pouch's resealable zipper keeps the snack dates fresh for a longer time. More info: *www.eppdubai.com*


**Paper-Based Confectionery Pouch:** Nestlé Smarties® candies expands its use of paper-based packaging for the product line, which requires different measures than conventional materials. Converted by American Packaging Corp. (Columbus, WI), the material used for the Smarties standup pouch is optimized for stiffness and durability to maximize shelf presence while providing strength and stability to withstand product fill and distribution. Key production goals of this paper pack were to mimic the functionality of plastic-based packaging while maintaining speed on the printing press. The gravure-printed pouch consists of surface-printed paper with gloss, heat-resistant overlacquer and a gravure-applied dispersion coating to support heat-sealability, barrier and product resistance. APC won Gold for Packaging Excellence and Technical Innovation, along with Silver for Sustainability. More info: *www.americanpackaging.com*


**Industrially Compostable Bags:** The new "Off The Eaten Path" industrially compostable package, converted by Printpack (Villa Rica, GA), offers environmentally conscious consumers another option for a sustainable-packaging circular economy. The new structure, which won Gold for Sustainabilty and Silver for Packaging Excellence, combines several product, process and graphic enhancements embodied within the new package and design. These include a fully certified, industrial-compostable, bio-based package, a proprietary sound-dampening technology for rigid bio-based materials, eye-catching clear and concise "compostable" messaging, and a consumer-interactive QR code providing details on composting options. More info: *www.printpack.com*


**Snack-Food Standup-Box Pouch:** Bryce Corp. (Memphis, TN), in partnership with customer Popcornopolis®, developed a new standup-box pouch that is one of a kind in the snack-food segment. The flat-bottomed design, consisting of multilayer, high-barrier films, features HD-flexo printing, a convenient press-to-close zipper

and sturdiness that maximizes presentation on each panel and boosts shelf impact. Winning Gold for Shelf Impact, the pouch's barrier-film technology combines with a reseal feature to provide maximum freshness for this indulgent treat. More info: *www.brycecorp.com*



**Lifting Mask Cosmetics Sachet:** LPS Industries LLC's (Moonachie, NJ) new cosmetics sachet for Repêchage® Vita Cura® B3 Lifting Mask was designed for upscale salon shelf appeal. The 0.6-oz pouch has outstanding detailed printing with gold layered tones. It won Gold for Printing and a Silver for Shelf Impact. More info: *www.lpsind.com*

**Colorful Parrot-Seed Heavy-Weight Bag:** With its vibrant colors and finely printed detail, the Volkman Seed Featherglow Large Parrot Bag is sure to catch the consumer's eye. It was converted at PPC Flexible Packaging's Buffalo Grove, IL, plant and won a Gold Award for Printing. Normally a difficult challenge in quality matching, this job is printed on both digital and flexographic printing presses to meet SKU and production-run requirements. Using Project Blue, a patented anilox and screening technology that delivers ultra-high definition quality comparable to 300 line screen, PPC met the quantity needs of the customer while also matching the digital quality. More info: *www.ppcflex.com*


For more details on all the winners, go to *www.flexpack.org*. ■

# INSTALLATIONS

1. Bean Station, TN-based metallized and barrier-film provider **FILMtech, Inc.,** recently completed the installation of a new **Atlas Titan ER610-DT** slitter/rewinder in its 120,000-sq-ft facility near Knoxville. With the addition of this compact dual-turret slitter, FILMtech can process web widths up to 65 in. and maximize productivity while increasing operator safety. "This investment continues to support our narrow-web customers' growth and provides a more efficient use of space within our factory,"

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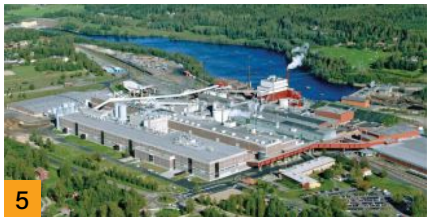
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says VP of Operations Joey Barnard. FILMtech is the exclusive North American licensee of CeramAlox® clear barrier products.

2. Flexible-packaging printer & converter **Glenroy®, Inc.,** addresses increasing customer – and consumer – demand for sustainable materials with the addition of a new **Nordmeccanica** tandem adhesive laminator. The Menomonee Falls, WI-based company will use the capacity expansion to accelerate its growth in high-barrier film laminations, recyclable products and standup-pouch capabilities. "The new laminator, which will be ready for production this spring, will improve run speeds and cure time," says Glenroy Adhesive Laminate Manager Jeff Huizenga. "The machine is in a temperature- and humidity-controlled environment for top-performance. This laminator is saving time and still allows us to provide the best, high-quality flexible packaging materials that Glenroy is known for."

3. The global pandemic and all that it has involved regarding travel restrictions has forced **Martin Automatic** to innovate new ways of working to keep its customers satisfied. A testament to this is the remote video assistance for the recent installation of a second **MBSC** non-stop unwind/splicer and an **STR** automatic transfer rewinder fitted to a 10-color **Gallus ECS 340** flexographic-printing press at Malaysian converter **Mega Label.** The company supplies labels to the food, pharmaceutical, clothing and healthcare sectors from its modern 62,000-sq-ft plant in Johor. The Martin systems had an immediate impact on productivity and waste levels, saving 5-10% of material and 5-10 mins per roll change.

4. Colombian printer **IMPREAC-Impresos y Acabados S.A.S.** expects to boost its capacity by more than 30% with the installation of a second **Nilpeter FB-Line 350** press, intended primarily to manufacture multilayer coupon labels. Located on the outskirts of Bogota, the company's 20,000-sq-ft plant has been able to serve customers without stopping production even amid the toughest moments of the pandemic. A sophisticated workhorse offering ease-of-operation and superior printing quality, the new FB-350 at IMPREAC is equipped with high-capacity cold-foil towers, a rail-based re-inserting system including the new Automatic Plate Positioning feature, and a short web path.

5. Battery-component converter **Northvolt** will transform a closed **Stora Enso** paper mill into a new Li-ion battery gigafactory. The site is expected to become operational in late 2024, using 100% clean energy to produce up to 100 GWh of cathode material per year to enable cell assembly at multiple Northvolt facilities. The manufacturing plant will reuse and refurbish much of the existing facilities and site infrastructure at the Kvarnsveden Mill and the surrounding industrial area in Borlänge, Sweden. The factory will play a key role in fulfilling more than $50 billion in orders from key customers and joins a wider European production network of facilities being developed together with partners in Sweden, Norway, Poland, Germany and Portugal.

Security printer **Royal Joh Enschedé** is validating data-matrix codes printed on new trackable postage stamps for **Deutsche Post** using a just-installed in-line inspection process from **Lake Image Systems.** By printing unique, 2D codes on every stamp, Deutsche Post easily can detect reused or forged stamps to prevent fraud, track a letter throughout its network and provide customers new digital and philatelist services with the barcoded stamp. The printer uses its **Domino K600i** inkjet press to print the codes of sheets containing 90 stamps, while the Lake Image **Discovery Multiscan 3** camera-inspection system reads, verifies and grades every code according to required specifications. ■

# TECHNICAL COATING INTERNATIONAL

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# WHAT, WHY AND HOW DO WE MEASURE SUBSTRATE PROPERTIES? PART 2

For this installment, I will add a discussion of control-charting, along with discussing various measurements. For this series, I will be using ASTM testing standards, which can be found and purchased on the ASTM website (*https://webstore.ansi.org*). European and Japanese standard test methods also exist, as well as some professional organizations such as TAPPI.

Let's start the discussion with film appearance. Figure 1 shows two packages with widely different appearances in bright sunlight.


**FIGURE 1.** *Two package substrates show widely different appearances in bright sunlight.*

## Gloss measures reflectance

The tapioca has an overall shiny appearance while the rice has a much flatter appearance. This highlights the possible range of a film property termed "gloss." The tapioca has a high gloss or shiny appearance while the rice has a matte (lower gloss), more paper-like appearance. Gloss is measured with ASTM D 2457-21 [1]. High-gloss films are smoother than matte films [2]. Gloss is measured by measuring the reflectance of the film surface using a standard instrument configuration (see Figure 2). The actual value of the measured gloss is dependent on the angle at which the reflectance is measured (see Figure 3). The interested reader also can check the Rhopoint Americas Website [3] for a description of gloss measurements.

Gloss often is used to add eye appeal, enhance printing appearance or to differentiate a package on a point-of-sale shelf. When plastic packaging first was being used to replace paper packaging, gloss was a primary film property. The high-gloss packages would stand out from surrounding paper packages. After most paper packages were replaced, whole shelves of glossy packages were seen and then the matte films, with their paper-like appearance, became desirable as now they would be easily differentiated from the high-gloss packages.

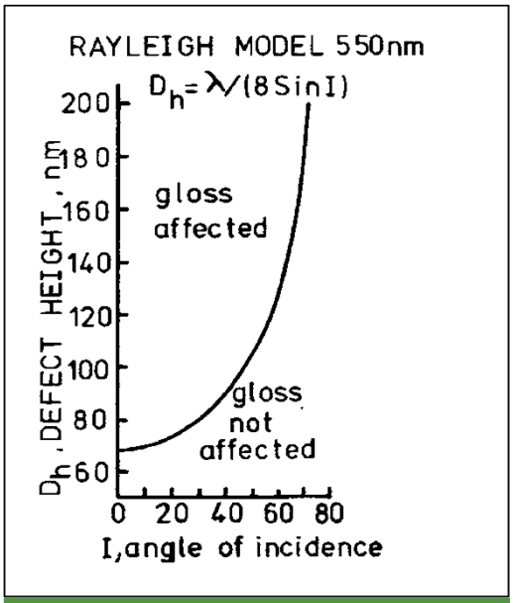


**FIGURE 2.** *Diagram of the impact of surface roughness on the gloss of a substrate measured at various angles of incidence and wavelength of the incident light. Smoother surfaces yield glossier surfaces. Low angle of incidence gives more sensitive gloss measurements.*

## Haze measures transparence

Film haze is another aspect of film appearance. Haze may be measured with ASTM 1003-21 [4] using a hazemeter or by light transmission using a spectrophotometer. Haze is a measure of an essentially clear film's transparence and wide-angle, light-scattering properties. Hazy films may appear as imparting a cloudy or smoky aspect to the film. ASTM 1003-21 is limited to measuring haze values of less than 30%.

There are two components to film haze: surface haze and internal haze. Surface haze is due to surface roughness and is impacted by the film-making process. As such, control-charting the total or surface haze can give insights into the control of the film process. Internal haze may be due to film additives, internal-density variations from resin crystallization or the blending and mixing together of different density polymers. Again, control-charting haze measurements can give important information on the process control of blended resins, additive levels or film contamination (see Figure 4). Surface haze may be separated from internal haze by adding an oil layer to the film surface to remove the impact of surface roughness on the haze measurement.

If voids are present in the film from additives or contamination, the internal haze will be increased. At an upper limit of void formation, during stretching from CaCO3 [5] or incompatible polymers [6] as void initiators will give an opaque film with a flat or opalescent appearance, respectively. High-opacity films are used to give shelf differentiation from clear films and can be produced to give a white paper-like appearance. Most opacity standard tests are for the opacity of paper, such as TAPPI T 519 om-06, or a simple "%-light" transmission test can be used to create a film-based opacity measurement. ■

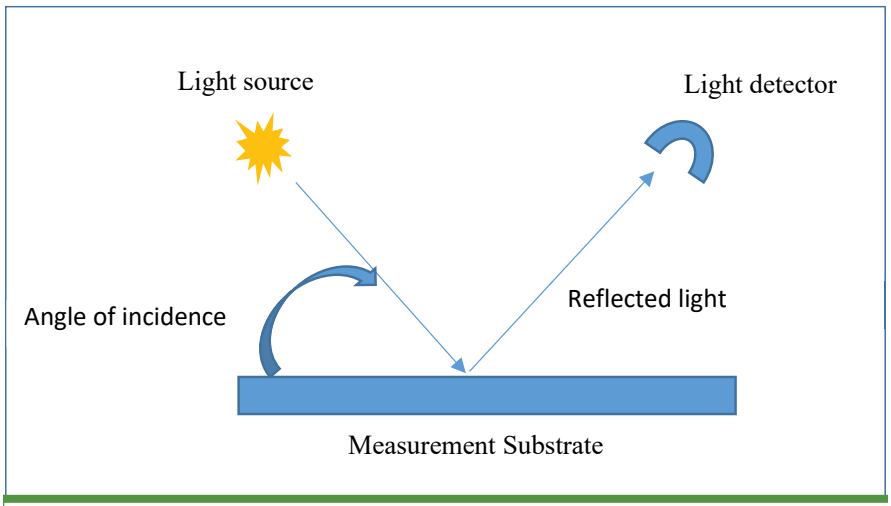


**FIGURE 3.** *Schematic of gloss measurement from substrate. Reflected light is measured at the same angle as the angle of incidence.*

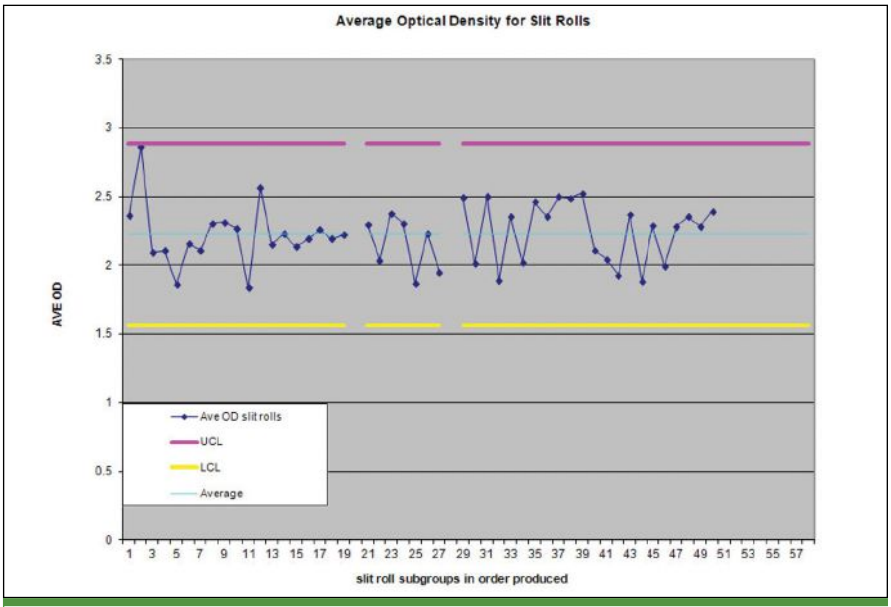


**FIGURE 4.** *Typical control chart of an in-control process for the property being measured. Control charting is necessary to ensure an in-control process and product properties.*


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# WHAT ARE THE PROS AND CONS OF CORES FOR VACUUM-COATER WINDING?

Cores are the cylindrical material used to wind the web onto. The web material, thickness and width, as well as the winding-system core-location type, need to be taken into consideration when producing a specification for cores.

To produce a well-wound roll, it is necessary that the web is wound onto a cylinder that is circular, concentric, straight and with a smooth surface. Extruded cylinders (pipes) can be bowed directly from the manufacturing process or cores may be bowed due to damage, such as by being dropped or poorly supported when stored. The cost of the cores also dictates the strategy used for the supply of cores. Low-cost cores may be used with an unlimited supply of replacement cores available from stock. With more-expensive cores, it may be that all customers are required to return the cores to improve the economics of the high-value cores. This does mean that even *more* care is required when handling and shipping the cores to prevent damage.

## Different materials = different challenges

There are various materials that can be used. It is important to understand the strengths and weaknesses of each of the core materials.

The most basic material is uncoated paperboard. This is manufactured continuously using multiple layers of kraft paper spiral-wound onto a mandrel, glued together and cut to long lengths. Where wide webs are used, the paperboard cores can sag, which can lead to winding variations. Storing the cores in a controlled temperature and humidity and supported along the length rather than just at each end can help minimize this. The board easily is damaged and will shed a large number of particles when it is damaged. Where core location that is done by inserting a ribbed-taper plug into the core ends hard enough that the ribs dig into the board sufficiently to prevent the core from slipping, this repeated compression of the core ends will be a constant source of particulates. These particulates will contribute to the number of pinholes in the vacuum-deposited coatings.

An alternative to ribbed-taper plugs is using an expanding shaft. This is where a series of pads on the surface of a full-length shaft, which is inserted into the core, is pushed out from the shaft surface to make contact with the inside of the core, both gripping and locking it into position. This does not damage the core ends and so minimizes release of particles from the core ends.

## Core-cutting considerations

When cutting away any remaining layers of web on a core, it is common for the knife to also cut into the surface of the paperboard core. This, too, can be a source of particles. I have seen this type of core being sawn to length only meters away from a vacuum-coater with a visible cloud of particles being produced adjacent to the vacuum system. Other operations, more concerned about coating pinholes, have been more careful, and new cores were cut to length in a separate room well away from the vacuum-coater, with a vacuum-cleaner close to the core cutter to minimize particulates.

Paperboard cores also contain moisture, typically around 6% to 8%, which will outgas when under vacuum. Board cores can collapse if the web wound onto them is applied with too much tension.

To minimize particle shedding, using an impregnated core is one option. The outer surface of the core is coated to seal and harden it, making the core less susceptible to damage. Depending on the coating used, this may only delay the release of particles as the damage accumulates and the benefit of the coating declines. This particularly is true with core cones where the ribs are quite sharp.

## Polymer, metal extruded tubes

Other core materials are polymers and metals, which have some similar features. Both can be extruded into tubes. However, these extrusions can produce curved tubes, which are difficult to straighten. An alternative, for both materials, is to machine the cores either from a thicker tube or from a solid billet; this also can increase the cost of these tubes. These materials are stiffer and harder than the paperboard cores, but this does not necessarily mean that they can be handled more roughly.

Dropping metal cores can knock them away from being concentric, or it may dent the surface. Cutting into either metal or polymer cores may raise lips to the groove cut into the surface. This type of damage has an effect in the layer of web wound onto the core. The severity of the damage on the core surface, along with how tight the roll is being wound, determines how may web layers will show damage resulting from the core damage.

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All cores need to have a clean surface before attaching the web and starting winding. There is no point in having a high-quality core if the surface is not kept clean. Any particles on the core surface also will damage the initial film layers wound onto the core.

There is a wide choice of materials that can be used to make cores, as well as a variety of coatings that can be applied to paperboard cores to customize them for the type of web that will be wound onto them. There also are cores that include a radio frequency identification (RFID) chip to allow the cores to be tracked through manufacturing and shipping. As core quality increases, it becomes more cost-effective to use them multiple times; and so, treating them with care is important and should be included in any plan for improving coating quality. ■

# EXPLAIN THE CONCEPT OF PRODUCT-PROCESS INTEGRATION IN WEB COATING: PART 2

In my last column, I gave some simple examples of Product-Process Integration. Here is a more complicated example illustrating the underlying framework.

"Starry night" is a defect in some black-and-white (BW) photographic film. Prototypical BW film is a simultaneously coated, two-layer product: an "emulsion" layer (that turns black or stays clear) and an overcoat containing "matte" particles to provide roughness. As the layers dry, some matte particles get pushed into the emulsion, leaving clear spots in the developed film. When backlit, the "black" region looks like a starry night sky (see Figure 1) [1].

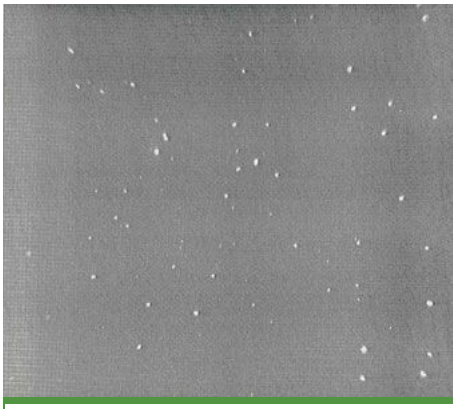

**FIGURE 1.** *"Starry night" defect in photographic film*

These "stars" pass light, requiring more silver in the emulsion to achieve the target optical density. A new class of high-productivity dryers exhibited problematic levels of starry night. Initial troubleshooting efforts mitigated the problem by optimizing the particles-size distribution and agglomeration while reducing the drying rate toward the end of the dryer…but this sacrificed line speed on sold-out assets.

## Taking a deeper dive

The deeper dive involved modeling, analytical work and statistically designed experiments. Table 1 shows "star" count per unit area as a function of film temperature and drying rate in the constant rate period [1]. The defect count is proportional to drying rate and is extremely sensitive to film temperature. So, what changes with film temperature in drying? Colder drying increases crystallinity, moisture diffusivity and modulus. These became intermediate targets to study [2].

**TABLE 1.** *Effect of drying on starry-night count*

| | | | | |
|---|---|---|---|---|
| Dry Bulb (°C) | 28 | 30 | 30.6 | 33 |
| Dew Point (°C) | 7 | 4.5 | 11 | 9.4 |
| Constant rate temperature (°C) | 16 | 16 | 18.7 | 18.7 |
| Drying rate (Moles/m$^2$sec) | 0.023 | 0.027 | 0.023 | 0.027 |

Starry night count:
Hot/Cold = 1.27
Fast/Slow = 1.19

**TABLE 2.** *Hierarchy of measured and controlled variables*

| Level | Examples: Starry night | 6s |
|---|---|---|
| Critical to quality | Starry night count, Optical density | CTQ |
| Critical measurements | Degree of crystallinity, modulus, diffusivity | Y |
| Critical controlled variables | Drying rate, film temperature in drying | y |
| Critical process settings | Drying profile (dry bulb, dew point, slot velocities) | X |
| Manipulated variables | Damper & steam valve settings, formulation | x |

The point of Table 1 is the structure of the experiment (not the physics of starry night). Traditional process experiments vary dry bulb and dew point in a regular pattern; here, those variables were manipulated to study underlying physical mechanisms (film temperature and drying rate) in a regular pattern to develop a hierarchy of relationships between process and product attributes. This approach has been incorporated into many improvement strategies. Table 2 shows the 6 Sigma notation for these classes of variables.

> "UNDERSTANDING HOW TO TWEAK THE FORMULATION AND DRYING PROFILE AVERAGED MORE THAN A **50%** INCREASE IN LINE SPEEDS ACROSS A SOLD-OUT PRODUCT TOTALLING HUNDREDS OF MILLIONS OF DOLLARS IN SALES."

I doubt anyone cares about starry night; it is an obscure defect in obsolete products that required a "deep dive" to manage. But in this case, understanding how to tweak the formulation and drying profile averaged more than a 50% increase in line speeds across a sold-out product line that totaled hundreds of millions of dollars in sales. I hope that is the kind of incentive that will get you to think more about Product-Process Integration – and encourage you to read the next few articles in this series. ■

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# HOW CAN CRUSH-KNIFE SHOCK LOADING BADLY IMPACT SLITTING PERFORMANCE?

Crush-Knife Shock Loading happens from excessive knife-to-anvil roll contact speed. The knife tip is elastic to some degree but, when rapidly slamming into the harder anvil roll, it doesn't have enough time to absorb deformation stress and vibrations…as in normal cyclic operation. The struck material behaves as if it's more brittle than it actually is. If the tip doesn't break, this load-bearing area will experience accelerated below-surface fatigue. If the knife tip *does* break and continues in operation, the new uneven radius area can work harden and eventually score the anvil surface. A clue to this problem is a cyclic, crunching noise heard with each rotation. In both cases, knife life is shortened.

There are three ways knife-to-anvil shock loading negatively impacts the knife and anvil roll *(pun intended):* 1) an unregulated air supply; 2) out-of-balance or non-concentric anvil roll or knife; and 3) web ramping (see Figure 1).

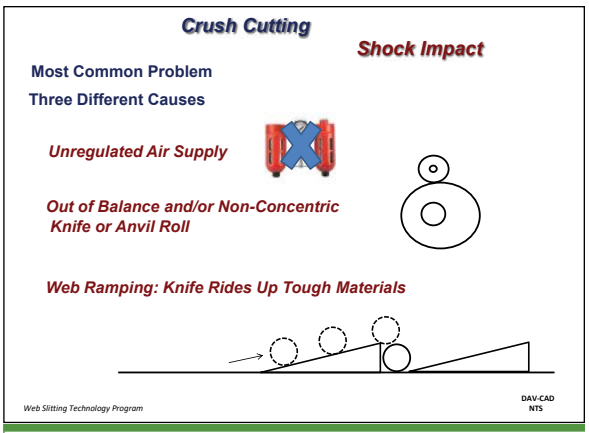


**FIGURE 1.** *Most common causes of crush-cutting shock loading*

## Unregulated air supply

First, the amount of air pressure applied to your knifeholders must be set properly for your web-fracturing requirements. Keep in mind that maximum holder air pressure might be excessive and could shorten knife life. Know how much pressure is needed.

Also, it's very important that knifeholders have individual on-off and adjustable air-flow control valves. They independently provide controlled, slow engagement and disengagement of the knife to the anvil roll. Uncontrolled knife engagement, such as detaching and re-attaching air hoses, can result in the knife slamming into the anvil roll at very high velocity, thus severely damaging the knife-tip radius at the contact point. A very sharp, clinking noise at knife engagement should not be ignored.

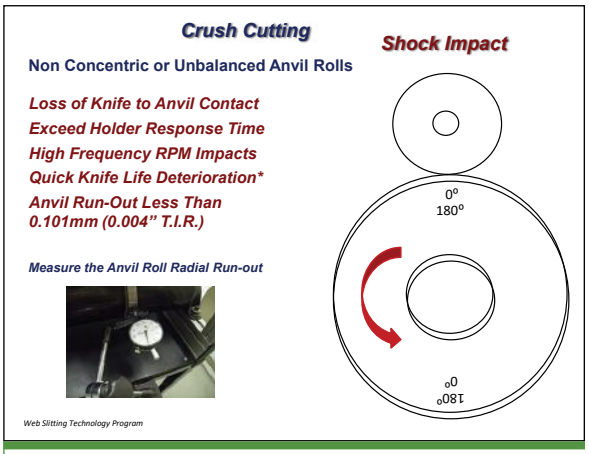


**FIGURE 2.** *Consequences of non-concentric or unbalanced anvil rolls on crush-cutting performance*

## Out-of-balance anvil rolls

The second is non-concentric or out-of-balance anvil rolls cyclically pushing against a crush-cut knifeholder's operating force with every revolution (see Figure 2). Holder designs have a natural response time that usually compensates for these mechanical changes but, if the anvil roll rotates or begins to vibrate faster than the holder can respond, the knife-to-anvil roll contact force reduces or can be lost. High-frequency shock loading begins. Knife-tip damage can be much quicker in this situation, especially with tough web materials, such as a fiberglass matting. Anvil-roll concentricity should not exceed a Total Indicated Run-out (TIR) of 0.101 mm (0.004 in.).

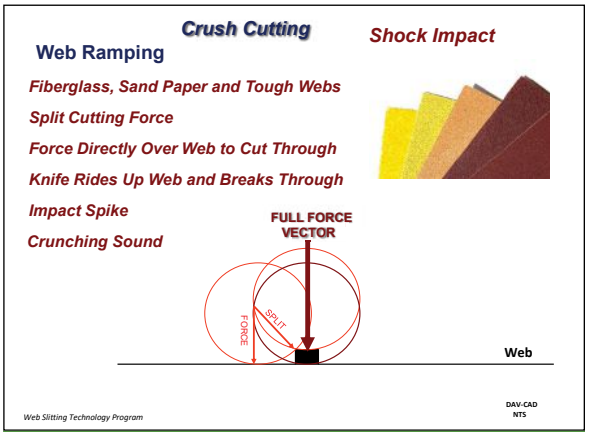


**FIGURE 3.** *Aspects of web ramping on crush-cutting performance*

## Web ramping

The third is web ramping. When cutting tough, irregular materials, such as fiberglass and sandpaper, the knife's circumference will contact fracture-resistant web elements. Because the web elements

resist fracture, the applied crush force is split momentarily between the knife's circumference, contacting both the anvil-roll surface and the hard element simultaneously.

For example, sandpaper has hard grit particles adhered to it. High crush-cutting loads are required to break through these elements and sever the web. The knife must ride up these grit particles to a position perpendicular to the anvil roll to achieve the cutting force needed to break through the grit and thus sever the web. A load spike results. Although a lesser impact force than air-pressure shock loads, this cyclic damage results in shorter knife life. Both the knife and anvil-roll centerlines need to be in-line with each other to obtain the maximum set pressure (see Figure 3).

So, verify your air-pressure system operation; check your anvil-roll run-out; and – because it's a fact of life when crush-cutting rough material – wear your earplugs. ■

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# YOU AREN'T DOING AS WELL AS YOU THINK YOU'RE DOING...ECONOMICALLY

Economists tend to focus on *real* economic activity. Most of the measures they use reflect increases in volume but not in prices. These measures either are adjusted to remove the impact of inflation (e.g., Real Gross Domestic Product and its components) or they directly measure volumes (e.g., employment, light vehicle sales, housing starts, home sales). Industrial production indexes reflect a combination of both approaches. Managers and investors, on the other hand, tend to focus on *nominal* (dollar) measures. When companies report earnings and revenue, they don't adjust those numbers for inflation.

Over the last three decades, when inflation was low, real and nominal measures tended to paint the same picture of the economy. When nominal corporate earnings were growing strongly, the real economy also was doing well. When nominal wages and salaries were rising, workers were really better off. Now, with inflation at its highest levels since 1982, the distinction between real and nominal matters. Companies aren't doing as well as they think they're doing, and workers are worse off, despite big raises.

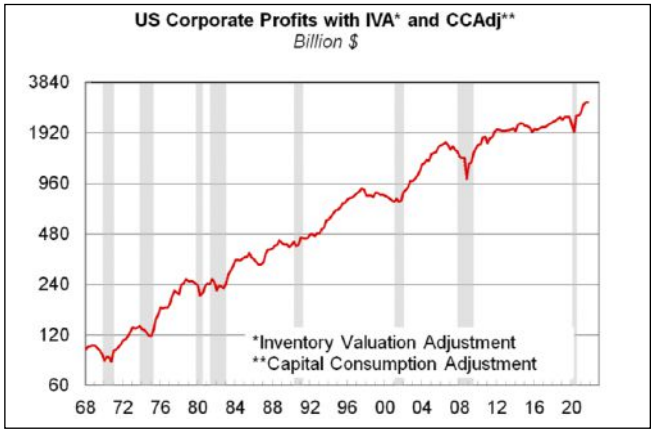
## Inflation in the pipeline

The Consumer Price Index rose 1.2% in March, with most of the increase coming from higher energy prices. The year-over-year inflation rate rose to 8.5%. Investors briefly took solace in the fact that, excluding food and energy prices, the CPI rose just 0.3% in March.

However, Producer Price Indexes, released the next day, showed big increases even when food and energy prices were excluded. The headline PPI for final demand, which includes services, rose 1.4%. It was up 1.0% excluding food and energy prices. The PPI for finished goods, which was the headline measure until 2014, rose 1.9%, on top of a 2.6% increase in February. The PPI for finished goods excluding food and energy, my favorite measure of underlying inflation, rose 0.8% and was up 8.4% year-over-year. Producer (wholesale) prices don't always lead consumer prices, but big increases in producer prices, especially for intermediate materials, suggest there is plenty of inflation "in the pipeline" that hasn't reached consumers yet.

## When "up" is really "down"

Nominal wages and salaries (average hourly earnings), which are reported with the monthly employment report, were *up* 5.6% year-over-year in March. Real average hourly earnings, which are calculated and reported with the release of the Consumer Price Index, were *down* 2.7% year-over-year.




Wages and salaries have not been keeping up with inflation. In a tight labor market, with the unemployment rate at 3.6% and job openings far exceeding the number of unemployed, that makes no sense and is probably not sustainable. (It may explain why a Grant Thornton survey showed that 40% of people who changed jobs in the last year actively are looking for another job.) And the labor market still is tightening. Payroll employment rose 750,000 in February and 431,000 in March. New claims for unemployment insurance are near a record low. Down the road, wages and salaries likely are to rise faster than prices. That won't be good for corporate earnings, which tend to turn down *before* the economy falls into a recession.

## Corporate profits rise but also slow down

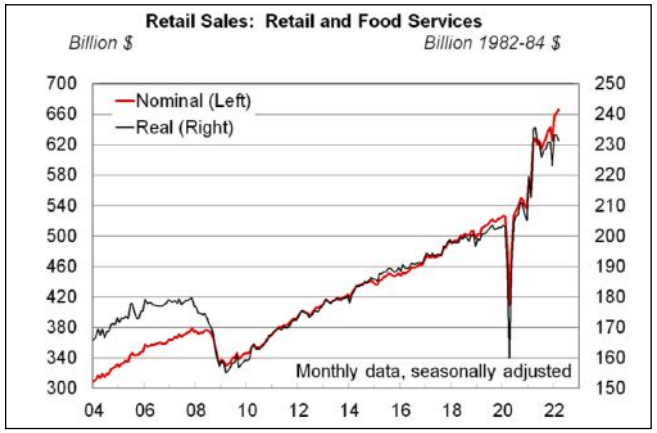
So far, though, corporate earnings have remained strong (see line graph above). Corporate profits from the National Income and Products Accounts (NIPA) were 21% higher in Q4 2021 than they were in Q4 2020 (and 22.1% higher than in Q4 2019, before the pandemic). I prefer the NIPA measure, which comes from the same source and data release as GDP, to S&P500 earnings per share, which are distorted by stock buybacks. (Reporting earnings per share when you're reducing your share count is cheating, but until analysts call them out, companies will keep doing it.)

Over the entirety of 2021, NIPA profits grew much more rapidly than inflation, but in Q4, profits grew at just a 2.8% annual rate, much less than inflation. I expect nominal earnings growth to remain strong in 2022 – and data on corporate tax revenue indicate profits were strong in Q1 – but much of the growth will come from higher prices, not

from increased economic activity. In real terms, earnings growth will slow. Managers, who like to report double-digit earnings growth, might prefer 10% earnings growth and 8% inflation to 4% earnings growth and 2% inflation, but their shareholders, on a real after-tax basis, would be better off with the latter. So would the overall economy.

### Ditto with retail sales

Unlike real GDP and many other data series, retail sales are reported in nominal terms (see line graph below). They were up 0.5% month-to-month and 6.9% year-over-year in March. A series calculated by the Federal Reserve Bank of St. Louis shows real retail sales declining for a second straight month in March and well below the unsustainably high levels in March and April 2021, after passage of the American Rescue Plan. However, this series is calculated using the Consumer Price Index, which might not be appropriate for the establishments covered by the retail sales data. A more appropriate price deflator might show that real retail sales are still trending up, but at a much slower rate than nominal retail sales.




While economists tend to prefer real measures of economic activity, we should be clear that it is much easier to measure nominal activity. Calculating nominal measures of activity basically involves adding up the dollars. It is arithmetic. Splitting nominal growth into its real growth and inflation components is much more difficult. It involves economics and statistics, and it requires decisions that are at least somewhat arbitrary. Nominal GDP data are probably quite accurate, but reasonable people can disagree over whether real growth is higher or lower than what is reported while inflation is lower or higher.

### It depends on what businesses you serve

I expect above-trend growth this year, but strength will be concentrated in sectors that have not fully recovered from the pandemic, either because of shortages of labor and materials (e.g., motor vehicles) or because of the pandemic itself (e.g., travel and entertainment and the derived demand for planes and jet fuel).

> "WITH INFLATION AT ITS HIGHEST LEVELS SINCE 1982, THE DISTINCTION BETWEEN REAL ECONOMIC ACTIVITY AND NOMINAL (DOLLAR VALUES) MATTERS."

Other parts of the economy won't grow as rapidly. If your sales are no longer being constrained by either the pandemic or by shortages of labor and materials, and your customers' inventories are no longer too lean, you should expect growth to slow to its long-term trend. Pent-up demand will keep housing starts near March's 16-year high, despite the recent surge in mortgage rates, but we shouldn't expect further growth.

Industrial production in US manufacturing, the favorite measure of real activity for this former manufacturing-sector economist, rose 0.9% in March, after a 1.2% increase in February. The March increase was led by big increases in production of motor vehicles and aircraft. In most manufacturing industries, production already has risen above pre-pandemic levels. The major exceptions are motor vehicles, aerospace and petroleum refining, which should benefit from pent-up demand for vehicles and travel this year. But pent-up demand and inventory rebuilding are, by their very nature, temporary. Growth will slow in each industry as they are exhausted. Once travel and entertainment are back to normal and pent-up demand for cars and houses is satisfied, likely in 2023, overall growth is likely to slow significantly. ■

*From the April 2022 issue of* Current Economic Conditions.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# The 2022 AIMCAL Awards

## Annual competition honors Product of the Year, Technology of the Year and Sustainability developments in the R2R web-processing industry.

*By Contributing Editor Hallie Forcinio*

The Assn. of International Metallizers, Coaters and Laminators (AIMCAL) honored its 2022 Product of the Year, Technology of the Year and Sustainability Award winners at a ceremony during the trade group's 2022 AIMCAL Executive Leadership Conference, held April 4-5 at the NASCAR Hall of Fame in Charlotte, NC.

The **2022 Product of the Year Award*** went to the **ProAmpac Holdings, LLC, Flexibles Division** (Cary, IL), for a quilted, multilayer film/foil phase-change mat used to insulate attics in residential, commercial and industrial buildings and reduce energy costs for heating, cooling and ventilating by up to 50%.

The eco-friendly, nontoxic **QE Platinum** material produced for customer **Syndego LLC** is a patented and patent-pending quilted mat of pillow pouches filled with proprietary phase-change material (PCM). The structure controls the temperature differential across the R-value instead of the traditional method of limiting heat flow by adding more R-value. Easily installed on top of existing insulation and designed to be effective for 20 years, the QE Platinum mat is positioned foil side up so the foil serves as both a radiant and moisture barrier. Additional energy control is provided by the PCM in the pillow pouches, which melts and serves as a heat sink to hold energy until the temperature in the space decreases. The PCM then re-solidifies and releases the stored energy. The PCM melt point is designed to be just above the ideal temperature for the area and minimizes temperature extremes. Maintaining a more consistent temperature can flatten kilowatt-hour (kW) usage and cut energy costs and, thereby, reduce the operation's carbon footprint. Other applications include cold-transport vehicles and cold-chain storage.

The judges liked the combination of technologies to achieve an improvement over existing insulation options and the potential for significant energy savings. "The material also is easy to install and reduces the amount of toxins and irritants released into the environment," noted one member of the panel.

The **2022 Technology of the Year Award** was bestowed on **Rheonics** (Winterthur, Switzerland) for its **InkSight** multi-station, ink viscosity-control system for printing presses. The Rheonics InkSight system delivers quality, cost and environmental benefits by managing all viscosity measurement and control functions, thereby allowing operators to focus on quality rather than measurement.

*QE Platinum material – ProAmpac*

In operation, an SRV sensor detects changes in ink viscosity and transmits a signal to the control cabinet. The Rheonics predictive tracking controller monitors viscosity, predicts the rate of change and operates a valve to dose solvent as frequently as every 20 seconds to compensate for changes due to temperature fluctuation, evaporation or the addition of fresh ink. The ColorLock software and graphical operator interface allow viscosity to be locked to the desired color density. Automating ink viscosity control reduces setup time and scrap, maximizes print quality and accurately doses solvents, potentially reducing emissions. The compact system integrates easily, offers a high level of accuracy and stability and requires no recalibration, cleaning or maintenance. Compatible with inks, primers and adhesives, the technology also is used in an array of coating operations.

*InkSight viscosity-control system – Rheonics*

The judges also awarded a **Technical Excellence Award** to **InkSpec** (St. Bruno, Quebec, Canada) for its **InkSpec MIIS-V3** viscometer, model 40339-2200, a patented and patent-pending device that measures and controls the viscosity of process fluids. Based on acoustic suspension technology, the unit is unaffected by flow, micro-foaming or machine vibration. The small, light sensor can be installed in tight spaces and mounted vertically or horizontally. Primary applications include flexographic, gravure and corrugated printing; food and beverage can coating; sheet coating; and medical device printing and coating. Other commercial applications include adhesives, gloss and coefficient of friction coatings for offset printing; glass, mirror and eye glass coating; and industrial laminating.


*InkSpec viscometer – InkSpec*

The judges had a lengthy discussion about the merits of each Technology of the Year candidate. For the first time in memory, with two submissions with similar functions, they also consulted an expert in coating and material development processes. After considering that input, the judges decided the comprehensive nature of the Rheonics technology, as detailed in its technical writeup, deserved the Technology of the Year Award, but the InkSpec technology also warranted recognition. Noted one judge, "The Rheonics system offers control over a wide range of viscosities and has the potential to reduce waste due to off-spec color caused by changes in ink viscosity."

The **2022 Sustainability Award** was taken by **Monadnock Paper Mills, Inc.** (Bennington, NH), for a 100% post-consumer-recycled (PCR) fiber stock for gift/loyalty cards. The 28-point Monadnock **Envi PC 100 Card** material is a coated/laminated structure engineered for dimensional


*Envi PC 100 Card material – Monadnock Paper Mills*

stability, durability, printability and performance equal to all-virgin-fiber cards. It can accommodate magnetic stripes, scratch-off and signature panels and maintains the structural integrity needed to allow affixing to a carrier with fugitive glues and damage-free removal by the consumer. Designed with maximum PCR content as an alternative to polyvinyl chloride, polylactic acid, virgin-fiber solid bleached sulfate and mixed virgin/recycled fiber cards, the Monadnock Envi PC 100 Card is renewable and has been independently verified as recyclable in curbside bins. Other potential applications for the PCR material include hotel keycards, near-frequency communication (NFC) cards and radio frequency identification (RFID) cards.

Members of the judging panel were excited by the prospect of replacing billions of plastic cards that aren't easily recycled with a renewable, recyclable alternative. They also noted the card's attractive appearance and durability. "I really had to work at it to tear it," noted one member of the panel.

Judges for the competition met via Zoom in a session moderated by AIMCAL Executive Director Chris Kerscher. Members of the judging panel included experts in converting and packaging: Dr. Charles A. Bishop of C.A. Bishop Consulting, Ltd. (Loughborough, UK); Larry Jopko, principal of Stickum Consultancy LLC (Houston, TX); Robert M. Kimmel, Sc.D., associate professor, director, Packaging Science Program, director, Center for Flexible Packaging, Department of Food, Nutrition and Packaging Sciences, Clemson University (Clemson, SC); and Steve Lange, managing member of ProcessDev LLC (Cincinnati, OH). ■

* The AIMCAL Product of the Year Award honors the late Peter Rigney, former publisher of *Paper, Film and Foil Converter* and long-time champion of the competition, who passed away in 1997.

More info: *www.aimcal.org*

# AIMCAL R2R Europe 2022: Conference Planner

## In cooperation with AIMPLAS, the comprehensive three-day program of technical presentations, facility tour set for June 7-9 in Valencia, Spain.

*By Editor-in-Chief Mark A. Spaulding*

Postponed two years due to the COVID-19 pandemic, the AIMCAL R2R (roll-to-roll) Europe Conference will make its successful in-person return this summer. Produced in cooperation with the AIMPLAS Plastics Technology Centre in Valencia, Spain, the three-day program of technical presentations runs June 7-9, 2022.

The comprehensive, web-processing agenda includes sessions on solution, extrusion and vacuum web coating; web handling; and gravure printing. Leading consultants and experts from academia and original equipment manufacturers will present best practices and advances related to coating-process technology; gravure printing and coating; laminating; oriented films; barrier materials; process-system developments; printed electronics; sustainability; strategies for improving productivity; new materials and substrates; monitoring and measurement; key market applications; and flexible-packaging and materials.

### Cutting-edge plastics technology research

AIMPLAS is a technology center with 30 years of experience in the plastics industry. It provides solutions to companies throughout the value chain – from raw-material manufacturers to plastic processors, and brand-owner end-users. AIMPLAS works to solve challenges facing the use of plastics in today's society to improve people's quality of life and ensure environmental sustainability.

The center employs more than 200 technical professionals, serving 2,800 customers through over 250 R&D projects and offers 185 different training activities. With about 125,000 sq ft of facilities with cutting-edge technology, its laboratories have the highest number of accreditations for plastics, according to the UNE-EN ISO/IEC 17025 standard.


*The AIMPLAS Plastics Technology Centre in Valencia, Spain, will host the three-day 2022 AIMCAL R2R Europe Conference program.*

The R2R Europe schedule also encompasses tabletop exhibitions / receptions, networking opportunities, an AIMPLAS facility tour and a guided tour of Valencia plus dinner. Interested in exhibiting and event sponsorships? Contact AIMCAL Member Outreach Director Tim Janes at +1-803-948-9469, email: *tim@aimcal.org*. ■

More info and to register: 803-948-9470, *www.aimcal.org*, +34-961-366-040, *www.aimplas.net*

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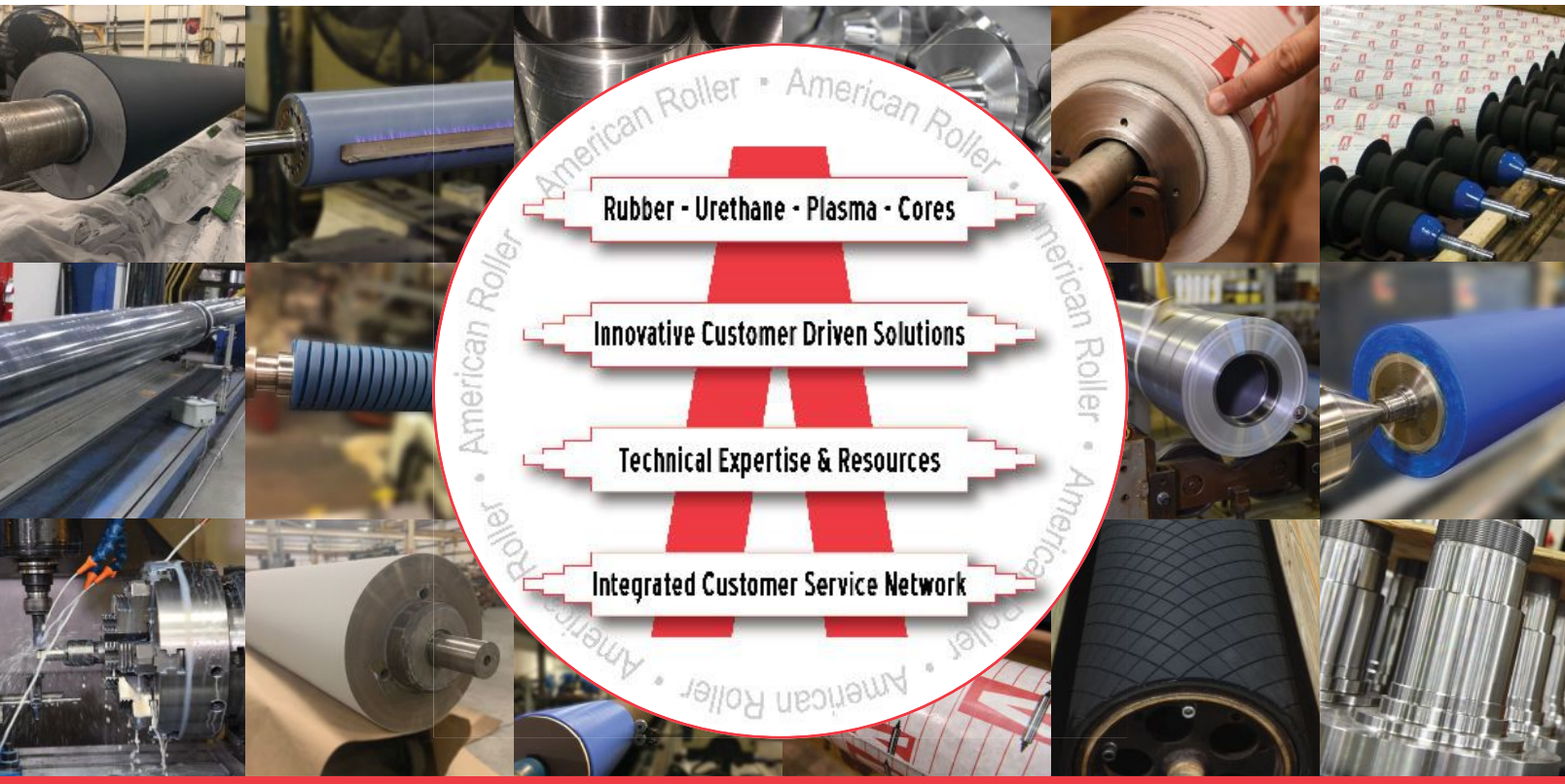


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A Special Supplement to the 2022 Q2 Issue

# CONVERTING QUARTERLY

Web Processing & Finishing Technologies

# Special Market Report: Medical & Pharmaceutical

## In this issue:

- Flexible structures, sustainability, printed electronics are top trends
- UVC decontamination as a solution for COVID-19 test-kit production
- Perforation rewinders for nonwoven wipes converting: Tips on tension control


The VTT Technical Research Centre of Finland has integrated a thin, flexible electronic label for condition monitoring of temperature-sensitive medicines.

AIMCAL®

Official Publication of the Association of International Metallizers, Coaters and Laminators

# Flexible structures, sustainability, printed electronics are top trends

## Med/pharma flex-pack market to reach $26.3 billion globally by 2028, as healthcare apps become "greener," more sophisticated amid COVID-19.

*Edited by Editor-in-Chief Mark Spaulding*

As one of the fastest growing end-use markets for packaging and roll-to-roll (R2R) converted products, medical devices and pharmaceuticals have perhaps seen the greatest amount of change in just the past few years. With applications ranging from traditional items such as "simple" bandages and drug blister-packs to breakthrough printed-electronics biosensors, this field has been impacted in myriad ways.

The ongoing COVID-19 pandemic has had a deep and enduring effect on packaging supply chains (and medical/pharma in particular), according to a new study from Smithers (see Figure 1). The disruptions of 2020 continue into 2022, with soaring prices for polymer resins and other raw materials, creating a new imperative for businesses to reappraise their supply-chain, purchasing and logistics strategies. The re-emergence of sustainability concerns in packaging, including new legislative targets for minimum recycled content in plastic formats, has converters prioritizing the sourcing of post-consumer recycled (PCR) resins, in place of virgin feedstocks, more often for medical/pharma applications.

### Flex packs are a key innovator

Amid these challenges, however, world packaging demand for PPE, medical devices and pharmaceuticals has not only held up well but grown at a more rapid pace, says Smithers. In the flexibles arena, med/pharma accounted for 14% or $5.1 billion of US flexible packaging sales in 2021, according to the Flexible Packaging Assn. (FPA). And globally, medical flex packs are expected to reach sales of $26.3 billion by 2028, based on a Research & Markets (R&M) report.

What's behind the growth? R&M lists increasing demand for pharmaceutical products in emerging economies, as well as growing demand for high-tech drug-delivery systems in developed countries as key drivers. Use of flexible packaging is rising in the healthcare field as companies operating in the industry are opting for sustainable

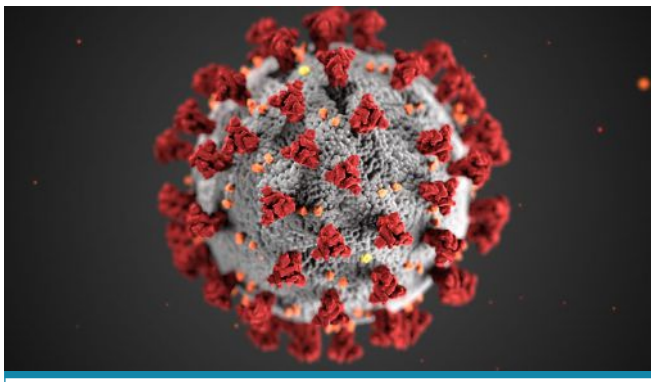

**FIGURE 1.** *The ongoing COVID-19 pandemic has had a deep and enduring effect on packaging supply chains (and medical/pharma in particular).*

functions and materials, sometimes even moving to paper-based packaging for its "green" cache and recyclability. Some examples include developments by Mondi Group, WestRock and Huhtamaki.

One breakthrough medical flex pack is the 2022 FPA Highest Achievement Award winner, converted by Vonco Products LLC (see page 12). The patented EnteraLoc™ medical-fluid device for tube-fed patients features flexible, standup pouches with custom spouts. Along with recognition for packaging excellence, sustainability and technical innovation, the EnteraLoc was honored for expanding the use of flexible packaging.

### "Greener" pharmaceutical packs

As important as one-time-use medical/pharma packaging is for safety and patient care, this has not slowed the concepts of sustainability and recyclability in the materials used. R&M notes that pharmaceutical demand is propelling growth for flexible "green" packaging, especially in new and recyclable polymers. This area is climbing 9.1% CAGR worldwide to reach more than $644 billion overall by 2027, says R&M, with the pharma sector making up to $90 billion.

Sustainability in pharmaceutical packaging is exemplified by FlexFilms (USA)'s F-ISB-M BOPET film and laminate structure for cold-forming blister packaging. A 2021 AIMCAL Award Honorable Mention, the product from the manufacturing arm of UFlex, Ltd. replaces traditional PVC and/or Nylon layers with BOPET (see Figure 2). It has a lower carbon footprint and satisfies the global trend to remove chlorine-containing materials from medical packaging.

## Biosensors, drug packs getting smarter

Another key trend impacting medical/pharma continues to be R2R printed electronics, with new concepts and commercial successes coming out regularly. The printed electronics market in healthcare is anticipated to grow 20.6% CAGR to 2026, according to Mordor Intelligence. Lower cost of R2R manufacturing, the use of digital printing, a rise in funding activity and the healthcare industry's inclination toward the newest technologies are top factors responsible for growth of printed electronics in healthcare fields.

Large volumes of medical sensors regularly are screen-printed roll-to-roll, and this method is the basis of more advanced wearable medical sensors, such as smart skin patches. Stretchable conductive inks, dielectric inks and silver chloride inks are helping to make the electronic skin patches for measuring vital signs, heart rate, respiration and other physiological parameters.

The primary task of smart pharmaceutical packaging is to improve a patient's medication adherence. Jones Healthcare Packaging actively has been developing this technology and now commercial samples are being tested by patients. The current product is printed flexographically using carbon inks on paper substrates to create carbon circuitry. In the future, functional electronics as well as printed displays could be integrated into the smart packaging itself.

**FIGURE 2.** *Sustainability in pharmaceutical packaging is exemplified by FlexFilms (USA)'s F-ISB-M BOPET film and laminate structure for cold-forming blister packaging. A 2021 AIMCAL Award honorable-mention winner, the product replaces traditional PVC and/or Nylon layers with BOPET, has a lower carbon footprint and satisfies the global trend to remove chlorine-containing materials from medical packaging.*


**FIGURE 3.** *A partnership unites Avery Dennison's low-cost NFC inlays using PragmatIC flexible integrated circuits with Schreiner MediPharm's labeling solutions to extend smart packaging to the unit-level for pharmaceuticals to improve patient safety.*

Via cooperation with Schreiner MediPharm and PragmatIC Semiconductor, Avery Dennison is leveraging near-field communication (NFC) technology to extend smart packaging to the unit-level for everyday pharma to significantly improve patient safety and experiences (see Figure 3). Such low-cost NFC offers tamper evidence, secure authentication, end-to-end traceability and easy re-ordering. In the case of pharmaceutical products, it also can connect patients to not only easy-to-read instructions, but also video/audio guides, help lines, social-media support groups and even to their doctors or clinicians. The Schreiner labeling solution uses flexible, robust, NFC integrated circuits from PragmatIC, which are thinner than a human hair and suitable for small-diameter objects, such as syringes and vials.

## Conclusion

So, what might the medical or pharmaceutical package of 2030 look like? With the trends covered in this article, a likely candidate is a flexible, standup pouch (having replaced a glass or plastic rigid container) that easily can be recycled and sports an intelligent label that communicates not only with the patient but with his or her physician for better long-term healthcare. ■

More info: *www.smithers.com, www.flexpack.org, www.researchandmarkets.com, www.mordorintelligence.com*

# UVC decontamination as solution for COVID-19 test-kit production

*By Theresa Thompson, Ph.D., application scientist; Mark Oesterle, product line mgr.; and Cristina Ortiz-Mateos, life science marketing specialist, Phoseon Technology*

The germicidal effect of UVC (ultraviolet C) has long been known as a solution for disinfection and sanitation. As the need for disinfection technology peaked in the 2020 global health crisis, this firm was approached by a major healthcare organization to aid in decontaminating molecular diagnostic tools. This project resulted in the largest UVC-LED decontamination system in the world to date.

**Editor's Note:** *This technical paper originally appeared in* UV+EB Technology*, 2021 Q4, pages 42-45. It is reprinted with here the authors' permission.*

## Introduction

The increased urgency for accuracy and mass production of tests to prevent the spread of SARS-CoV-2 brought to the surface a common challenge in healthcare manufacturing: The ability to scale up production without compromising results. In this case, the components in question were parts of a COVID-19 rt-PCR test kit.

Due to the nature of the PCR reaction, nucleic acids and proteins must remain free of contamination, and molecules – such as DNA and RNA enzymes, among others – will jeopardize the integrity of results. In many cases, humans are the source or carrier of these contaminants. Just by handling material, or even having it in the same environment as people, biological molecules can contaminate surfaces in minutes. The authoring company's job was to keep this from happening, using years of research and extensive work in eliminating RNase A [1-5], a resilient molecule.

As part of an extensive market study, the healthcare organization investigated other technologies, such as gamma radiation and chemical cleaning. Still, both were too costly, slow to install or in their actual performance, and expensive in maintenance or chemical usage. In chemical cleaning, the organization found that residual chemicals also were detrimental for the PCR reaction. UVC (ultraviolet C) was the right fit to address these concerns.

In this study, three conditions are explored: the critical role of UVC sourcing, the specific UVC capabilities and requirements to inactivate RNase A (or other contaminants), and the logistical assembly of the UVC decontamination system – all of which were essential for the successful execution of the project.

## UVC source and its impact in disinfection applications

For several decades, the source for UVC has been mercury lamps, which – although proven useful over the years – have increasingly shown severe drawbacks due to technical properties. First, as the name implies, these lamps contain mercury. In recent years, governments worldwide have clamped down on the use of this chemical element in all products, including lamps. In the event of breakage, mercury contamination is a serious concern, primarily if the lamps are used in disinfection applications. In addition, mercury lamps are widely classified as hazardous waste, requiring additional costs and resources for their proper disposal. All these factors contribute to the massive push toward a more sustainable disinfection alternative.

Second, mercury lamps are inefficient. Only about 10% of the power (mW) that goes into a mercury lamp produces energy, and only a tiny fraction of such energy is in the UVC region that contains the critical wavelengths for decontamination. As a result, users have a high electricity cost for low UVC power and added heat as the by-product of extra electric input. Often, the excess heat is detrimental to the static conditions of a closed system.

Finally, due to the prior two mentioned shortcomings, most disinfection applications with mercury require a secondary containment system for the lamps to avoid mercury contamination. The reason for these is two-fold:

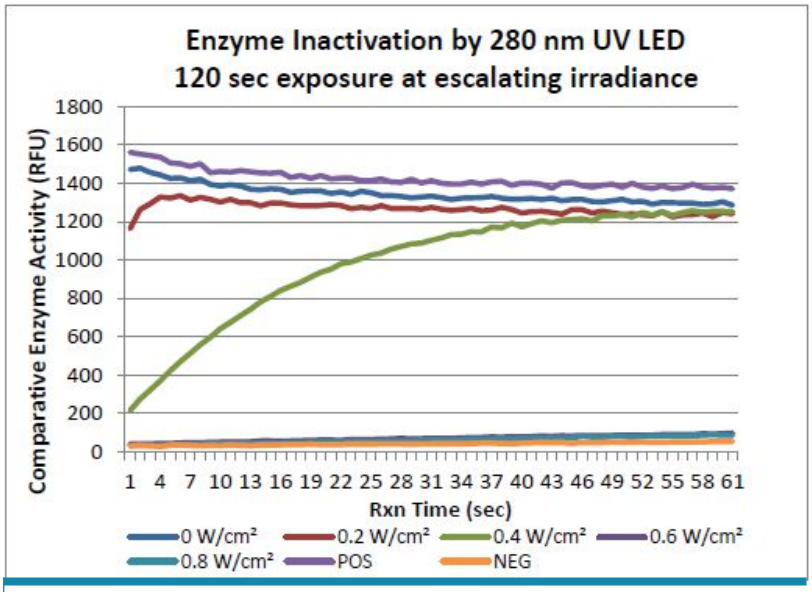


**FIGURE 1.** *Enzyme inactivation can be used as a surrogate for microbial decontamination or directly for nuclease inactivation. Enzyme activity was measured as remaining activity (relative fluorescent units) after 280 nm UV LED exposure at irradiances of 0, 0.2, 0.4, 0.6 or 0.8 W/cm² (at the lamp window). POS indicates enzyme activity while NEG shows the inactivated nuclease.*

The secondary containment system includes a water-cooling jacket, and the mercury lamps are under high pressure and can explode. While not dangerous, in and of itself, the destruction of a mercury lamp can douse whatever is below it in mercury. In addition, the secondary containment system has detrimental effects on the performance of a disinfection system: It increases the previously mentioned lamps' inefficiency by placing a surface between the decontamination source and the target and adding extra distance between the two.

UV loses about 3% to 6% of its intensity as it passes through surfaces, in this case, glass. The loss can be much higher if the glass absorbs some wavelengths. In applications where there is a cooling jacket, the energy must travel through four additional surfaces. In addition, UVC attenuates in the air. A standard industry estimate is that the intensity drops off with the square of the distance, so being an inch or more away from the source

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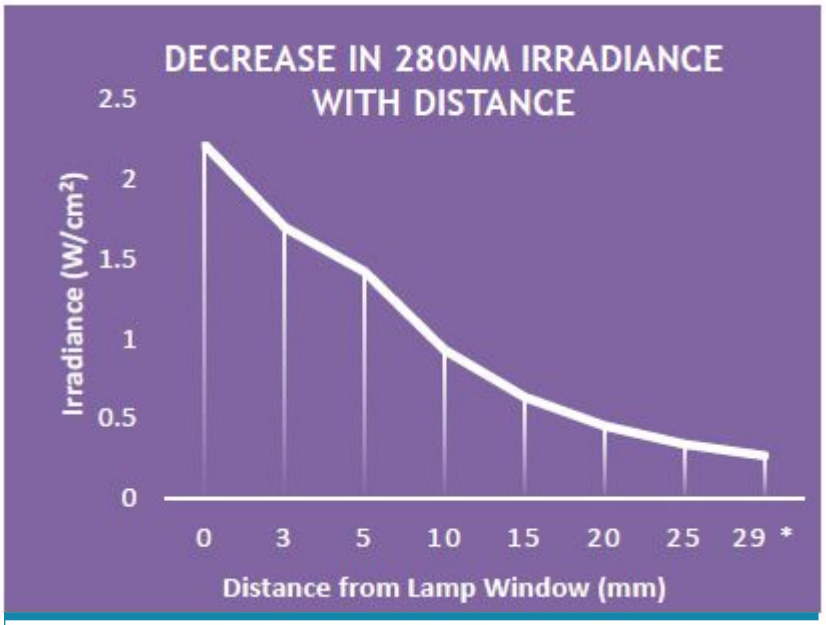


**FIGURE 2.** *Irradiance-distance decay for 280-nm UV-LED lamps. The maximum adjustable height for this test = 29 mm.*

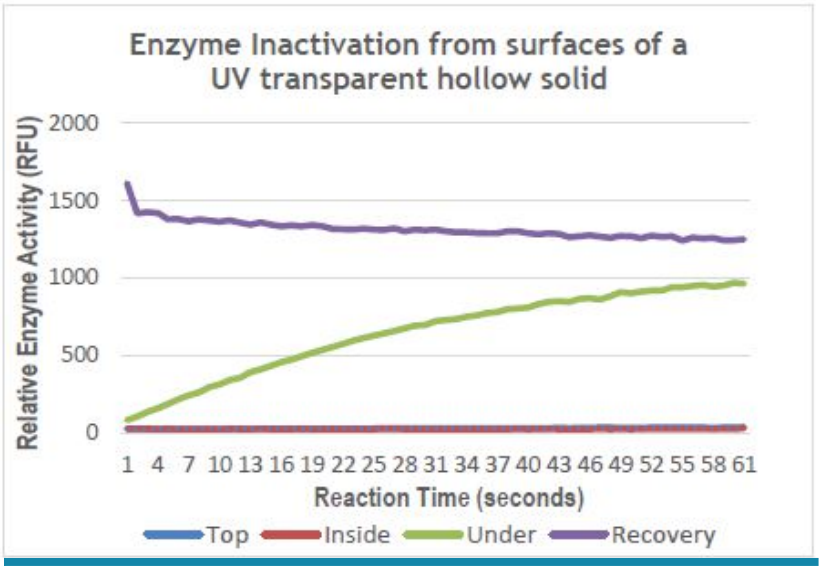


**FIGURE 3.** *The sample listed as "inside" was placed in a hollow cavity and allowed to dry before exposure, with UV passed through one wall of the hollow solid before impinging on the enzyme. For the sample listed as "under," two sides of the hollow solid were between the dried enzyme sample and the UV source.*

has a significant effect. This company's recommendation to customers is to place the lamps as close to the item undergoing treatment as possible. Recent advances in UVC LEDs have outpaced mercury lamps in efficiency and output.

## UVC requirements for RNase A inactivation

Successful UVC disinfection or decontamination requires a strategic approach to the manufacture, assembly and use of UV-LED sources that revolves around the biological source of contamination. In this case, RNase A was the target of UVC inactivation. Closely following, the desired levels of decontamination and the materials subject to UVC treatments were the other variables that led the decontamination system's technical design. As part of the treatment plan, experts chose to target RNase A with 280 nm, an established germicidal wavelength for protein targeting. UV-LEDs can be targeted by wavelength to affect various biological structures such as proteins, nucleic acids, enzyme cofactors, or other cellular components, providing focused decontamination.

As previously mentioned, susceptibility to UV is determined by the chemical structure and composition of both the molecule and the surface (or structure) receiving treatment. Therefore, experimental parameters such as wavelength choice, exposure time, energy density and irradiance must account for the specific materials subject to decontamination. Using enzyme activity as a model for protein function, our experts have found that both UV-energy density and irradiance have essential effects on protein function, with a general trend of increased irradiance and energy density resulting in higher levels of inactivation (see Figure 1).

## Assembly of the large-scale UVC-LED decontamination system

After considering the biological and chemical variables, the engineering team put together a treatment execution plan. The distance and accessibility (direct line of sight) between the UVC source and target are critical parameters to large-scale (and indeed any) decontamination. Figures 2 and 3 show the decrease in UVC effectivity as distance and accessibility barriers increase. As shown in the graphs, the positioning of the sections in need of decontamination highly affects the choice of irradiance and energy density required for treatment. In addition, the effect of material thickness and composition also should be tested for any part.

Once the technical conditions for wavelength, intensity, energy density,

distance and position were optimized for the specific test-kit component and contaminant in question, the assembly and manufacture of the large-scale system began. Starting with UVC-LEDs as small as 1 $mm^2$, these were assembled into lamps and finally into a custom system that met the project needs. The use of LED technology and strategic engineering design allowed the decontamination systems to be mounted directly on the conveyor used in COVID-19 test-kit manufacturing. The lower cost of operation compared to mercury lamps or chemical usage meant increased profit for the customer.

## Conclusion

UVC-LED disinfection brings a personalized solution to long-standing challenges in the packaging and manufacturing of vulnerable materials. Current UVC-LED alternatives such as gamma radiation, chemical cleaning or UVC sourced from mercury lamps remain expensive, slow and potentially hazardous options for manufacturers. The addition of LED technology brings speed and ease to the disinfection process. Further, the customer's in-depth market study provided both a financial and environmental framework for the effectiveness of this technology, which is a breakthrough in the industry. These findings extend beyond decontamination of COVID-19 rt-PCR test kits and apply to the packaging, pharmaceutical, food-safety or other industries that must remain contaminant-free. ■

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# Perforator rewinders for the production of nonwoven wipes: Tips on tension control

*By Jay Roth, sales engineer, ELSNER Engineering Works, Inc.*

During the COVID-19 pandemic, canister wipes are in hot demand. This firm has manufactured dozens of perforator rewinders used in manufacturing rolled canister wipes. With that demand, however, many new operators have been hired and there is more need to train for smooth production runs. Good tension is essential for consistent and efficient operation of a perforator rewinder. This article will look at this firm's perforator-rewinder systems used primarily for coreless, nonwoven canister wipes production, explain the components and describe how each part helps control the web as it goes through the machine. The article also will break down each tension zone and share best practices of controlling the web tension.

## Perforator rewinder overview

This firm's ENR-Series of automatic perforator rewinders are used to convert nonwoven fabrics from master rolls into retail-product rolls. The machines are designed to convert the retail-product roll in different types of roll configurations. These configurations are coreless roll and coreless roll (log) segments. Roll (log) segments are achieved by an optional slitting unit. The modular-design machine can be equipped to produce the various roll configurations as required by the customer. The line consists of up to four integrated sections.

***Section 1: Master Roll Unwinding.*** This unit can support up to a 50-in. diameter x 48-in.-wide master product roll (see Figure 1). The roll is mounted to the Unwind Stand frame by means of a pneumatic arbor that sits in a set of arbor journals. An off-the-floor roll lift is provided to lift the master roll off the floor into the journals. The material on the master roll is unwound by means of a pull-roll assembly and is assisted by a driven-belt assembly that lays on the outside diameter of the master roll. The web may be edge-guided or center-guided, both in automatic and manual modes. Tension is controlled by means of a dancer assembly.

***Section 2: Plow Section*** is optional and is used to slit the master roll down the center and fold the two slit webs into various customer-driven fold configurations. The optional folding plows may be manually positioned or automatically positioned (option) across the web as needed. The Plow Section can be added onto the perforator-rewinder systems at any time.

***Section 3: Rewinder Section*** consists of multiple assemblies to convert and rewind the rolls. The function of each of the sections is described below.

***Section 3.1: The Perforator Assembly*** creates perforations in the material as it moves through the assembly. It consists of a rotating top-knife blade and a stationary bottom-knife blade. The stationary blade has notches in the cutting edge to create the specific perforation desired. A pull-roll assembly is provided just before the rotating knife blade. Perforation spacing may be infinitely adjusted from 4 to 12 in. via the HMI. The rotating perforator is controlled by means of a closed-loop motor.

***Section 3.2: The Shear Slitting Assembly*** consists of up to seven sets of shear slitters and rotating anvils (see Figure 2). The purpose of the slitters is to slice the web material from the master roll into multiple sections or "lanes." If not required, individual slitters may be locked into the raised position and moved out of the way for different lane configurations.

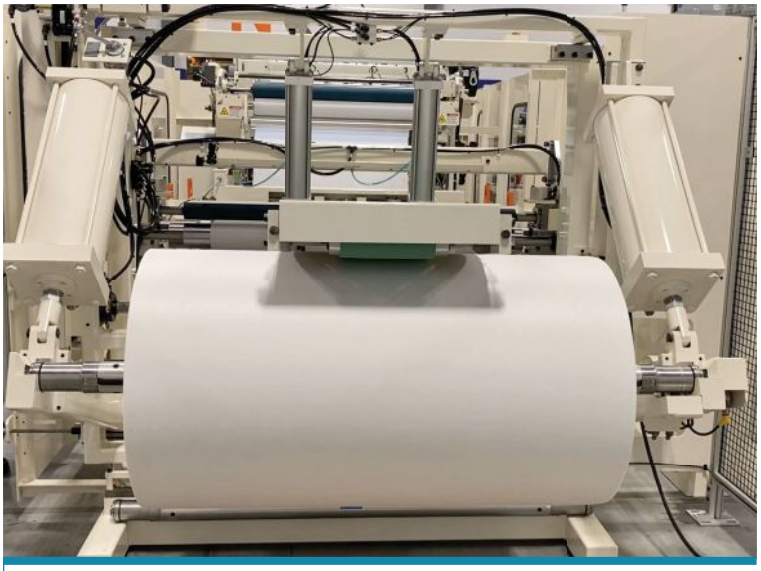

**FIGURE 1.** *Master roll unwinding section of the automatic perforator-rewinder system*

***Section 3.3: The Bowed Roller Assembly*** will spread the numerous lanes apart slightly before rewinding occurs. This is to prevent interweaving of the material lanes as they are being rewound on the rewind spindles. The bowed roller is independently driven and controlled via an HMI-entered value.

***Section 3.4: The Rider Roller Assembly*** is a wide roller that lays against the product as it is being rewound on the winding spindles. The rider roller assists in winding and creates a denser rewound roll, if required.

***Section 3.5: Turret and Spindle Assembly:*** The rewinding of the material is done on a driven spindle. There are four spindles mounted on a four-station turret assembly. The spindles have collapsible leaves that are expanded when winding begins, then collapse when the product rolls are taken off the spindles. The four stations of the turret: the Roll Start Station, the Roll Winding Station, the Roll Strip-Off Station and the Roll Ready Station. The Roll Start Station is where the material is introduced onto the spindle. The Roll Winding Station is where the roll finishes its winding process. The Roll Strip-Off station is where the finished rolls are removed from the spindle.

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**FIGURE 2.** *Shear slitting assembly*

**FIGURE 3.** *Unwind dancer assembly*

***Section 3.6: Roll Starter Assembly*** engages a winding spindle at the Roll Start Station. The assembly consist of a series of belts that assist in guiding the leading edge of the product around the spindle. After initial winding has begun at the Roll Start Station, the Roll Starter Assembly retracts out of the way to continue winding.

***Section 3.7: The Web Separator Assembly*** consists of a driven roller that is servo-actuated into a position that creates a nip between it and another driven roller (located on the Roll Starter Assembly), which causes a separation of the web or product to occur at its perforation.

There are two options for tails of the roll to be tied: Ultrasonic tail tie or glue closure.

***Section 3.8: The Tail Control Assembly*** is a series of brushes/and or Ultrasonic Horn Assemblies that are used to control and wipe/pin the tail of the product against the outside diameter of the roll after web or product separation occurs.

***Section 3.8.1:*** The purpose of the optional ***Glue Closure Assembly*** is to apply a small amount of glue to the end of the forming product roll to adhere the end of the product roll, or tail, to the product roll itself.

***3.9: The Roll Strip-Off Assembly*** consists of two parts: A horizontal, servo-controlled linear actuator and a servo-controlled, vertical-stripping assembly that is mounted to its carriage. The purpose of this assembly is to remove the rewound product roll lanes from a winding spindle.

***Section 3.10: The Discharge Conveyor Assembly*** is a belt conveyor that receives the rewound roll-product lanes as they are stripped off the winding spindles. The conveyor carries the finished rolls away from the machine at 90° from the main product flow through the machine.

**Section 4: Reject Conveyor Section (Optional).** The section ensures that bad product is discharged off the main line before it gets to the downstream equipment.

## Tension Control Zone 1: Unwind dancer

This firm's initial perforator rewinder uses the position of the unwind dancer assembly to control or trim the speed of the belt drive on the unwind stand (see Figure 3). The position of the counter-balance weight on the dancer-arm assembly controls the amount of tension in the web. On the latest model, this firm has replaced the manually positioned weight with a pneumatic transducer, allowing control from the HMI at the front of the machine. The higher the pressure, the lower the tension and conversely, the lower the pressure, the higher the tension. If an increase in web tension is desired, move the weight toward the pivot point of the dancer, making the dancer easier to lift. The dancer pressure is saved in the HMI recipe for a given product.

## Tension Control Zone 2: Perforator pull roll

The pull roll on the initial system has three operating positions. The first is fully "up" and locked away from contact with the driven steel roller. With the pull roll "up," it allows for other tension-control mechanisms to take charge. The second position is referred to as the "float" position,

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which leaves the pull roll to lay on the lower driven roller just by its own weight, providing some isolation of tension between the unwind and rewind sections but allowing for some slip during the run.

The final position is "locked down." This means that the locking pin on the handle is fully engaged with the provided hole in the perforator frame. This provides fully isolated tension zones and is used for more tension-critical materials. A product that has a lot of machine-direction (MD) elasticity might need this to keep from stretching the web when pulling from the rewind back to the unwind. Having tension controlled over a shorter distance gives better control in this situation.

**FIGURE 4.** *With optimal tension control, perforator rewinders can produce rolls at 700 fpm and 22 indexes/min.*

On the newer model, pneumatic cylinders are used in place of the locking mechanism. Again, this allows full control without leaving the operator station.

### Tension Control Zone 3: Rider roll

The rider roll on the ENR-Series can be used to aid in tension control and to impart pressure on the forming roll. Slight speed adjustments of the rider roll versus web speed help make a tighter or looser roll. Rider-roll speed typically is set to run fractionally above web speed. Controlling the positioning of the rider roll is another tool for good tension control.

All ENR rewinders also are equipped with an option to lift the rider roll off of the forming roll. Lifting the rider roll away from the forming roll passes complete winding tension control to the rewind spindles. Choosing to leave the rider roll against the forming roll is done to create a tighter/denser wind. The rider-roll settings all are within the HMI's recipe screen, so unique settings for each product code can be saved and loaded repeatably.

> "AVOIDING TROUBLESHOOTING ISSUES SUCH AS TELESCOPING ROLLS, BAGGY ROLLS AND WEB BREAKOUTS RELIES ON PROPER TENSION CONTROL."

### Tension Control Zone 4: Spindle torque

The final tool to control web and roll tension is the torque imparted by the winding spindles. All ENR rewinders are equipped with an electromagnetic clutch that allows for precise and repeatable adjustments. This torque setting is adjustable for each spindle and determines how easily the spindle drive is allowed to "slip" during the winding process. A higher torque setting results in less slip and a tighter finished roll. Low torque settings allow more slip and usually result in a loosely wound roll. Of course, proper care and setup of the machine and keeping tabs on all settings are critical to efficient use of all perforator rewinders. Proper blade selection and material quality always are a high priority.

### Conclusion

If tension control is optimal and the machine is running at optimal speeds, this firm's series of perforator rewinders (see Figure 4) produce rolls at web speeds up to 700 fpm and a cycle rate up to 22 indexes/min. Roll throughput will vary depending on roll length. Avoiding troubleshooting issues such as telescoping rolls, baggy rolls and web breakouts relies on proper tension control. Being in control of web tension is how to ensure highest efficiencies. ■

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# Slot-die coated electrodes: Achieving the highest quality anode and cathode coating

*By Scott Zwierlein, coating process engineer, FRONTIER, a Delta Modtech Co.*

In an era when battery technology is advancing at a record pace, it is important to ensure that battery manufacturing is capable of keeping up. In many cases, the accuracy and precision of the coated electrode are what can make or break a new technology. For example, it may be imperative to control the mass of anode or cathode loading to within +/-2% or better. Also, with the introduction of new, exotic and expensive raw materials, it will be important to minimize waste from excess coating or exposure to contaminants. Different types of current collectors used as substrates for electrodes may present difficulties in the coating process. All coating methods are not alike. The electrode-coating method should be evaluated to determine whether it can produce electrodes that conform to these high standards. This technical paper will address the advantages and disadvantages of a number of coating methods to provide the tools to evaluate which process will best suit your technology.

**Editor's Note:** *This technical paper is based on the author's presentation at the AIMCAL R2R USA Conference, held in Orlando, FL, in October 2021.*

## Introduction

With the increase in electric-vehicle (EV) sales and portable electronic-device usage, battery manufacturing is booming. The seismic shift is spawning new innovative approaches to improving battery performance – and a golden opportunity for the converting industry. According to research firm Reports and Data, the global battery market is projected to grow from $119 billion in 2020 to $328 billion in 2028.

The use of batteries in products such as EVs and wearable devices continues to push the innovation envelope, but it likely will adhere to the following criteria:

1. Make batteries smaller.
2. Make batteries deliver more power.
3. Make batteries safer.
4. A combination of 1-3.

The converting industry can influence innovation particularly in the realm of battery-electrode coating (see Figure 1). In broad strokes, the higher the quality of the coating on those electrodes, the higher the quality of the battery (We'll break down what defines quality below.).

This is a great opportunity, but also a formidable challenge, as the shrinking size of batteries necessitates thinner coating layers that must be just as accurate and precise as their thicker counterparts. As it refers to the coating process, accuracy is the ability to coat at your target thickness from one coating run to the next. Precision, on the other hand, is producing on-target coating thickness continuously throughout a coating run. Let's take a closer look at the role of coating within battery manufacturing.

## Technologies may change, but methodology not so much

The majority of today's battery-electrode coating slurries are composed of a carbon, graphite and binder, coated in a thin film onto a current collector (typically, an aluminum foil is used with the cathode, and a copper foil for the anode). These thin films then are layered upon each other with a separator in between. The films can be stacked in a rectangular shape or wound together (see Figure 2). The current collectors at the edges or tips of these films are

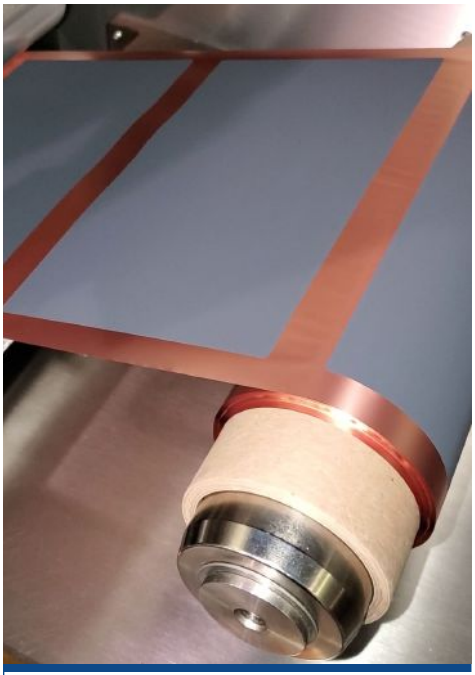

**FIGURE 1.** *Converting innovation influences battery-electrode coating.*

bonded together by tabs in a welding process, thus allowing like electrodes to be combined.

This methodology likely will *not* change with the advent of new battery technologies, no matter what new materials are used in the slurry; thus, the need to improve the coating process, and ultimately improve the quality of the layers, is paramount. Improving coating quality can be broken down into five areas:

1. Thinner coating
2. Better uniformity
3. Defect reduction
4. Less waste
5. Safety

## Understanding the two coating methodologies

Now that we've defined quality parameters, let's take a closer look at two differing coating methodologies: Mechanical metering and volumetric metering.

***Mechanical metering*** is when two mechanical surfaces create a gap that is equal to the desired coating thickness. The fluid then is distributed onto the substrate as it moves through the gap. To change the thickness, you need to mechanically adjust the spacing between the two rollers. Three types of mechanical metering include Knife-over-Roll, Comma-Roll and Roll Coating.

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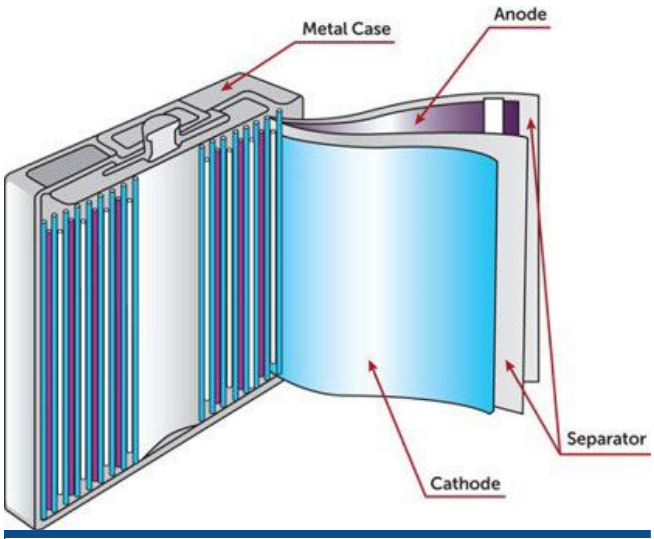


**FIGURE 2.** *Example of films wound together in a battery*

***Volumetric metering*** is where a specific volume of fluid is dispensed onto the substrate surface. Instead of a mechanical metering of a gap, we have a pump that delivers a fixed volume, equal to the desired coating thickness. You simply adjust the pump to change the thickness. The lone volumetric pre-metered system is Slot-Die Coating.

Now let's consider the performance of those methodologies in relation to both today's and future battery-electrode coating requirements, and which one is optimal.

## Quality Goal #1: Thinner coating

In comparing the coating methods, slot-die allows for the lowest minimum, achieving as low as 2 microns of minimum wet thickness (see Table 1). It's important to note that most battery manufacturing requires minimum coating levels only near 25 microns, which means roll coating may be acceptable. However, if we follow the marketplace trend, thinner coating will require smaller wet-thickness minimums. It should be noted that all the methods allow for a maximum wet thickness over 1.0 mm.

## Quality #2: Better uniformity

Uniformity is another critical factor. It's a measurement of the highest point of variation in the thickness of material at any point on the film. The lower the variation, the better.

**TABLE 1.** *Comparison of coating-method thicknesses*

| Coating Method | Minimum Wet Thickness | Maximum Wet Thickness |
|---|---|---|
| Slot-Die | 2 microns | >1.0 mm |
| Roll | 25 microns | >1.0 mm |
| Knife-over-Roll | ~50 microns | >1.0 mm |
| Comma Roll | ~50 microns | >1.0 mm |

*(Wet thickness is the thickness of the wet material when applied.)*

**TABLE 2.** *Comparison of coating-method uniformity*

| Coating Method | Cross-Web Uniformity | Shear Level |
|---|---|---|
| Slot-Die | 2% | Low to Medium |
| Roll | 5% | High |
| Knife-over-Roll | <10% | High |
| Comma-Roll | 5-7% | High |

Precision plays a role here, and because the material is volumetrically pre-metered, slot-die coating leads in this category as well, with a cross-web uniformity of +/-2%. It also boasts a machine-direction uniformity of +/-1%.

***Shear*** has a tremendous impact on electrode-coating uniformity, especially considering how the composition of slurry continues to evolve, and different materials are integrated into the mix. Shear is the grinding or sliding of the fluid upon itself. Because all battery slurries are not true ionic solutions, but a mixture of carbon and graphite, they will have tiny, jagged materials. The abrasiveness of the slurry will slowly wear out the mechanical metering surfaces of the coating device. With the slot-die method, the slurry is dispensed directly through the slot-die head onto the substrate, and you don't have the mechanical grinding action. The wear issue is decreased significantly.

## Quality Goal #3: Defect reduction

Defect management plays a big part in keeping costs down, but it's always been a challenge due to the coarseness of the coating materials. For example, if a slurry particle gets stuck between a roller, it can leave streaks or lines in the coating.

It's important to note that with slot-die, you also are further away from the roller than the other processes – usually 2X to 5X the wet-coating thickness (see Figure 3). This dramatically reduces the chance of streaks or long-term defects. With a slot-die head, the most you'll get is a spot defect.

Because materials are stored in a supply vessel with slot-die, there are other benefits (see Figure 4).

- The supply vessel mixer reduces the chance of agglomeration.
- The headspace in the vessel can be inerted by pumping in CO2, Argon or other gasses.
- The material can be vacuum de-gassed to remove air bubbles.

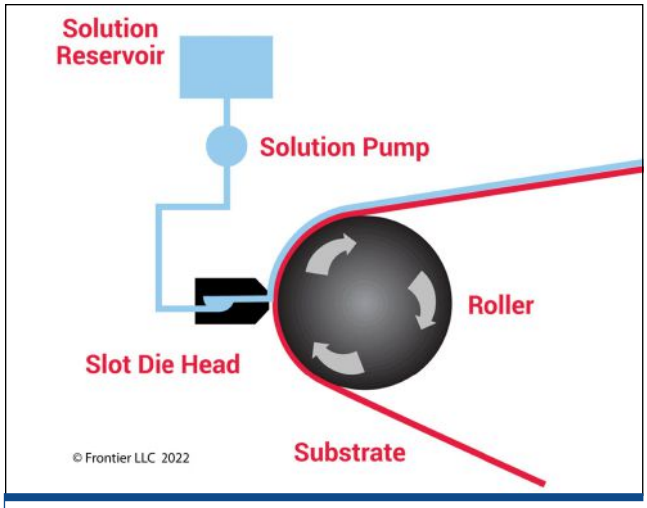


**FIGURE 3.** *Schematic of slot-die coating (Copyright Frontier LLC 2022)*

### Quality Goal #4: Less waste

An ongoing issue with mechanically metered coating is the waste component. If you have a full material hopper but you've produced the quantity required, you can't stop. You have to coat it out and use the entire supply whether you want to or not.

Slot-die coating offers clear advantages:

- **No waste.** With slot-die coating, the materials are in a closed system, and you can stop or start whenever you want. There is no cleanup, and you don't throw any unused materials away.
- **No evaporation.** Because the materials are in a closed system, evaporation is reduced, and the chance your mixture could mix with other airborne chemicals or particulates is eliminated.
- **No need to cut or clean connectors.** You don't need to create a continuously coated film with slot-die. Because the slot-die allows you to stop and start material distribution – both in the machine-direction and cross-web – you can produce strip and patch coating. This can be beneficial if you are producing rectangular films that need to be stacked on top of each other. You avoid the time and expense of removing dried slurry to expose connector tabs.

### Quality Goal #5: Safety

While there's no guarantee what types of materials will be used in the future, presently, operator exposure to hazardous materials is an ongoing concern. Slot-die coating's closed system can yield significant safety benefits. Operator

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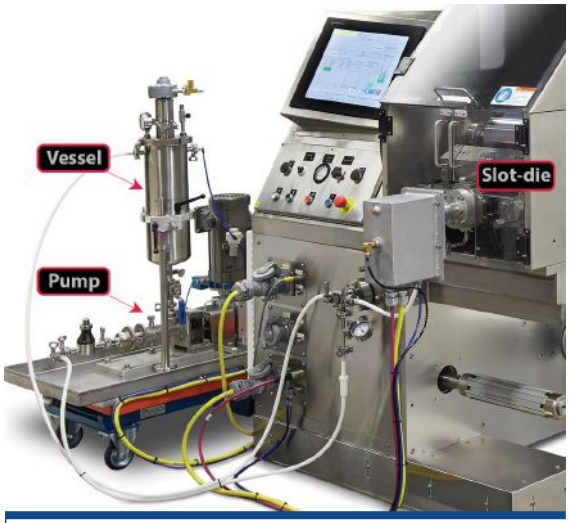


**FIGURE 4.** *Slot-die coating uses a closed system with a vessel and pump.*

exposure to hazardous solvents and vapors, such as N-Methyl pyrrolidinone and sulfuric acid, is minimal, as all materials are stored within the slot-die head and slurry supply vessel (see Figure 4).

## Future-proof your coating choice

Converters must balance short-term costs with long-term needs. Short-term, with battery manufacturers requiring standards such as only 25 microns for minimum wet thickness, coating methods such as reverse-roll coating still may be applied.

But long-term, the push toward more battery energy output in smaller form factors will be relentless and more aggressive. Future-proofing your converting capabilities requires moving toward equipment best-suited to deliver on more challenging standards for the battery industry. ■

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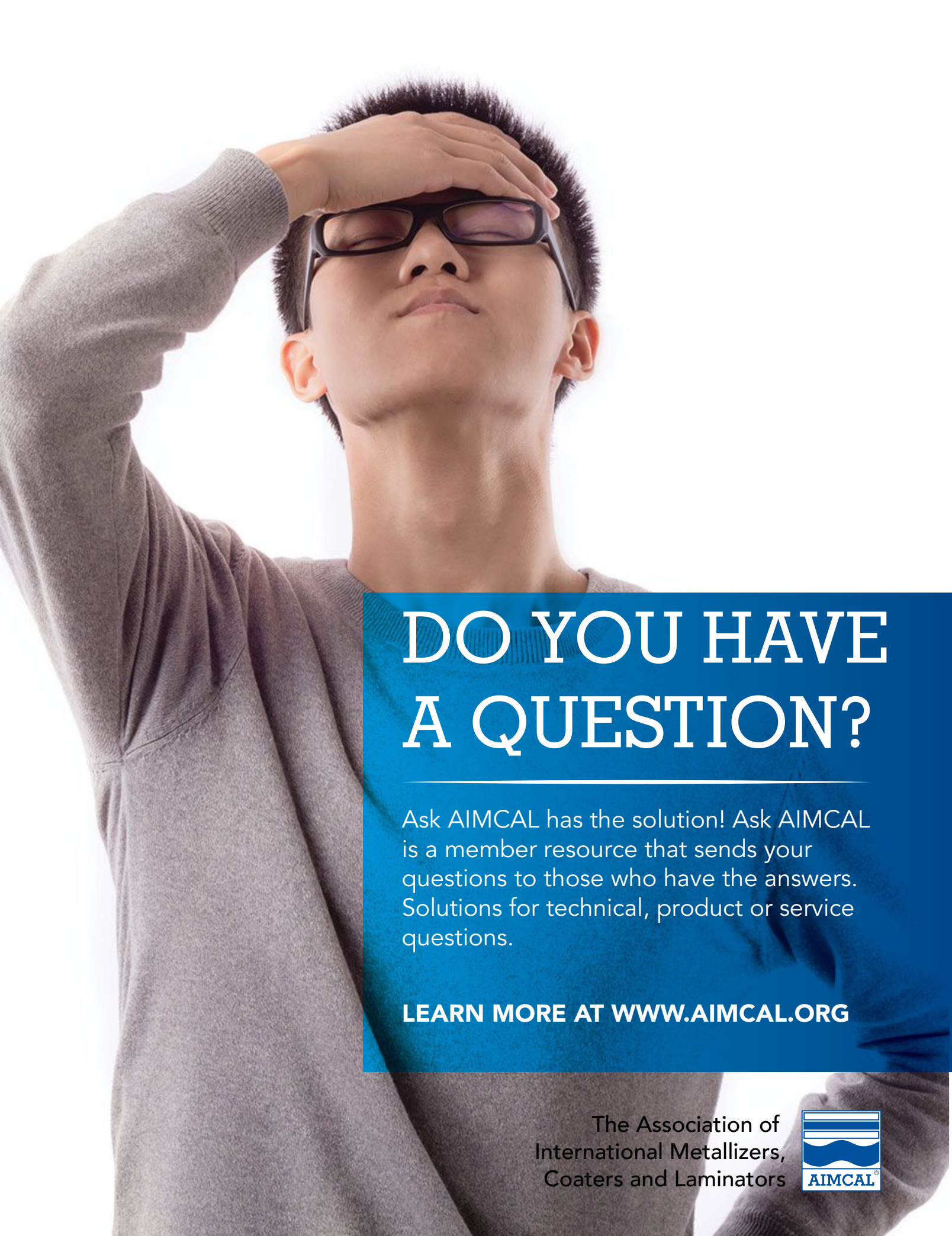

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# Benefits of using new automation for quick changeovers in rotary perforating systems

*By Craig S. Jackson, Vice President, Stewarts of America*

Rubber rollers, anvil rolls and pin-perforating rolls are all round, spin and have one purpose in certain web-processing and converting applications, and that is to – colloquially speaking – "poke holes in stuff." The advantages of quick-change tooling systems for these various rollers can be very significant. Production setup and throughput productivity are maximized, while the chance of damage to the machine, tooling and personnel is minimized dramatically. Quick-change tooling removes guesswork and increases accuracy, while procedural documentation is minimized. Systems can range from tooling that is simple to remove and replace, all the way to fully automated setups that change out with a touch of a button via stored recipes that the machinery remembers for future use. This article will cover how to incorporate such quick-change rolls and rollers into a process.

## Introduction

The standard method of perforating typically involves a pinned / needle roller or other tool that pushes against an anvil roll. The web is sandwiched between these rollers, and the pins are forced through the substrate, creating the perforations (see Figure 1). A wide variety of pin sizes and pin patterns are available to create a broad array of hole sizes and pattern specifications based on customer or product requirements. The perforation size and pattern affect the transfer of air, water vapor or liquid through the material. These perforations can be controlled accurately to create a great value-add to the in-process or finished material. Perforations also can be designed to have multiple benefits, such as an easy-tear line that doubles as steam ventilation in microwave-heating applications, or an air-escape hole with perforations laid out in the pattern of a product logo, removing the requirement and cost of printing the logo. The holes created can be nano, micro or macro perforations and can be round apertures, slits or impressions.

To exchange tooling, the roller must be removed by hand or with heavy material-handling equipment, serviced and manipulated on a workbench and then replaced into the machinery. It is a similar process for removal and replacement of the anvil roll. The spare and replacement tooling must be stored securely to prevent damage to the pins and hardware. The tooling also needs to be labeled and categorized if multiple tools are used to make sure that the operator knows where to select the correct tooling for the job. Instructions are needed to set up the tooling for each job-particular specification. Typically, this whole process is performed manually with operators who are experienced with the handling of the delicate tooling.

## Applying automation into the process

How to incorporate automation into the process has been answered in multiple ways for perforating technologies, with graduations of options to meet varied budget and operational requirements. There are basic (manual), intermediate (semi-automatic) and advanced automated (fully automatic) options available. These quick-change technologies also may be combined with other automation methods to make the process truly hands-free for the machine operators.

Typically, perforating-tooling changeouts at room temperature can take 30 mins to an hour. Heated perforating systems can take up to 12 hours to cool, and then must go through the "30-mins to 1-hour" changeout. The solution? A multi-roller quick-change system, specially engineered

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so that it can be used with both room-temperature and heated systems. The quick-change tooling even can be used with applications that are independently driven and matched to the system speed. The tooling changeover time drops to less than 30 secs, even with heated applications.

The quick-change can be varied in size and number of tools mounted to the unit. Many of these systems also can be engineered to allow removal of the inactive tooling while the active tooling is running, saving even more downtime. For the manual option, a hand crank with a low-ratio gearbox helps keep things simple, easy and economical. For the semi-automatic option, an electric motor is included so that tooling can be changed out with the press of a button. Sensors are mounted to the unit to detect which position of the quick-change system is active. For the fully automated option, the unit comes with a touchscreen that has an animation to show which tooling set currently is selected and what tooling sets are available. A barcode reader may be integrated into the HMI. The operator simply scans the barcode on the product to be perforated, and the correct tool set automatically is activated into place. The HMI can monitor tooling use and wear, and an alarm can be set to alert the operator when the tooling requires cycling or replacement.

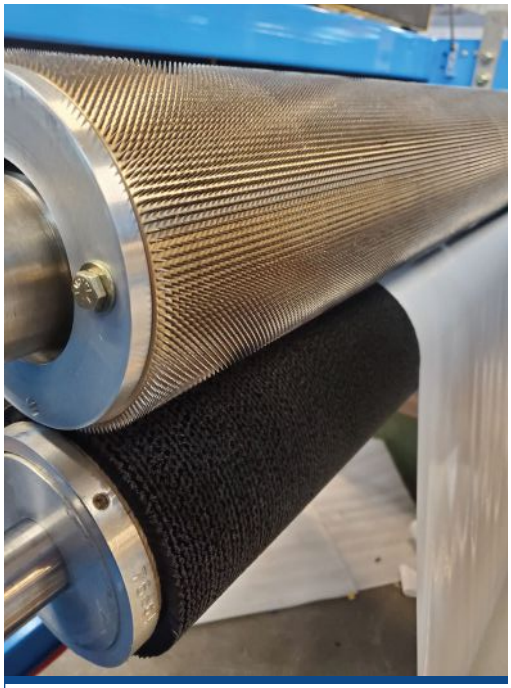

**FIGURE 1.** *Closeup of a carousel with a web of materials moving between the perforating roller and anvil roll.*

### Product and process-specific recipes

This automated selection, combined with a recipe system that automatically sets penetration depth of the pin into the material, gives the operator all the parameters he or she needs to duplicate a setup. A servo-

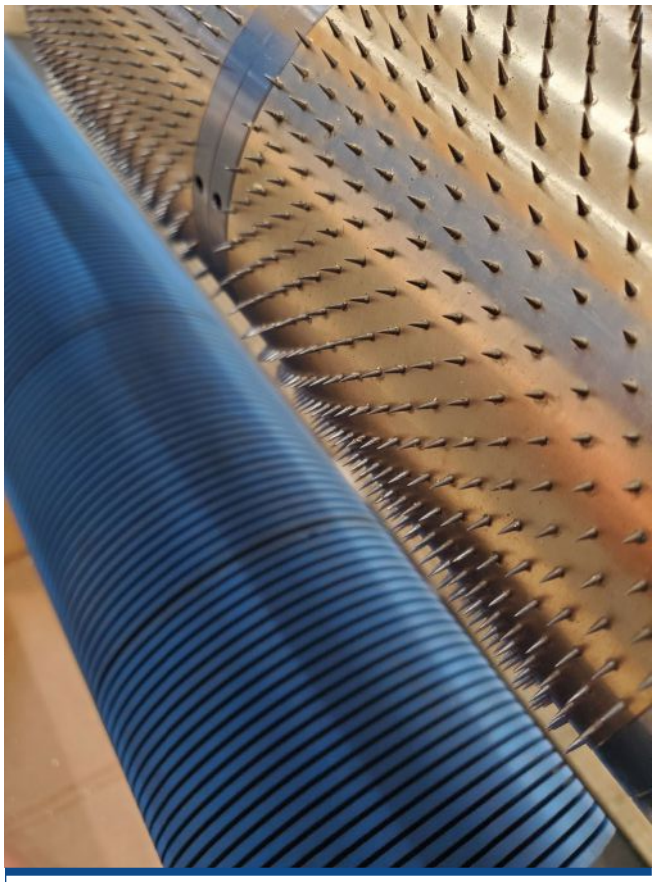

**FIGURE 2.** *A perforating roller teamed with a rubber-cover anvil roll is only one combination of components available to produce sophisticated web-processed materials.*

drive system is optional to accurately control penetration depth of the pins. If a heated system is used, the operational temperature may be one of many remembered parameters and, to move the automation even further, vision systems are available to interact with the perforating unit's servo-motor system to monitor and adjust on-the-fly the size of the perforations being made.

Nano, micro and macro perforating often requires different anvil rollers to be used with the perforating tooling (see Figure 2). These can consist of brush rollers, felt-covered rollers, rubber rollers, silicone-covered rollers or grooved rollers. These too can be placed on a quick-change system for fast changeouts. Often, because anvil rollers will wear in spots, the quick-change option allows the unit's components to be rotated out on a timed basis so that a fresh area of a roller can be used against the tooling, ensuring optimum and repetitively accurate hole sizes. Such systems also may be used with vertical and hole-punching applications.

## Conclusion

A rapid return-on-investment with quick-change systems is almost assured. By adding the reduction in man-hours required to change over the tooling, the storage required, the reduction of errors the system prevents, not to mention the increased quality of the in-process or finished product seen, the reduced wear and tear and damage on the tooling and machinery components, converters will see the benefits quickly outweighing the costs. ■

*Submitted in partnership with Finzer Roller, Inc.* www.finzerroller.com.

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# Applying smart technology for splicing, roll-change productivity on coating and laminating lines

*By R. Duane Smith, process mgr.-Web Handling and Specialty Winding, Davis-Standard LLC*

## Introduction

Consistent unwind splicing and winder transfers are paramount to high productivity on all web-substrate processing lines. This especially is true when manufacturing quality flexible-packaging materials on extrusion coating and lamination production lines. In addition, current industry trends require processing of ever-thinner web materials at ever-increasing production speeds. To meet profitability and output goals within these parameters, it's important to apply new technology that minimizes scrap and maximizes production uptime.

The impact of a failed unwind or winder transfer on a continuous roll-to-roll (R2R) web-processing line is substantial when you consider that every time a transfer fails, the line must be stopped. Then, the web-material scrap is cleaned up and disposed of, and the line is re-threaded and restarted. Typically, the total time from the web break to viable production is more than an hour from the line's scheduled run time. Thankfully, smart technologies can optimize the unwind splicing and winding web-transfer process. In addition, these technologies provide the tools to quickly diagnose or, better yet, predict when a critical element's performance degrades enough to cause missed transfers.

This paper outlines the critical components of unwind splicing and winder transfers with examples of smart technology supporting best practices on a continuous extrusion coating and lamination line.

## Understanding the unwind splicing operation

Productivity targets for continuous R2R web processing hinge on the ability to introduce new rolls of web material into the operation with splicing accuracy approaching 100% (see Figure 1). Achieving this efficiency level requires a splicing process that delivers accurate web-transfer tension, reliable pasting and cut-off operations, and precision web-tension transfer control. This makes it possible for high-quality, repeatable splicing at various speeds and roll diameters.

The five steps of a typical unwind splicing operation are as follows:

1. Indexing the new incoming roll into the proper pre-paste position to ensure the web is correctly pasted;
2. Accelerating the incoming roll to closely match the surface speed of the new roll to the expiring web's speed;
3. Firing the paster roll, so the expiring web makes contact with the incoming roll at 180° degrees from the leading edge of the new roll prepared with splicing adhesive;

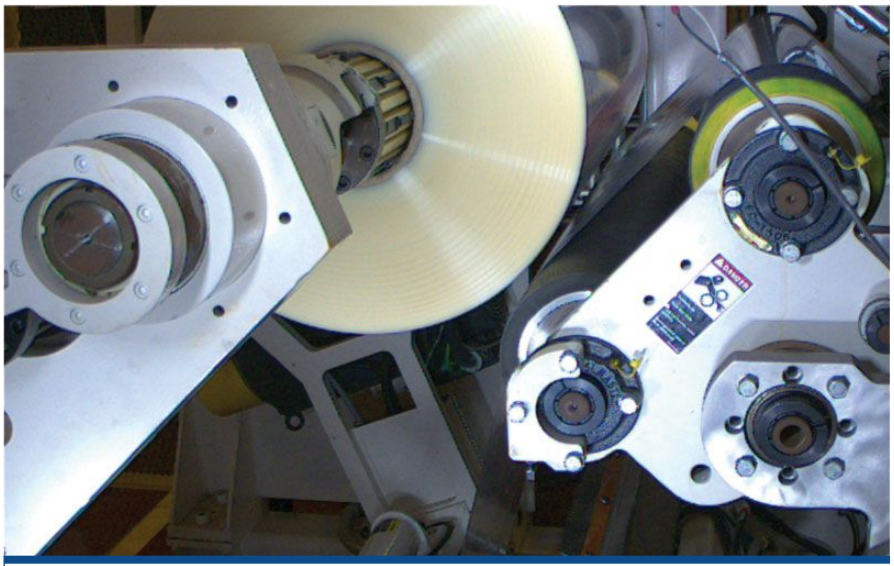

**FIGURE 1.** *Automatic turret-unwind splicer on a flexible-packaging line (Courtesy of Davis-Standard)*

4. Firing the cut-off knife to cleanly cut the expiring web for the desired tail length; and
5. Transferring the web-tension control seamlessly from the expiring roll to the new incoming roll of web material.

Figure 2a-d shows these steps of a typical unwind splicing operation.

***Accurate Web-Transfer Tension:*** Because thinner (lighter gauge) web materials are in demand, they need to be unwound at lighter tensions during the process. This requires that the roundness of the new rolls of material be monitored to be sure that high-speed unwinding of out-of-round rolls of material does not produce tension upsets that can distort the web or cause web breaks. If the incoming rolls are not concentric or round within a specific tolerance, then the line speed must be reduced to ensure that web-tension variations from these out-of-round rolls after the splice do not cause production problems.

The surface speed of the incoming roll and the speed match of the paster roll also are critical to reduce tension upsets during splicing. The incoming roll's diameter needs to be accurately measured for best results. Just before the material is unwound from the expiring roll, the new roll must be sped up to match the expiring web's speed within a tolerance of +/-1%. The surface speed of the paster roll must match the roll speed of the web and incoming roll for a successful splice without tension upsets.

***Reliable Pasting Operation:*** Absolute control of the process from when the expiring web is pasted onto the surface of a new incoming roll is a necessity for consistent splicing. The pasting-roll system must provide a firm and uniform paste across the roll to ensure a good splice. The firing of the paster roll needs to be initiated, so the nip occurs at 180°, (+/-90°) from the splice adhesive on the leading edge of the new roll. Contact just *before* the new roll's leading edge can cause the paster roll to bounce over the adhesive. Contact just *after* the leading edge can break the hold-downs, causing a missed splice. As line speeds increase, timing of

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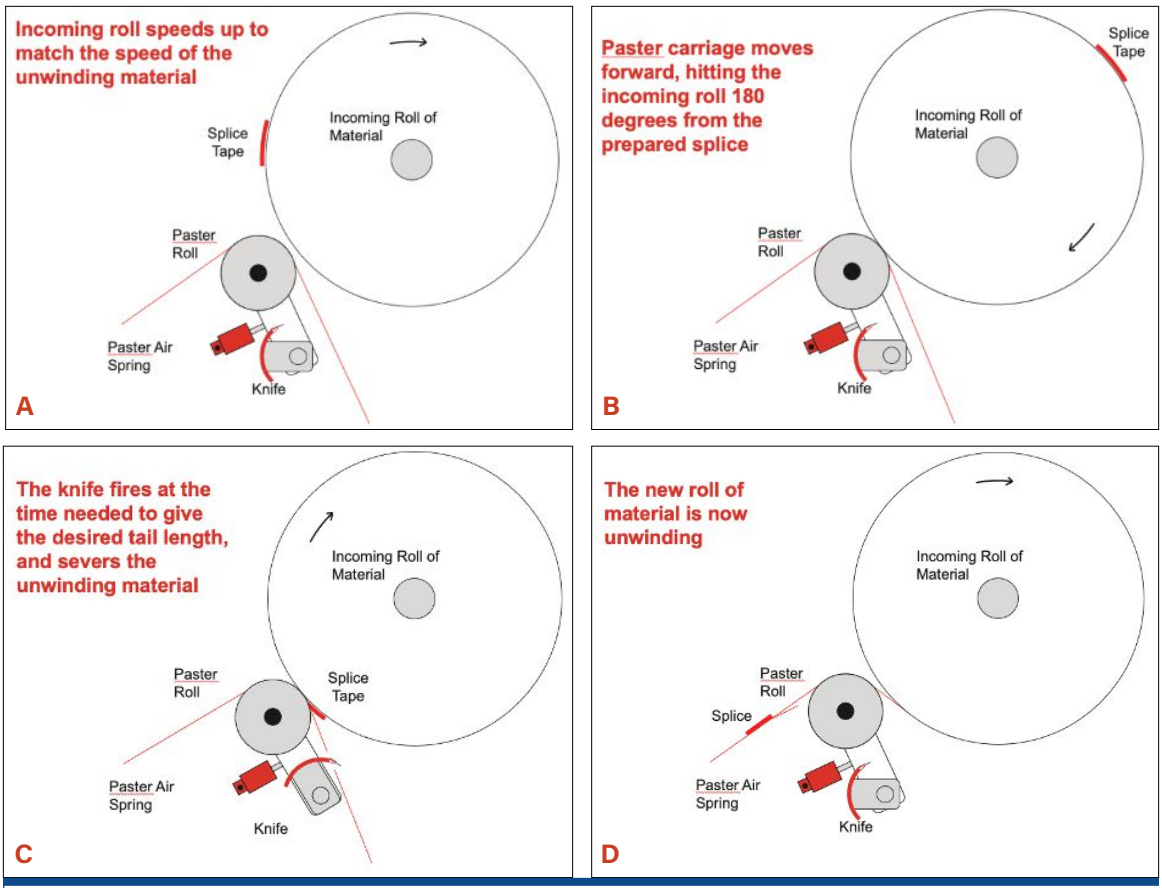


**FIGURE 2.** *Steps of a typical unwind splicing operation.*

the paster roll firing becomes more critical. This especially is true when introducing smaller-diameter rolls into the operation.

To enable consistent splicing for a variety of speeds and roll diameters, the firing of the paster needs to be calculated based on line speed and rotational speed of the incoming roll. This calculation uses the reaction time of the pasting system to predict when to fire the paster so the pasting nip will occur in the correct orientation to the prepared splice. This reaction time can vary greatly depending on the pressure used to fire the paster and the mechanical condition and environment of the paster-roll system.

***Reliable Cut-off Operations:*** After the expiring roll's web is pasted to the leading edge of the new roll, a clean and consistent web cut-off is needed. The knife cut-off system should be oriented, so the contact angle of the knife penetrates the web opposite the incoming web's direction. A short tail length ensures the splice will pass through the operation without catching and tearing apart along the web path or causing other web-converting or finishing problems.

The cut-off operation needs to be initiated before the paste has been made. This allows the cut to coincide with the prepared tail at the paste point for a short, controlled tail length. The timing of the cut needs to be calculated based on line speed and the incoming roll's rotational speed to predict when the webs will be joined together. This calculation uses the reaction time of the knife cut-off system to predict when to fire the knife for a short and controlled tail length. This knife-firing reaction time can vary greatly depending on the pressure used to fire the knife and the mechanical condition and environment of the knife cut-off system.

***Web Tension Control Transfer:*** As soon as the web starts to unwind off the spliced roll, the roll is switched from speed control to automatic tension control. The required braking torque applied to the new roll of material is calculated based on the roll's diameter and the tension setpoint. As long as the tail length is minimal, the unwind tension-measuring system should detect and provide feedback on only one tensioned web.

This post-splice web tension needs to be monitored to confirm the transfer tension is within the limits of the maximum deviation allowable for the material being introduced into the process. This typically is +/-10% of the tension setpoint. Larger tension upsets need to be flagged to identify the root cause quickly.

### Understanding the winder's roll-change operation

As with unwind splicing, web transfers during the winding process are significant contributors to scrap, downtime and lost production sources. Every time a transfer is missed, the line stops and production is delayed. The web, which now is "gift wrapping" the winder, must be cleaned up, the line re-threaded and restarted, and leveled out to produce a saleable product.

Web transfers to a new core should have little to no web foldback and be free of web-tension upsets, resulting in offsets or wrinkles at the start of the winding operation. Quality transfers also should be insensitive to the speed of the winding operation. The stationary-knife roll changer is recognized globally as one of the best transfer systems for making reliable roll changes nearly 100% of the time, regardless of speed and width. The stationary-knife roll changer provides straight-line transfers with little to no foldback and no scrap at the core. All winder-roll changers, including the stationary-knife system, must be properly installed and maintained to ensure absolute reliability when making quality web transfers onto new cores. The essential components of a winder's roll-changing operation include

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proper positioning of the pressure roll and the cut-off knife systems. This is followed by indexing to the correct roll-change position for the core's outside diameter.

During the transfer, the spindle drive must be accelerated, so the surface speed of the new core matches the incoming web within a tolerance of matched speed to a 1% maximum overspeed. The required roll-change force then is applied to the pressure-roll loading system for a successful transfer. The roll-change force must be sufficient to make a good paste but not so high as to cause a bounce when the pressure roll is fired into the new core.

After the web is cut and transferred to the incoming core, the spindle drive is switched from speed mode to the programmed web-tension control for the winding operation. Usually, the web tension will be tapered when winding at the full roll's diameter. This is because the web's tension at the start of the winding on a new core typically is higher than the in-wound tension profile for the winding roll. Also, pressure-roll nip loading must be altered from the transfer pressure to the programmed nip pressure or positioned for a minimum gap when winding in gap mode.



## Applying smart technology to analyze performance and predict costly failures

The above summaries provide an overview of the many variables that impact performance during a continuous R2R process. Smart manufacturing solutions, such as this firm's active-checking vision-based system, help simplify the process. This customizable cloud-based platform uses advanced sensors and control programs to supply real-time data about critical parameters and key performance indicators (KPI) using predictive analytics and alert notifications. Alarm displays are initiated when KPIs are outside the recommended operating range. Proactive monitoring can reduce downtime significantly, promote timely maintenance and improve production-line consistency.

Smart manufacturing solutions for unwind/splicing and winder/roll-change operations also should include high-speed image recording systems that automatically capture complete transfer operations. These real-time, automatic image recordings allow for a quick and thorough analysis if a missed transfer occurs. Recording sequences for quality web transfers provides an excellent tool for training new operators and process engineers. Following are some examples of how a smart manufacturing solution can improve various aspects of roll-splicing and transfer operations.

***Continually monitor the roll diameter and concentricity of incoming rolls of material to the unwind.*** A laser or other advanced sensor can accurately measure the roll and provide feedback to ensure rolls are within the acceptable range. If the measurement is out of range, the operator is warned of this condition immediately. The process line can be automatically slowed down or stopped to make an adjustment and avoid further error.

***Improve paster firing efficiency by measuring the time it takes from the command to the actual paste or web cut-off.*** Reaction times can vary depending on the pressure used to fire as well as the mechanical condition of the paster-roll and cut-off systems. The cumulative average from three previous transfers can be calculated to predict when to fire these components by monitoring reaction times.

***Predict issues that impact roll-change performance.*** Sensors on the unwind and winder can highlight pressure issues beyond the acceptable variation for consistent transfers. This can include monitoring the transfer-paste nips and the programmed nip force for the pressure roll while winding. Variation of the unwinding and winding web tensions during and after a transfer can be observed and compared to setpoints. Alarm warnings are displayed if these factors are out of the acceptable range. In addition,

the operator will know what preventative maintenance is needed for specific components.

***Ensure the cut-off knives on both the unwind and winder are sufficiently sharp for clean cutting of the web.*** The timing of knife replacement will vary depending on the abrasiveness of the web material and the speed and diameter of rolls being processed. Smart technology programming tracks the number of times the knife has been fired to predict sharpness, maintenance and potential replacement to avoid transfer issues from a dull knife.

These and other alarm warnings are accessible to operators from existing displays. In addition, due to the collaborative nature of smart technology, all warnings are logged and brought to the attention of supervisors and maintenance departments. As a result, corrective action is taken before variations deteriorate to a point where they cause missed transfers or production of defective products off the line.

## Conclusion

Our industry has reached a point where scrap, downtime and lost production due to missed splices during the unwinding and web-transfer process can be prevented. By applying smart manufacturing solutions to your R2R-production lines, you can significantly increase the productivity and profitability of high-quality products. Tools that help avert missed splices assure quality transfer reliability and increased running time, significantly impacting your bottom line. ■

*R. Duane Smith, process mgr.-Web Handling and Specialty Winding, Davis-Standard LLC (Fulton, NY), is known throughout the paper, film and nonwovens industries for his technical expertise in web handling and winding with nearly 50 years of working in this area. He holds two US patents in the winding field. Smith is the editor of the TAPPI Press ebook,* "The Ultimate Roll and Web Defect Troubleshooting Guide." *He has been honored as a TAPPI Fellow and by the Society of Plastics Engineers with an SPE Certificate of Recognition for his contributions to the SPE and the plastics industry. Duane can be reached at 860-650-4992,* www.davis-standard.com.

# Some thoughts on naming and classifying web-handling defects

*By David R. Roisum, Ph.D., principal, Finishing Technologies, Inc.*

*"If names are not correct, language will not be in accordance with the truth of things."*

—Confucius

## Introduction

We *had* a big problem in web handling. That was that some words, such as telescoping, had many aliases including scoping, coning, shooting and so on. Worse yet, the same word could be used for two totally different defects. An example here is the wound-roll defect corrugations often was improperly called tin-canning (a different defect) by many in the film industry.

That big problem was *almost* totally solved nearly a decade ago with the latest publication of the *Ultimate Roll and Defect Troubleshooting Guide* [1]. This "encyclopedia" of some 500 defects codified the proper names of most things and listed common aliases for completeness. I say *almost* solved because, even a decade later, many people are not aware of this standard language or continue to stick with the confusing lexicon peculiar to their own plant, which may be quite different than their sister plant, competitors and customers.

## Taxonomy

As useful as consistent naming might be, it does show the underlying structure among defects. This was the situation in biology some 250 years ago before Swedish botanist Carolus Linnaeus gave structure to the names of plants (and later animals), which largely replaced the common and confusing names that had been in everyday use. He introduced taxonomy to a haphazard set of information. However, this was and is no easy task. Taxonomy is both an art and a science, in equal measures, and is necessarily a work in progress.

Web handlers already have given a taxonomy to many defects [2]. A good taxonomy can be used to quickly and surely separate one defect from another, without resorting to "DNA sequencing." This is essential so that operators, QA and customers all can use it with ease. This taxonomy usually has two parts. The major class is the outcome, usually recognizable at a glance. A subcase is what often is referred to as the root cause. However, it would be more carefully termed root-cause *mechanics* because, while there is a single physics, there seldom is a single predictive factor.

## Core Crush

Let us begin with a simple teaching example – core crush. The major case is easy to recognize at a glance because the core loses its cylindrical geometry (For more on cores, see *Vacuum Verbiage*, page 20). However, and this is a big however, each of the subcases has a totally different set of symptoms and remedies. Type I core crush is a *tight* defect common with winding of *low* modulus materials. The load that crushed the core came from the interlayer pressures of winding. The failure happened during or very soon after winding. Type III is a totally different defect. First, it is a *loose* defect common with winding of *high* modulus materials. Second, the load that crushed the core did not come from the winder but rather from roll handling. Third, the core fails not during winding but rather during handling. Type II is a more rare defect where the load that crushed the core is neither winding nor handing, but rather chemical and/or thermal shrinkage of the web. BOPP plastic film is the poster child for this failure mode.

So, step one is to diagnose the *major* case; in this instance, core crush. This is where many people stop and make wrong guesses about remedies. Common sense would tell you to reduce winding tightness if the core crushes, but you would be correct in only one of the three subcases. Step two is to diagnose the *subcase*. That tells you whether to increase or decrease winding tightness via any or all of the TNTs. Step three is to redesign the product if winder tightness does not have the authority to fix the problem to everyone's satisfaction. The easiest redesign for this defect is to change the core, such as increasing core-wall thickness.

## Telescoping

Telescoping is different than rough roll edges, even though both result in roll ends that are not flat. Telescoping is when the layers of the wound roll slide upon each other in the machine direction (MD) and/or the cross direction (CD). We will not cover the 10 or so subcases here [3], because this article is about taxonomy, not defect troubleshooting, which

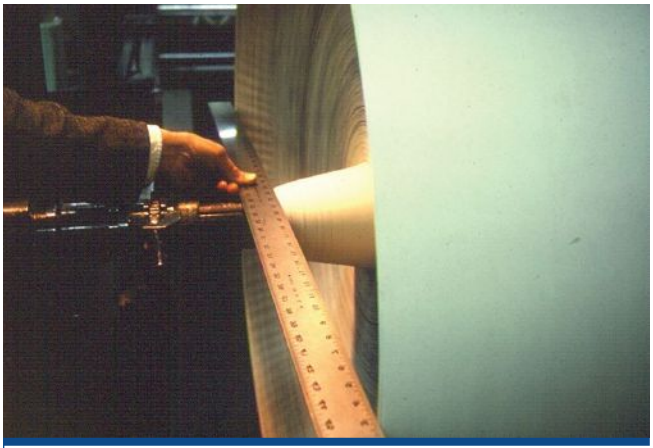

**FIGURE 1.** *An example of the common Telescoping Type Ia*

is covered in great detail elsewhere [4]. Instead, we will just take the first two.

Telescoping Type Ia, shown in Figure 1, is by far the most common. It occurs on core-supported winders (or unwinds Type Ib). In this subcase, the layers slide near the core first in the MD, which is demonstrated with the J-line test. MD slippage then *enables* sliding in the CD, which is seen at a glance. Telescoping Type II, on the other hand, can occur on any winder type. Here, sliding is *only* in the CD. The poster child here are adhesives that do not cure, such as PSAs, or are not yet cured and thus have low "green tack."

While Type I happens during winding (or unwinding), Type II happens in storage. It is like a ticking time bomb, just waiting to go off in the next few minutes to next few months. Table I shows just how different the symptoms and remedies are and why the troubleshooter absolutely must take the second step to correctly diagnose the subcase to get the correct remedy list.

## Wrinkle

More so than telescoping, we cannot cover wrinkles in any detail, nor is there any need. It is covered in chapter-length detail elsewhere [5], and we even have a free Internet troubleshooting app to help you through the troubleshooting tree [6]. I will just show in Table 2 a list of the 20 or so most common wrinkle types that would comprise 99% of anything you would ever run into.

There are several things to observe with this list. The first is that the major case can be seen at a glance – sign of a good taxonomy. No Ph.D. or DNA sequencing is needed. The

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**TABLE 1.** *Comparing two common telescope types*

| Characteristic | Telescoping Type Ia | Telescoping Type II |
|---|---|---|
| When | During winding | After winding in storage |
| What slips | Layer to layer | Adhesive shear |
| Roll-end shape | Like a sombrero | Like a bowl |
| Defect class | Taper | Tight |
| Tension start / end | High / Low | Low / Low |
| Nip start / end | High / --- | Low / Low |
| Product Redesign | Increase web-web COF<br>Increase Core OD<br>Decrease Roll OD | Increase adhesive-shear viscosity<br>Decrease storage temperature |

second is that the subcase, i.e., "root cause," often can be found by mere process of elimination from readily known information. The third is a bit more subtle. That is that while almost all wrinkle types are "tension-sensitive," only two of the 20 are "caused" by tension, and they are seen only on ultra-low modulus (stretchy) materials.

### Why is getting the subcase so very important?

If you stand back and look at the defects presented thus far, you will notice that some defects are tight defects, some are loose defects and some are not affected by tightness much or even at all, and this is true even within a single major case of defects. This is why common tropes such as "It is best to wind loose or with maximum taper," are hopelessly naïve. Applying the correct remedy for the wrong defect type is, well, *wrong*. It will just waste time and money and further risk the ire of the customer. Furthermore, after the tension/tightness knobs have been played in the correct direction for a specific defect, you will then need to redesign the product to reduce defect rates and severity any further. Some products, no matter how desirable for other reasons, might not be economically transported or wound.

Another aspect of diagnosing subtypes is important if you want to do trials and want useful measures of severity. Science and taxonomy both inform us on which measures are more likely to be sensitive to a specific defect. Measuring pounds of internal rejected waste or counting customer returns seldom will work well for many reasons. First, rejection is subjective and thus adds noise to the



**TABLE 1.** *Common wrinkle types and subtypes*

**MD – troughs, wrinkles, creases oriented in MD – all subcases have to do with width**
Tension too high (only low modulus materials)
Tension drop (only low modulus materials)
Temperature or moisture increase
Slender roller deflection
Roller bumps or valleys or grooves
Improper spreading
Lane(s) in the web

**Diagonal Shear – wrinkles at an angle w.r.t. MD – all subcases have "crookedness"**
Crooked web (such as bagginess)
Crooked machine (roller misalignment, roller diametral profile, uneven nip etc)

**CD - troughs, wrinkles, creases oriented in MD**
Buckles (such as air buckles, starring, etc.)
Tunnel wrinkles (delamination)

**Baggy Web**
Manufactured or converted baggy
Gage bands stretched into lanes during winding (most common)
Brutish handling or storage (very uncommon)

**Corrugation**

**Curl**
"Two sidedness" in forming
Coating on one side
Lamination
Rollset
Chiral

already noisy process. Second, and most importantly, it is likely that several different defects are lumped together in the same bin. Bad-looking wound rolls and wrinkled webs could be a catchall for one, two or perhaps 10 totally different winding and flatness issues seen by a customer, on a product or in the plant.

### Do you need to classify everything?

Absolutely, otherwise you would not know for sure what a customer is complaining about or an operator is referring to. Thus, each trouble must be uniquely named with no gaps or overlaps. There are many resources to help you here [1,5,7]. However, that does not necessarily mean that *taxonomies* need to be generated. Recall that the primary utility of taxonomy is to help make diagnostics quicker and surer so that we can proceed to remedy lists, decision-making and implementation.

If you have a slip pimple, for example, the problem can be diagnosed at a glance because there is nothing that looks like it. Also, while a slip pimple is a tight defect, grouping it with other tight defects does not improve the understanding of the winding and defect mechanics very much at all. While slip pimples begin with a seed of contamination, sometimes slitter debris, no insight would seem to be gained if slip pimples were grouped with other debris complaints, such as fouling of printing equipment from paper slitting dust.

In a similar way, I suspect that cutting/slitting defects also might not benefit much from taxonomy. If you have bottom band axial wobble, you may see "slitter" rings on the ends of very flat rolls. Would you benefit in understanding by grouping it with radial wobble, which also can cause slitter jumps? Probably not. In either case, you would up your band grinding and mounting and motor-shaft runout game. Perhaps someone more knowledgeable or clever than I might come up with a slitter-defect organization that is widely applicable beyond merely listing defects or listing best practices.

While not web handling, several attempts have been made to name and classify coater defects [8]. I sense that this effort has not been as successful because there are a lot more coater types than winder types, for example. There also are many more coating and web chemistries which matter, while web handling is almost totally agnostic to chemistry and just concerns itself with a handful of material properties

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to do the bulk of its work. Nonetheless, separating coating streaks from coating bubbles, for example, will help speed up finding the specific defect you are working on, even if a useable taxonomy has yet to be devised as far as I know. ■

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> "APPLYING THE CORRECT REMEDY FOR THE WRONG DEFECT TYPE IS, WELL, WRONG. IT WILL JUST WASTE TIME AND MONEY."

# Saving energy and CO2 emissions with electrothermal drying systems

*By Kai K O. Bär, Ph.D., managing director / president, adphos Digital Printing GmbH*

The hot-air convection dryers that predominantly are used today in flexographic and gravure printing are energy-intensive and emit large amounts of climate-damaging $CO_2$. The possibilities and alternatives for gas dryers are shown in a quantitative comparison in the area of decorative gravure printing and impregnation.

## Introduction

According to the technical-physical definition, "drying" is a solidification of a liquid application by removing the liquid phase. This can be done mechanically (pressing), by reduced atmospheric pressure (vacuum), cold (freeze-drying), heat (thermal drying) or radiation-induced (direct molecular excitation of high-energy radiation). UV or electron-beam systems are not dryers in the sense of the above definition, but they enable radiation energy-related crosslinking processes to solidify specially developed coating recipes (UV, electron beam). The drying technologies mainly used today in the various printing and coating processes, such as gravure printing in the décor sector, are based on conventional drying.

## Basics of drying technologies

When the wet-coated substrate is heated and the associated temperature increases from a certain level, the liquid phases begin to evaporate. To achieve drying of the printed or coated substrate, the resulting vapor must be absorbed by means of a suitably designed gas flow (mostly air) and removed in a defined manner (from the substrate and from the dryer). The various drying technologies are shown in Table 1.

Regardless of the mechanism of evaporation – conventional substrate heating or, alternatively, direct molecular interaction with the liquid phase – it is important for these evaporation-based systems that the vapor transport is integrated. The energy requirement of the respective drying system is influenced strongly by the dimensioning, adaptation and execution of the steam removal and is decisive for the achievable energy efficiency. The dryers mainly used today are gas-convection systems in which the gas flow is heated by burning fossil fuels (natural gas or oil). This exothermic chemical reaction generates thermal energy, but also $CO_2$ as a reaction product. For typical natural gas, the $CO_2$ emissions, depending on the burner technology per generated heat output of 1 kW (corresponds to 1 kWh / h), are 0.25 to 0.40 kg / h. When operating a gas dryer with 500-kW dryer output, up to 200 kg / h of $CO_2$ are generated.

Since the beginning of 2021 at the latest, we in Germany have noticed the effects of the so-called $CO_2$ tax on fossil energy and heating systems. If you follow the current

**TABLE 1.** *Potential drying technologies*

| Drying technology | Drying principle |
|---|---|
| **Water-based systems** | |
| Gas-convection dryer | Substrate heating with heated gases |
| Conduction dryer | Substrate heating with heated drum, plate and warm/hot-air flow |
| Infrared dryer | Substrate heating via middle (MIR), short (KIR) or near (NIR) infrared-based systems and warm/hot-air flow |
| **Alternative drying systems** | |
| Microwave | Evaporation through polar molecular interaction and warm/hot-air flow |
| High-frequency | Evaporation through polar molecular interaction and warm/hot-air flow |
| Advanced NIR (aNIR) | Combined evaporation through polar molecular interaction and locally integrated warm-air ventilation |

**TABLE 2.** *Drying systems and their properties*

| Thermal process description | Comment |
|---|---|
| **Alternative fuel** | |
| Ammonia (NH3) | Leads to emissions of nitrogen oxides (NOx) |
| Hydrogen (H2) | Not sufficiently available<br>Poor manufacturing efficiency (14 kWh electricity / kWh of natural-gas equivalent) = extremely high price |
| **Radiation curing systems** | |
| UV curing | Limited to thin film (printing/coating) |
| Electron-beam curing | Requires special new paint and coating recipes |
| **Electrothermal systems** | |
| Electrically heated hot air (resistance, induction heated) | Low efficiency, high cost |
| Infrared-based systems | Only applicable for non-temperature-sensitive substrates and thin film printing/coating |
| Advanced NIR (aNIR) | Very compact (≤1s) – high energy efficiency<br>Applicable for temperature-sensitive substrates, solvent-based layers and impregnation processes<br>Significant production and quality improvement possible |

development of gas and fuel prices, the present-day $CO_2$ taxation in Germany of 25 €/t $CO_2$ still is very moderate compared to many other countries. The EU currently is planning an approved increase in the $CO_2$ tax to 65 €/t by 2026 as part of the "Green Deal Program." The ambitious climate goals of the future German government and the calculated damage costs from $CO_2$ emissions, which the Federal Environment Agency recently calculated at 180 €/t $CO_2$, make a significantly more dynamic $CO_2$ taxation appear inevitable in the near future. But how can $CO_2$ emissions be reduced or even avoided?

What options or alternatives are there for the respective drying systems that can be used? The answers to these questions are summarized in Table 2. From this reference, it can be seen that the goal of a significant reduction in $CO_2$ emissions can be achieved only with electrothermal process systems. However, this also assumes that the electrical energy for the drying process must come from renewable sources.

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**TABLE 3.** *Energy / CO2 comparison between gas dryer / aNIR dryer*

| Energy / CO2 Comparison | Gas dryer | aNIR dryer |
|---|---|---|
| **Average energy consumption (kWh / 1000 m2) paper 7.5 gsm (10 gsm):** | | |
| Thermal (gas) [kWh / 1000 m2]: | 22-24 (25-63) | --- |
| Electrical (blower, aNIR-thermal) [kWh / 1000 m2]: | 2-3 (4-5) | 7.6-11.7 (10.5-16) |
| Total output [kWh / 1000 m2]: | 24-27 (29-68) | 7.6-11.7 (10.5-16) |
| **Energy savings with aNIR** | **Benchmark** | 16-35 kWh / 1000 m2 (18-52 kwH / 10002) |
| Energy savings with plastic substrate (10 gsm) | | Up to 75% (80%) |
| Electrical | No data | 8-20 kWh / 1000 m2 |
| Total output | No dafa | 8-20 kWh / 1000 m2 depending on print layout |
| **CO2 savings** | | |
| At 7.5 gsm / 1000 m2 | | 0.3-10 kg/m2 |
| At 10 gsm / 1000 m2 | | 3.3-15 kg/m2 |

## Practical examples

A comparison made between gas dryer and aNIR drying technology on a gravure-printing press (number of printing units: four; décor paper width: 2,250 mm; application weight of the water-based inks: 7.5- to 10-gsm is based on the operating data determined in the study, *"Energy and resource-efficient digital printing process in the décor industry (2017)"* and current internal benchmark studies with various international décor-printing companies.

In all cases, 15 printing machines of various ages (commissioned between 1990 and 2010) were examined. Table 3 shows the results for comparison.

Based on the actual consumption and resulting from the typical production portfolio, energy savings of up to 80% can be achieved with the aNIR technology, depending on the print job (see Figure 1). With small batch sizes and reduced web widths (compared to 2,250 mm width), an even greater energy reduction can be achieved.

From this, it can be estimated that with an electricity / gas price ratio of ≤4, the use of the aNIR system already leads to a neutrality of energy costs. If the costs for $CO_2$ emissions are added, even with an electricity / gas ratio of 5:1, the operating costs for energy for the aNIR driers are the same or lower. In addition, the aNIR technology significantly reduces the waste rate, because the dynamic working method and the very compact dryer design reduces the required web length in the gravure-printing press by almost 7%. In addition to lower operating costs and an improved ecological balance, the compact aNIR technology is characterized by reduced space requirements and low weight. It also reduces the overall complexity on a gravure press. In relation to these advantages, the investment required for an aNIR-based gravure-printing machine is very low. Modernization and upgrade measures often can pay for themselves after a short time.

## Impregnation process

In addition, energy comparison data already are available for the impregnation of decorative products from practice. These are listed in Table 4 for a comparison of gas dryers and aNIR dryer solutions. Like the drying comparison in gravure printing, the impregnation process results in high double-digit savings in energy requirements and even

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**FIGURE 1.** *A gravure-printing press (left) equipped with aNIR technology (right) for drying water-based inks and varnishes.*

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greater savings potential in terms of $CO_2$ emissions (up to 85 kg/1000 m²). Possible dryer-length savings of up to 90% compared to gas dryers, justify the retrofitting potential to increase productivity for already installed impregnation channels.

**TABLE 4.** *Comparison of the energy requirement and the CO2 emissions between gas and aNIR dryer during the impregnation of décor products*

| Comparison of energy requirements | Gas dryer (today's standard) | aNIR dryer |
|---|---|---|
| Electrical | 20-30 kwh / 1000 m2 | 130-170 kwh / 1000 m2 |
| Thermal (gas) | 200-340 kwh / 1000 m2 | |
| Total | 220-370 kwh / 1000 m2 | 130-170 kwh / 1000 m2 |
| Total energy savings | Benchmark | 90-200 kwh / 1000 m2 |
| CO2 savings | Benchmark | .50 up to 85 kg / 1000 m2 (equals 2 tonnes / day) |
| Dryer length savings | | 90% (>25 meters at 30 mpm) |

**Wet application weight: 250 gsm; dry weight: approx. 125 gsm*

## Conclusion

Gas dryers installed in decorative gravure-printing presses emit considerable amounts of $CO_2$, which can reach up to 100 kg / 1000 m². Realistically, $CO_2$ emissions can be reduced to a large extent only through the use of electrothermal drying systems. With advanced NIR (aNIR) technology, no primary $CO_2$ emissions arise during drying. With aNIR, productivity and process quality for printing, lacquer and impregnation applications are improved significantly. The available aNIR-based dryer solutions enable cost-neutral dryer operation – despite a high electricity / gas price ratio. ■

> "WITH AN ELECTRICITY / GAS PRICE RATIO OF ≤4, THE USE OF THE ANIR SYSTEM ALREADY LEADS TO A NEUTRALITY OF ENERGY COSTS."

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# Ink-viscosity optimization and automation systems for gravure printing and coating: Part 2

*By Joe Goodbread, Ph.D., chief technology officer; Sunil Kumar, Ph.D., chief executive officer; and Manpreet Dash, markets development and applications engineering, Rheonics*

While the latest printing presses are equipped with sophisticated quality control and automation systems, one of the most important variables in printing – ink viscosity – typically still is measured with inexact and cumbersome methods, such as efflux cups and falling-ball viscometers. Sensors that measure up to the accuracy operators expect from their color control and press adjustment systems enable on-line, automatic, dynamic control of viscosity within previously unattainable narrow limits, affording start-to-finish maintenance of print quality in even the longest print runs. Using accurate, repeatable viscometers with a responsive control system improves color quality, efficiency and reduces waste and emissions.

**Editor's Note:** *Part 1 of this technical paper covered the various challenges of on-line ink viscosity measurement and control.*

## Gravure challenges

Gravure printing poses special challenges to accurate viscosity measurement and control. Whereas in flexographic-printing systems, cleaning is performed in-line with the printing process, many gravure machines use an off-line cleaning routine. When changing jobs, the ink system is removed from the machine and sent to a wash station where remnants of the previous job's inks are removed in a device resembling a dishwasher. However, this kind of handling can be rough on viscosity sensors, changing their baseline and even damaging their mechanisms. For machines with removable ink systems, another kind of installation provides a compact, integrated sensor and control valve unit (see Figure 5), which remains on the machine during job changes and is cleaned by an integrated, automated washdown system that removes all traces of the previous ink color from the sensor and associated piping.

A special sensor operating mode can self-test the sensor's condition, indicating when washdown is complete and also signaling the operator when the sensor becomes contaminated during a printing run. The adapter for mounting the sensors provides for convenient connection points directly in-line with the ink pan while providing auto-wash function at the end of the print run.

## Complete automation for higher accuracy, reliable and agile printing-process control

Resonant viscosity sensors often are paired with conventional PLC-based control systems. These typically do not make use of all the features available in modern, Industry 4.0-compatible sensor systems. More sophisticated systems can, for example, make use of the highly accurate and reproducible measurements provided by

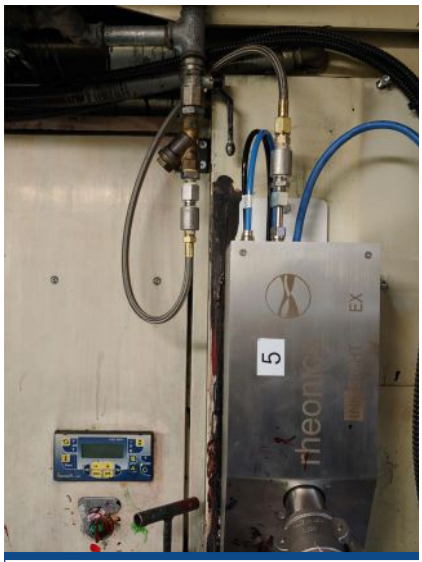


**FIGURE 5.** *Adapter for in-line mounting of the sensor and including an auto wash system*

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resonant sensors to enable "lock and load" setting of job parameters stored from previous runs of the same job.

One such system of hardware and software offered by this firm enables simultaneous on-line control of ink viscosity on multiple print decks (see Figure 6). All sensors are connected to an industrial-grade computer. The computer controls a valve island, which in turn controls the solvent-dosing valves (see Figure 7). The operator controls the system by means of an intuitive user interface and touchscreen, next to the operator control panel (see Figure 8). The touchscreen displays a dashboard, on which the operator can monitor the viscosity of all stations. Touch-sensitive controls enable the operator to switch individual stations on or off, enable automatic control and set the viscosity limits. A single dashboard can manage multiple sensors and control valves spread across the factory floor. A separate station hub switches to a display that monitors the viscosity over time and allows adjustment of individual sensors and valves.

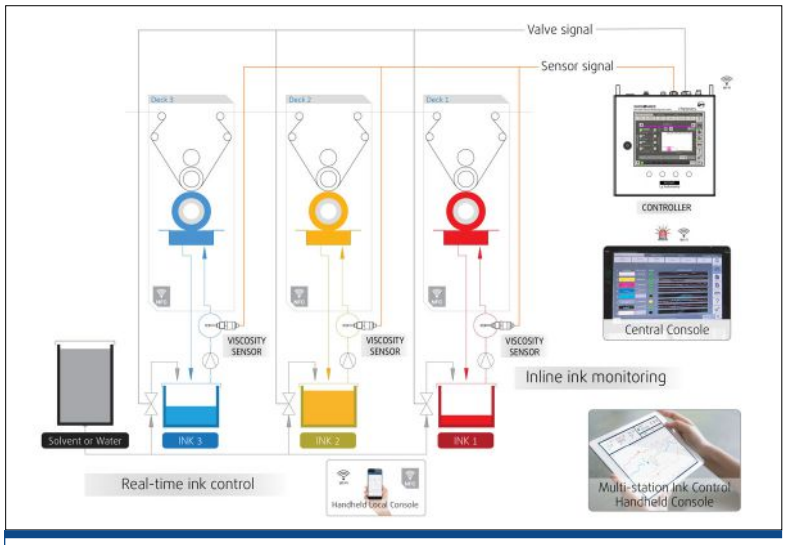


**FIGURE 6.** *Real-time ink control is achieved through in-line ink monitoring facilitated by placement of viscosity sensors at each print deck. They connect and transmit data to a central multi-station and single-station handheld consoles.*

## Predictive tracking control

During printing, there is a continuous loss of solvent due to evaporation, at a rate that increases with increasing printing speed and rising ink temperature. Loss of solvent raises ink viscosity. The sensors update the measurements of ink viscosity and temperature once a second (see Figures 9a-b). This, in turn, enables the controller to determine whether the viscosity falls within the desired range. The controller adds just enough solvent to compensate for deviation of the viscosity from the setpoint. During printing, it is possible to maintain a deviation of only 0.5% from the optimal viscosity. The system uses dosing valves to add the very small amounts of solvent that are necessary to achieve such fine control. The plots in Figures 9a-b are of the same color with different scales, with vertical magenta lines indicating automatic solvent dosing.

The control system is extremely accurate because it can compensate rapidly and often for the evaporation occurring constantly during printing. To achieve such very small deviations from the setpoint, the system will sometimes dose as little as 10 gm of solvent every 30 seconds.

**FIGURE 7.** *Viscometer installed using a flow adapter, showing the control valves for precise dosing of solvent to regulate ink viscosity.*


**FIGURE 8.** *Interface screenshot showing an 8-station gravure press with six stations active*

When fresh ink is added to the ink bucket, its viscosity is intentionally set higher than its final value. The predictive tracking control responds by immediately dosing more solvent, measuring the response to the dose and repeating until the desired viscosity is reached (see Figure 10). The setpoint is approached gradually with very little overshoot.

**TABLE 1.** *Viscosity automation and sustainability goals*

| Present and future goals | How complete viscosity automation helps reach those goals |
|---|---|
| Sustainability | • Reduced waste and setup scrap lead to lower environmental impact<br>• Precise, targeted solvent dosing<br>• Ability of the balanced resonator viscometers to work reliably and repeatably *at any viscosity* means these viscometers support transition from solvent-based to water-based inks |
| Compliance | • Accurate dosing of solvents ensures minimal, precise amounts of solvents are consumed, leading to reduced emissions<br>• Less scrap, waste and rejects to dispose |

## Quality assurance, improvement and standardization

An experienced operator knows what viscosity must be maintained for each type of ink in any particular job. Metallic and white inks, for instance, have heavier pigment loading than "normal" inks and present special measurement challenges. Furthermore, the required viscosity also depends on the type of substrate on which the printing is done.

When the ink is too dilute, its viscosity is too low, and the pigment loading is insufficient to give proper color density. When too concentrated, the viscosity is too high, and it tends to produce "pinholing," which also decreases color density. Accurate initial adjustment of viscosity during setup, and maintaining constant viscosity through the print run, enables more consistent and accurate color density in the printed image. This lets the operator control the final color quality by accurately setting and controlling ink viscosity.

## Viscosity control: the key to dE<2 and beyond

Data and insights have enabled the operator to improve color quality and maintain lower and constant dE2000 values, especially during long runs. Tighter viscosity control

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**FIGURE 9a.** *Temperature-compensated viscosity (black. 25cP) and temperature (green, ~18° C) vs. time, coarse vertical scale*


**FIGURE 9b.** *Same plot as 9a, with zoomed-in vertical scale. Temperature-compensated viscosity variation is less than 0.2 mPas.*

**TABLE 2.** *Solvent consumption and emissions data reported by a customer in printing industry after commissioning of SRV viscometers and controller*

| | 2013 | 2014 | 2015 | 2016 | 2017 | 2018[1] | 2019 | 2020[2] |
|---|---|---|---|---|---|---|---|---|
| **Solvent consumption** | 27.045 | 23.239 | 28.532 | 28.848 | 28.112 | **23.442** | **22.197** | **16.420** |
| **Total emissions** | 12.193 | 11.214 | 13.281 | 15.487 | 13.389 | **11.841** | **11.841** | **7.240** |
| **Permitted emission** | 16.727 | 16.896 | 20.400 | 27.971 | 24.655 | 22.388 | 21.954 | 28.798 |

Notes:
[1] Proprietary viscosity-automation solution commissioned on printing-press ink stations in June 2018
[2] Second system commissioned on laminator in April 2020

results in far fewer errors in color-strength deviations in the print-inspection system. Operators who use the systems are able to trust the sensors and control system to provide accurate and repeatable color accuracy. This trust has led to achieving more rapid setup times for small jobs and consistently excellent print quality for very long runs. And because the sensors need neither maintenance nor recalibration, no further standardization of viscosity values is required beyond the initial setup for each ink. For specific substrates, operators now know what viscosities to maintain. Each new order is stored with the viscosity set values for repeat orders of the same job.

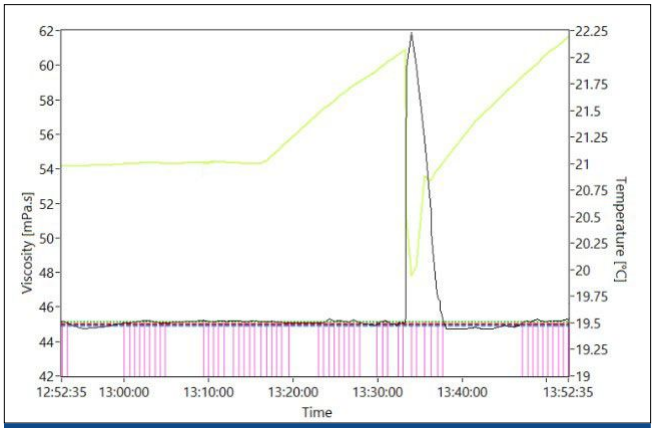


**FIGURE 10.** *Response of the system to adding a large volume of cool ink to a system running at 21° C. Note the rapid recovery time of the temperature-compensated viscosity.*

Finally, Figure 11 shows a series of measurements taken from a print job of 24,500 meters and 13 rolls. The run was interrupted several times, and so was printed on five different days and, in part, at different speeds. Despite the long timespan and interruptions, the dE2000 value never exceeded 1.8.

## Achieving sustainability goals with complete viscosity-automation solutions

Reliable viscosity-automation solutions ensure that only minimal and extremely precise amounts of solvents are used for ink-viscosity adjustments. Table 1 shows how complete viscosity automation helps reach sustainability goals, such as reducing waste and setup scrap, and minimizing emissions. When used with an integrated control system and software, records of all solvent additions are kept to enable evaluation and optimization of solvent-consumption pattern (see Table 2). Customers using this firm's viscosity-automation solutions have reported about a 40% reduction in solvent consumption and total emissions.

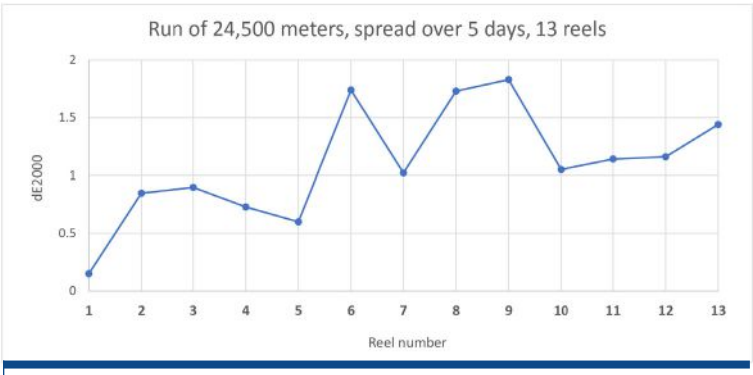


**FIGURE 11.** *dE2000 for a run of 24,500 meters spread over five days and 13 rolls*

## Conclusion

As printing speeds increase, and profit margins get tighter, "getting it right the first time" for each job becomes much more important. Tight viscosity control with an accurate sensor combined with a responsive control system enables gravure printers and coaters to streamline process while improving color quality and reducing waste. ■

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# Attainable sustainable: Using electron-beam tech in compostable flexible packaging: Part 2

*By Sage M. Schissel, Ph.D., applications specialist, PCT EB and Integration, LLC*

Sustainable practices, including material reduction and the use of bio-based, recyclable or compostable materials, are forefront in the minds of both consumers and the packaging industry. This especially is true for flexible packaging, which traditionally has consisted of multilayer, non-recyclable structures. In this study, the use of electron-beam (EB) technology in the life cycle of a compostable, flexible package was investigated.

**Editor's Note:** *This technical paper originally was published in* UV+EB Technology*, 2020 Q2, pages 14-20. It since has been updated with newly expanded experimental-test results. Part 1 covered how EB curing aids the mono-material trend, degradation of materials by EB chain-scission and the experimental setup.*

## Results and Discussion

The purpose of this study is to establish EB-curable, overprint varnishes (OPVs) can be used in the production of compostable, flexible food packaging without significantly impeding the compostability of the packaging. Furthermore, EB exposure was investigated as a means of accelerating the disintegration during composting. High doses were used to weaken the compostable film through chain-scission.

## Packaging compostability

An integral aspect of using EB-cured OPVs in compostable flexible packaging is demonstrating that the OPVs do not inhibit or significantly impede the disintegration of the compostable film. In addition, because EB is well known to interact with cellulose, it is also important to establish what effect an EB curing dose (30 kGy) has on the compostability of the film [21,29]. To this end, select samples (see Table 1 in Part 1) were composted and their disintegration progress visually documented (see Figures 1A-D).

Comparing the control film (see Figure 1A) to a film that's received a curing level dose (B), the EB dose does not appear to have a significant effect. After two weeks of composting, the EB sample (1B) appears to have slightly more disintegration than the control (1A), but those impressions flip after three weeks. After four weeks, both samples almost are completely disintegrated, with only a few small pieces of film still left at the edges of the test frame.

The addition of an EC-cured OPV also does not appear to significantly impact the disintegration time of the film. The majority of both the EM-coated (see Figure 1C) and EG-coated (1D) samples was disintegrated after four weeks. Both samples retained slightly more film at the edges of the test frame after four weeks than the control (1A); however, by the end of six weeks (a five-week photo not being included in the test results), the disintegration levels of the OPV-coated samples and the control are visually the same.

## Post-treatment of packaging

With the compostability testing providing positive qualitative results and demonstrating that EB-cured OPVs can be effectively used in the production of compostable, flexible food packaging, the potential of EB technology to affect a package after consumer use was considered. Composting, even on an industrial scale with controlled conditions, is a time-intensive, multi-week process.

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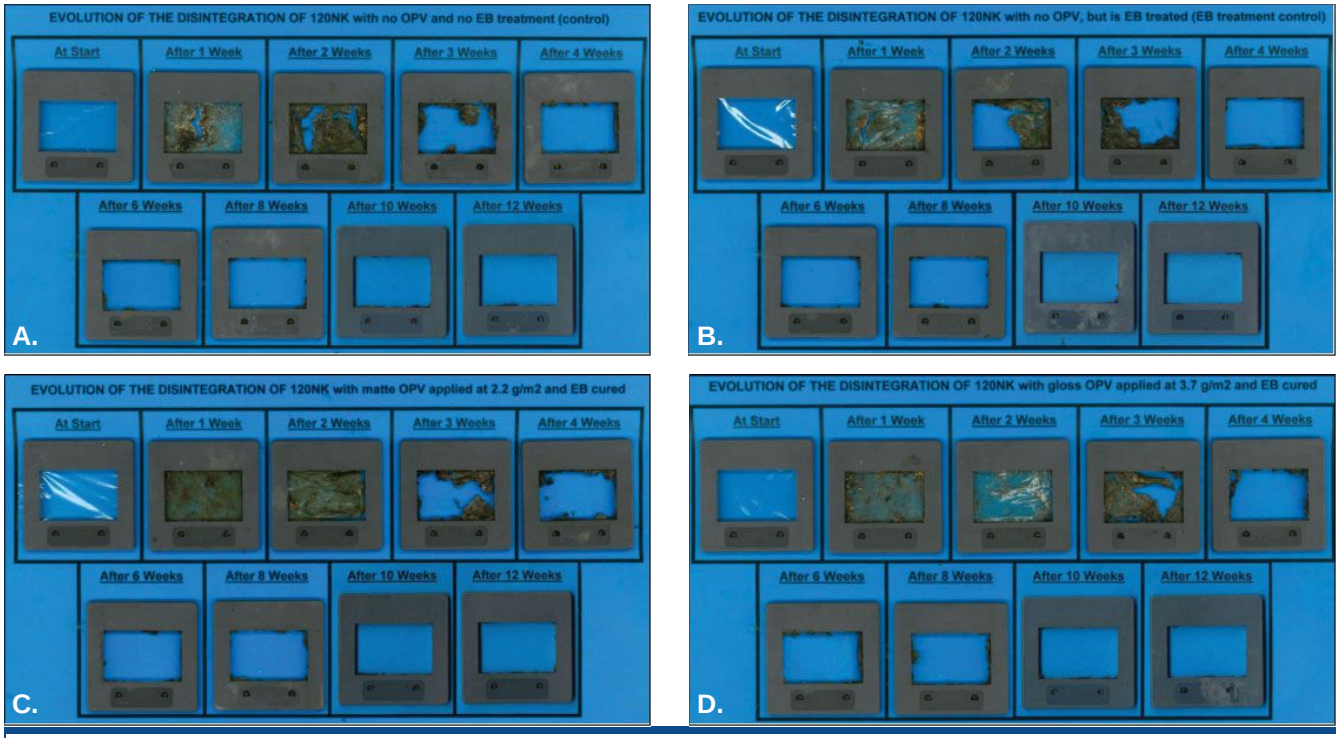


**FIGURE 1A-D.** *Results of the compostability testing for unprinted samples. After six weeks, the OPV-coated samples (1C and 1D) have the same amount of uncomposted material left in the frame as the plain film (1A). Sample conditions are listed in Table 1 of Part 1.*

Accelerating the disintegration of material could allow compost facilities to efficiently convert a higher volume of packaging with little to no changes in infrastructure.

***Visual effects:*** The degradation of the compostable packaging structure (film/print/OPV), caused by EB irradiation, was first evaluated visually (see Figure 2). Samples exposed to an EB post-treatment dose of 50 to 400 kGy were compared to a control (see Figure 2, 0 kGy).

Remarkably, there are no discernible effects of the EB post-treatment until 150 kGy. At 150 kGy, there is some slight discoloration of the film and noticeable cracking of the OPV. As higher post-treatment doses are applied, the yellowing of the film intensifies and the film shrinks and wrinkles.

***Puncture-strength reduction:*** Puncture strength was used as a quantitative measure of the scissioning effect caused by high doses of EB. As chain-scission increases, the strength

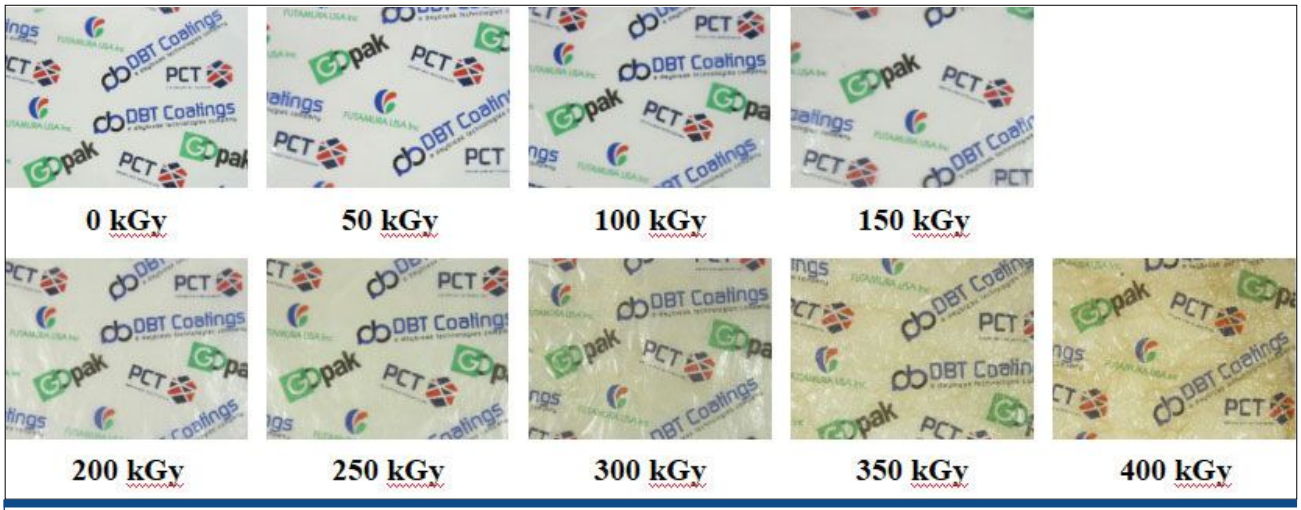


**FIGURE 2.** *Visual effects of EB post-treatment. Samples are coated with EB-cured EG OPV (see Table 2 in Part 1).*

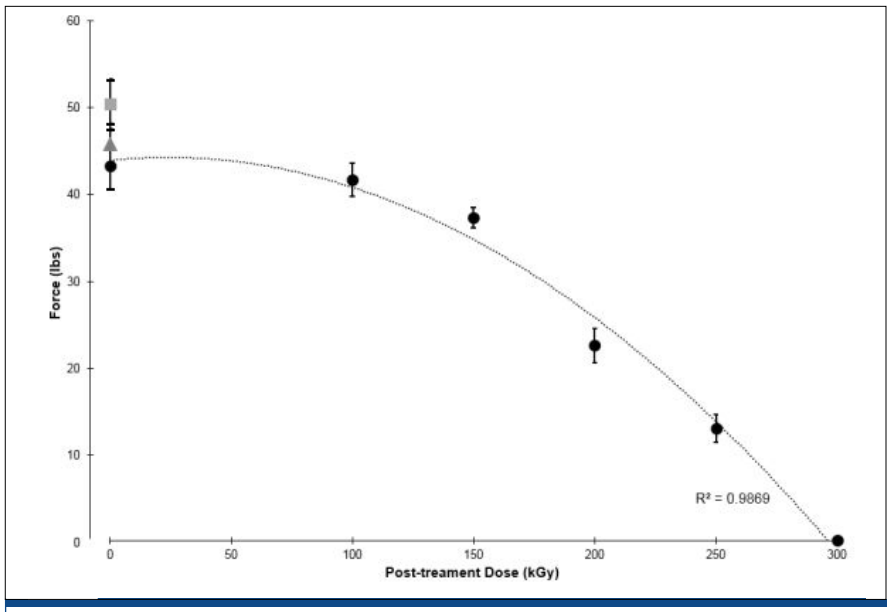


**FIGURE 3.** *Puncture resistance of the compostable packaging film decreases as the EB post-treatment dose is increased. The grey square (■) and triangle (▲) are samples A and B of Table 1, respectively. The black circles (●) represent samples of the construction listed in Table 2.*

of the film is expected to decrease. Figure 3 shows a clear correlation between the puncture resistance of the compostable film and the dose level of the EB post-treatment. Comparing the plain NK120 film to the plain film after receiving a curing-level dose (see Figure 3, grey square and triangle, respectively), there is an approximately 5-lb decrease in puncture resistance. Note, there is some overlap of the error in these measures. No significant difference is seen when print and EG OPV are added to the construction (black circle, 0 kGy). As the EB post-treatment dose is increased, the puncture force decreases. The relationship of these two variables follows the trend line of a second-order polynomial with an $R^2$ value of 0.9869.

Interestingly, there is almost no loss of puncture resistance between the 0 kGy and 100 kGy post-treatment dose. While EB dose levels generally are kept quite low for curing (~30 kGy), this result, along with the visual results, demonstrates that there potentially is a much larger EB operating window than previously thought. The effect of EB on other mechanical properties would need to be investigated to confirm. However, a larger operating window could be a beneficial option for improving ink and coating performance through enhanced crosslinking.

***Compost results:*** Based on the results of the puncture-strength testing, three samples were chosen to test the effect of EB post-treatment on the compost rate of the packaging structure, a control and two different post-treatment doses (see Table 2 in Part 1). Significant differences between the samples were observed (see Figures 4A-C).

After one week, the control and 150-kGy post-treatment samples turned brown, but no disintegration had yet occurred. Contrastingly, the 300-kGy post-treatment sample already had experienced a significant amount of disintegration. After two weeks, a large portion of the 150-kGy post-treatment sample had disintegrated, while the control sample still was almost completely intact. Similar amounts of material remain between three and six weeks for the control and 150-kGy post-

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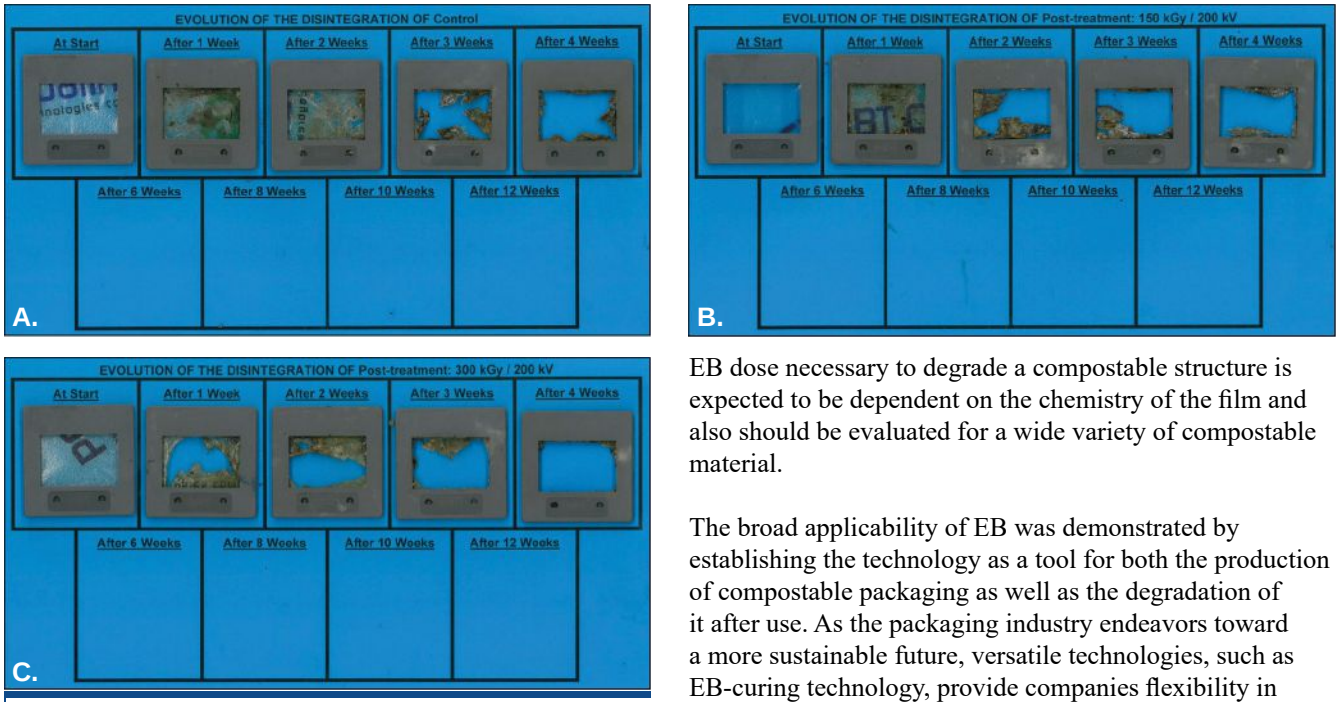


**FIGURE 4.** *Results of the compostability testing for printed samples with EB post-treatment. After one week, the 300-kGy post-treatment sample (4C) shows significant disintegration, while the control (FA) and 150-kGy post-treatment samples (4B) are completely intact. Sample conditions are listed in Table 2.*

treatment samples, until both appear fully disintegrated at eight weeks. The 300-kGy post-treatment sample appears almost fully disintegrated, with only a few remnants in the sample frame, as early as four weeks. From these results, using a high-dose EB post-treatment to increase the rate of disintegration of compostable material looks promising.

## Conclusions

A qualitative compostability test was conducted and showed that EB-cured OPV did not make a significant impact on the compost rate of a cellulose film. These results indicate that the reviewed structures would likely pass a quantitative, mass-balance test.

Furthermore, a post-treatment EB dose was evaluated as a potential means of increasing the composting rate of the flexible-packaging structure. The degradation of the film was confirmed visually as well as by demonstrating that puncture strength decreased as the post-treatment dose was increased. The qualitative compostability testing of these post-treated structures showed high-dose EB post-treatment positively impacts the composting rate.

In addition to quantitative compostability testing, future work in this area includes broadening the scope of OPVs, inks and compostable substrates investigated. The optimal EB dose necessary to degrade a compostable structure is expected to be dependent on the chemistry of the film and also should be evaluated for a wide variety of compostable material.

The broad applicability of EB was demonstrated by establishing the technology as a tool for both the production of compostable packaging as well as the degradation of it after use. As the packaging industry endeavors toward a more sustainable future, versatile technologies, such as EB-curing technology, provide companies flexibility in developing new avenues to achieve their recycling and composting targets. ■

**Acknowledgements**

The author would like to acknowledge DBT Coatings for initiating and funding the first round of compostability testing and sharing the results. These data provided the impetus for further exploration of EB's role in compostable packaging. The author also would like to acknowledge Futamura for donating the NK120 film and GOpak for donating printing-press time and materials.

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## Apparatus and method for lithium-ion cells

**US Patent Application #20220085434**
**(filed Nov. 23, 2021)**
**Inventors: Gregory R. Day, et al (Madison, AL)**
**Assignee: The Boeing Co.**
**Abstract:** A method including supporting a plurality of lithium-ion cells disposed within respective isolation chambers of a thermally insulating cell support structure, and disposing a thermal dissipation member between a housing and the plurality of lithium-ion cells so as to collectively form a heat sink with each lithium-ion cell of the plurality of lithium-ion cells and the housing, where the plurality of lithium-ion cells are disposed within the housing, the thermal dissipation member closes a respective open end of each of the respective isolation chambers to physically isolate each isolation chamber from each other isolation chamber, and the thermal dissipation member is thermally coupled to the plurality of lithium-ion cells so as to dissipate thermal energy from one of the plurality of lithium-ion cells to the housing and at least another of the plurality of lithium-ion cells, through the thermal dissipation member.

## Lithium-sulfur (Li-S) batteries and methods of manufacturing thereof

**US Patent Application #20220077492**
**(filed Sept. 9, 2021)**
**Inventors: Youngjoon Gil, et al (Seoul, Korea)**
**Abstract:** A Li-metal or metal alloy-based batteries with a multilayer structure and the method of manufacturing the same are provided herein. The method includes a preparation step, a stacking step, a pressing step, a cutting step and a termination plating step. Further, a sintering step may be performed prior to the termination plating step. The multilayer structure includes multiple unit battery structures and each battery structure is configured to include an anode layer including a Li-metal or metal allow with a two-dimensional (2D) material coated on the Li-metal or Li-metal alloy, a cathode layer including carbon-sulfur composites and solid or polymer electrolytes between the anode layer and the cathode layer. The 2D material includes MoS2 and the carbon-sulfur composites include carbon nanotubes, sulfur, carbon wires, carbon powder or Li.sub.2S powder.

## Process for preparing electroactive materials for metal-ion batteries

**US Patent Application #20220074045**
**(filed June 21, 2021)**
**Inventors: Sefa Yilmaz, et al (Abingdon, UK)**
**Assignee: Nexeon, Ltd.**
**Abstract:** The disclosure relates to a process for preparing particulate materials having high electrochemical capacities that are suitable for use as anode active materials in rechargeable metal-ion batteries. In one aspect, the disclosure provides a process for preparing a particulate material comprising a plurality of composite particles. The process includes providing particulate porous carbon frameworks comprising micro pores and/or mesopores, wherein the porous carbon frameworks have a D50 particle diameter of at least 20 microns; depositing an electroactive material selected from silicon and alloys thereof into the micropores and/or mesopores of the porous carbon frameworks using a chemical vapor infiltration process in a fluidized bed reactor, to provide intermediate particles; and comminuting the intermediate particles to provide said composite particles.

## Method for preparing anti-bacterial surface on medical-material surface

**US Patent Application #20190328939**
**(filed July 1, 2021)**
**Inventors: Li Ren, et al (Guangzhou, China)**
**Assignee: South China University of Technology**
**Abstract:** The present invention discloses a method for preparing an anti-bacterial surface on a medical-material surface, including the steps of: (1) conducting chemical graft of amino silane after performing oxygen plasma pretreatment to the medical material surface and then reacting the medical material with the amino silane surface with an acyl compound; (2) placing the medical material with an initiator-modified surface into an anti-adhesion monomer aqueous solution for a graft polymerization reaction; (3) placing the medical material with an anti-adhesion polymer brush-modified surface into an azide compound-containing dimethylformamide solution; and (4) placing the medical material with an azide surface into an anti-bacterial agent click solution for a click reaction, obtaining an anti-adhesion polymer layer and anti-bacterial agent layer-comodified anti-bacterial surface. ■

### TELL US ABOUT YOUR NEW INVENTION

Have you applied for or received a new US patent on a converting-related machine or material? Tell us about it. Send the details, including US Patent Application Number, filing date, inventor and assignee, to Editor-In-Chief Mark Spaulding, *Converting Quarterly*, at *mark@aimcal.org*. We'll publish the abstract in the next available issue.

## Roll stand fits sheet, cast extrusion

Davis-Standard (Pawcatuck, CT) introduces its new XP Express® - AGT (Active Gravity Touch) roll stand for both sheet- and cast-extrusion operations. Film processors benefit from technical and bottom-line advantages of the roll stand's inverted-down, multi-roll design. This arrangement facilitates improved die-nip management and handling, efficient web cooling and conditioning capabilities, precision roll-drive control, and high-performance web-path options. In addition, the XP Express AGT addresses low melt-strength resin delivery from die slot to nip, and expands the processing of thin gauge materials. The XP Express AGT is available in widths from 36 to 80 in. (900 to 2,000 mm) and with process rates up to 5,500 lbs/hr. Processors can integrate this roll stand into an existing line or collaborate with the co. to engineer a solution that addresses current and future operational goals.

**DAVIS-STANDARD,** 860-599-1010, *www.davis-standard.com*

## Butt splicer and rewinder run non-stop for paperboard applications at 600 mpm

Martin Automatic (Rockford, IL) featured the non-stop MCBHD butt splicer and LRHS rewind at the recent ICE Europe 2022 in Munich, Germany. The systems, engineered for paperboard production and converting operations, can handle web widths up to 1,250 mm and rolls up to 1,800 mm in diameter. Co. has more than 500 machine installations in Europe. Its original, and in many cases, patented designs, such as the inertia-compensated dancer roller and, the Airnertia™ idler roller, offer high-frequency response to speed changes in processes running delicate webs. Integrating Martin Automatic splicers and rewinders into production lines provides converters with significant cost savings – reduced waste and improved efficiency reflect directly on the bottom line.

**MARTIN AUTOMATIC, INC.,** 815-654-4800, *www.martinautomatic.com*

## New knifeholder line provides for high slit quality for narrow widths

Maxcess (Oak Brook, IL) debuts its new Tidland Advantages Series Knifeholder said to be ideal for packaging, tag and label and converting customers who require quality narrow-width slits. The Advantage Series offers customers Tidland quality and easy maintenance at an attractive price point. The knifeholders feature reduced downtime using a removable blade cartridge to make changes off-line. In addition, blade cartridges are reversible, allowing customers to cut on both sides of the knife rings for extended blade life and reduced maintenance costs. Featuring minimum slit widths of only 19.5 mm (0.768 in.), the Advantage Series has precision depth-control adjustment for blade overlap and extended side-stroke distance to simplify the setup process.

**MAXCESS,** 844-MAXCESS, www.maxcessintl.com

## Flame-retardant adhesives help protect tapes, coated films by self-extinguishing

FLEXcon (Spencer, MA) expands its portfolio of L-59FR Series Flame-Retardant Adhesives. The material features a self-extinguishing, non-halogenated flame-retardant formulation and is now available in both 2.0- and 4.0-mil coatweights as either a transfer tape or coated film. All products now meet industry-leading UL 94 flammability standards. Testing has been expanded on the 2.0-mil products to comply with components of Federal Aviation Regulation 25.853, Appendix F, for Vertical 12-sec and 60-sec burn, Heat Release, and Smoke Density. Coated films meet Federal Motor Vehicle Safety Standard 302 for a range of automotive applications. L-59FR Series high-tack and high-shear adhesive reportedly provides excellent adhesion to polypropylene, stainless steel, polyethylene, acrylic, and glass surfaces within aircraft and motor vehicles.

**FLEXcon,** 508-885-8200, *www.FLEXcon.com*

## Integrated corona-treating system fits laboratory, off-line production

Enercon Industries Corp. (Menomonee Falls, WI) now offers a fully integrated, turnkey corona-treating system that improves surface energy of films for printing, coating and laminating. The free-standing, off-line surface treater includes unwind, rewind, corona or plasma treater, power supply and high-voltage transformer. The turnkey option is available for narrow-web applications up to 32 in. wide using co.'s CoronaFlex for standard corona-treating applications. It also is available with

the Atmospheric Plasma3™ treater. Both standard and deluxe systems feature a portable stand with an integrated cantilevered unwind, rewind design allowing for easy loading and unloading of material.
**ENERCON INDUSTRIES CORP.,** 262-250-6070, *www.enerconind.com*

## Sustainable alternative for plastic PSA-tape backings is bio-based material

Ahlstrom-Munksjö (Helsinki, Finland) launches new MasterTape™ Pack Green pressure-sensitive tape backing consisting of bio-based tape backings with greater sustainability attributes. Available in multiple variants and basis weights, including saturated tape backings, as well as saturated and release-coated tape backings, Mastertape has different levels of release that are compliant with various adhesive systems. The line also can be fully customized based on customer requirements. The tape backing is fully certified to Forest Stewardship Council® standards, is 85% bio-based and repulpable.

**AHLSTROM-MUNKSJÖ,** 920-766-4611, *www.ahlstrom-munksjo.com*

## Air-cooled, high-power UV-LED curing system meets printing, coating apps

GEW (EC), Ltd. (Crawley, UK) introduces its new AeroLED curing system for the narrow-web printing market. The fully air-cooled, high-power UV LED system provides for full cure, printing, coating and converting applications up to 600 mm wide. It delivers power and reliability with a totally new concept which eliminates many of the operational problems in existing air-cooled LED systems. Its innovative design makes AeroLED extremely cost-effective and step changes the accessibility of LED printing, says co. Cool, filtered air is distributed from a single central fan sited away from the press and exits through the UV lampheads for quiet and reliable operation.


**GEW (EC), LTD.,** +44-1737-824500, *www.gewuv.com* ■

**Editor's Note:** *We welcome your new technology information on raw materials, machinery and accessories for converting of labeling and release liners for our 2022 Q3 issue. Email your press releases, etc., to Editor-in-Chief Mark Spaulding at* mark@aimcal.org. *Submissions are due July 1.*

# INDUSTRY CALENDAR

### MAY 2022

**25-27 AWAVirtual™ IMLCON™ IMDCON™ IMECON™ 2022:** AWA Alexander Watson Associates. *https://awa-bv.com/product/in-mold-technologies-platform*

### JUNE 2022

**7-9 AIMCAL R2R Europe Conference 2022:** AIMPLAS Plastics Technology Centre, Valencia, Spain. AIMCAL & AIMPLAS. *https://aimcal.org/AIMCAL/Events/2022-R2R-Europe-Conference*

**7 AWAVirtual™ Mergers & Acquisitions Executive Forum 2022:** AWA Alexander Watson Associates. *https://awa-bv.com/product/mergers-acquisitions2022*

**13-15 AWA Global Release Liner Industry Conference & Exhibition 2022:** Barcelona, Spain. AWA Alexander Watson Associates. *https://awa-bv.com/product/grlice21*

**14-16 Amplify Print 2022:** Convention Ctr., Minneapolis, MN. Foil & Specialty Effects Assn. and APTech. *https://amplifyprint.org*

**27-30 WOW World of Wipes® International Conference 2022:** Marriott Marquis Hotel, Chicago, IL. INDA, Assn. of the Nonwovens Fabrics Industry. *www.worldofwipes.org*

### JULY 2022

**11-14 SEMICON West + FLEX Conference 2022:** Moscone Ctr., San Francisco, CA. SEMI. *www.semi.org*

### SEPTEMBER 2022

**10-14 21st International Coating Science & Technology Symposium 2022:** Minneapolis, MN. International Society of Coating Science & Technology; facilitated by AIMCAL. *www.iscst.com*

**11-12 AWA North American Standup Pouch – Narrow-Web Converting Seminar 2022:** Stephens Convention Ctr., Rosemont, IL. AWA Alexander Watson Associates. *http://awa-bv.com*

**11-12 AWA Label Release Liner Industry Seminar 2022:** Stephens Convention Ctr., Rosemont, IL. AWA Alexander Watson Associates. *http://awa-bv.com*

# SUPPLIER INDEX

# HOW MIGHT "100-MPH" DUCT-TAPING OF ROLLERS BE USEFUL…OR A NUISANCE?

Taping of rollers is a very polarizing topic. Some people swear *by* it; some people swear *at* it. So, here we will outline when and where and how tape might be useful, and where it will be, at best, a nuisance.

A first application for duct tape is not really web handling. Rather, it is for quite **temporary emergency repairs**. Yes, there is such a thing as 100-MPH duct tape. It got its name from helicopter pilots in the Vietnam War who occasionally used duct tape to repair a damaged rotor blade. Of course, that was not an FAA-certified repair. In this application, duct tape is used only in the rare cases that were well thought out and applied like your life and the lives of your buddies depended on it to get out of a hot spot and limp back to base where proper repairs could be made.

A second application of 100-mph duct tape is to **simulate grooving**. An example is taping a 10-meter-wide winder drum running 3,000 mpm and that had a crushing nip from wound rolls weighing a dozen tons. Careful thought and theory indicated that the current grooving was not enough. However, you could guess wrong and spend tens of thousands of dollars regrooving a $100,000 drum. Instead, duct tape provided a very good way to simulate grooving **for better air handling**. It is just about the right thickness and, with great care, just durable enough to run a few trial rolls under the most demanding duties. If and when the new "grooving" proved itself, you then would cut metal of a similar geometry. For more modest converting needs, a spiral of masking tape may be a better fit. The roughness of the creped surface of the tape is more than enough to reach up through the thin air boundary to grab ahold of smooth webs traveling above modest speeds.

A third application is to simulate a **concave spreader**. This is a 10-step process, as given in Table 1. Sometimes when I teach in-house classes, we actually go out on the plant floor for hands-on practice of this art/craft/science. At the end of the process, if successful, we might consider cutting the shape permanently into the metal idler roll. Some people think that a computer-controlled lathe cut on the roller will perform better, but tape is the 80/20. In fact, there are at least two cases where tape will *outperform* cutting the shape into metal. The first is where the modulus of the webs run vary widely, in which case you can optimize spreading power by adjusting the number of wraps of tape (amount of concave), which can't be done with metal. The second is for a wrinkle at an angle, indicating there already is an asymmetric pull, meaning you would probably tape one end only.

> "TAPING OF ROLLERS IS A VERY POLARIZING TOPIC. SOME PEOPLE SWEAR BY IT; AND SOME PEOPLE SWEAR AT IT."

**TABLE 1.** *Ten steps to create concave spreading with tape*

| | |
|---|---|
| 1. | Determine which (couple/few) rollers need tape |
| 2. | Tape only well-wrapped rollers |
| 3. | Tape and roller body must both be in traction |
| 4. | One to four wraps of masking tape or similar |
| 5. | Band as much as 5% to 10% of the web width, ends only |
| 6. | Web edge must end on the tape bands, not overhang |
| 7. | Neatness counts |
| 8. | Evaluate results, then with a new operator |
| 9. | Remove tape, restart process, evaluate results again |
| 10. | If consistently helpful, cut that concave shape into idler roll |

## Like your life depended on it

Of course, tape can be messy, even when it is applied with a craft like your life depended on it. It also may need to be reapplied if web width changes (because the tape collars must be at the edges of the web). Finally, QA might object that the tape is not FDA-compliant. No problem – the brief tape trial just teaches us how to cut metal. The web material run, usually a trial of only a few minutes, will be discarded and the machine cleaned up before running production material.

Tape is like cockroaches… Once in the plant, always in the plant. That is why people who do this literally may need to go to school so they don't apply tape for ill-defined and poorly evidenced reasons, such as those beyond the three applications given above. Taping spirals to expect spreading, taping the wrong rollers and taping wrong are all at best a nuisance and, at worst, waste time and make things worse. ■

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920-312-8466; drroisum@aol.com
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# FILTRATION MEDIA

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New Era provides membrane casting and coating lines for the production of supported and unsupported membranes including RO, FO, NF, UF and MF. Systems are built to customer specifications and have included two, three and four coating stations to apply aqueous, organic and surface treatment/protective coatings. Tank systems including single sided and non-contact rolls fabricated from a wide variety of materials have been provided. We have also provided coating and tank supply systems complete with recirculation, monitoring and correction controls. For more information on these and other systems, please contact us by phone, email or through our online portal.

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