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CONVERTING TO  
PRINTED/FLEXIBLE  
ELECTRONICS

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UNLOCKING NEW  
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IMPROVING PACKAGING  
PRODUCTIVITY

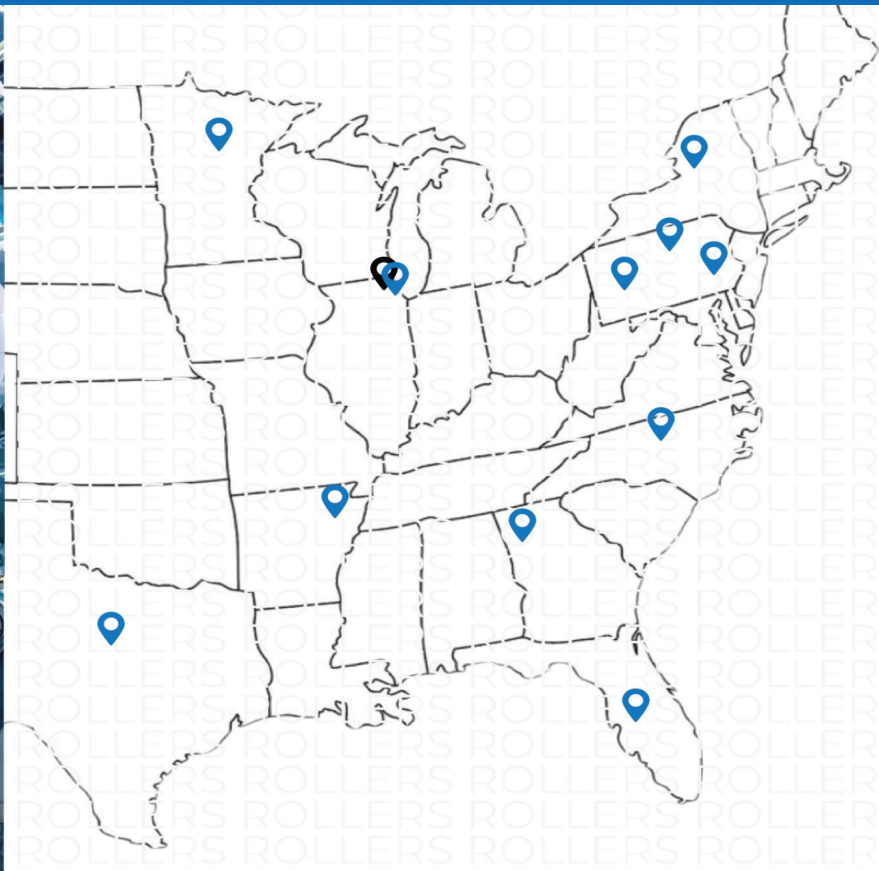
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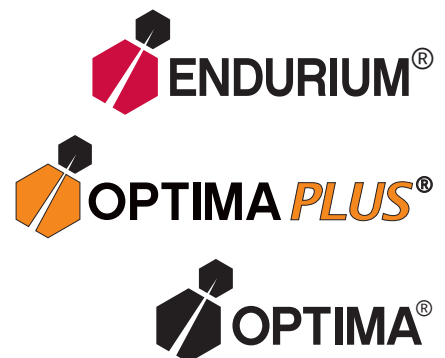


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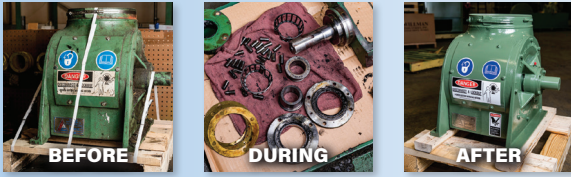
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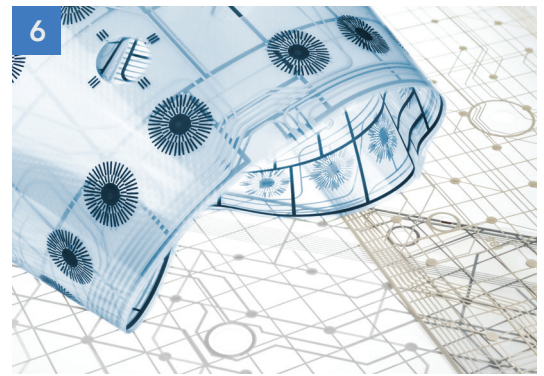


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## “Danger, Will Robinson!”



**Angel Morris**  
Editor

I saw a funny message on Facebook that said, “Life is short. Make sure to spend as much time as possible arguing with strangers on the internet.” I gotta say, it gave me a good chuckle. For one, sarcasm is how I hug; and for two, could its message hit the nail any harder on the head? In the words of *Home Improvement*’s Al Borland — 1990’s TV sitcom sidekick: “I don’t think so, Tim.”

Yet here we are, spending more time than ever trying to “virtually” change folks’ minds. If we post an article perfectly explaining our beliefs, everybody and their dog will come ’round to our way of thinking, right? Or, if we retweet that meme showing how stupid the other side’s thoughts are, they’ll realize their whole life is a lie and jump squarely onto our bandwagon, yes? As ’70s-’80s *Diff’rent Strokes*’ funny guy Arnold Jackson would reply: “Whatchu talkin’ ’bout, Willis?”

While convincing folks online of something other than the norm is touchy, this month’s cover story considers the value of new ways of thinking: Printed/flexible electronics are an alternative approach to conventional printed circuit boards and our author explains why. Our converting expert wraps up a series on winding, offering solutions to seven common roll defects, and we take a look at an often-ignored way to improve packaging productivity ... if you’re willing to think beyond software or hardware investments.

While some are willing to at least consider ideas opposing their own in the workplace, too many of us seem to scroll online with blinders on. And our determination to force our opinion on others has turned many into the worst kind of bully — the one who hides behind a computer or cell phone with little to no consequences for their behavior. Online insensitivity has me choosing to indulge in a different time-killer these days. Lately I’m enjoying nostalgic TV over FB, for drama that may mimic real life but usually works out in the end; and for laughter that doesn’t have to be at another’s expense. Here’s to old-school screen time over modern-day scream time ... and a willingness to recognize not everyone has to enjoy the same show.

“Goodnight, John Boy.”

**Angel Morris**  
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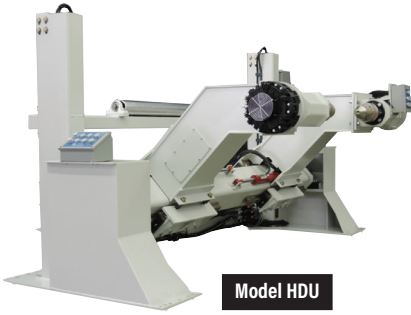
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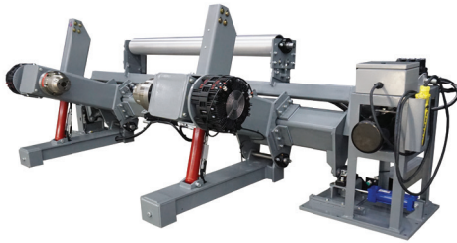
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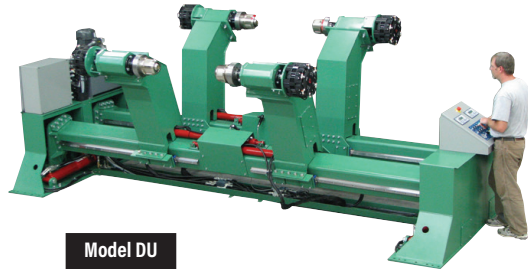
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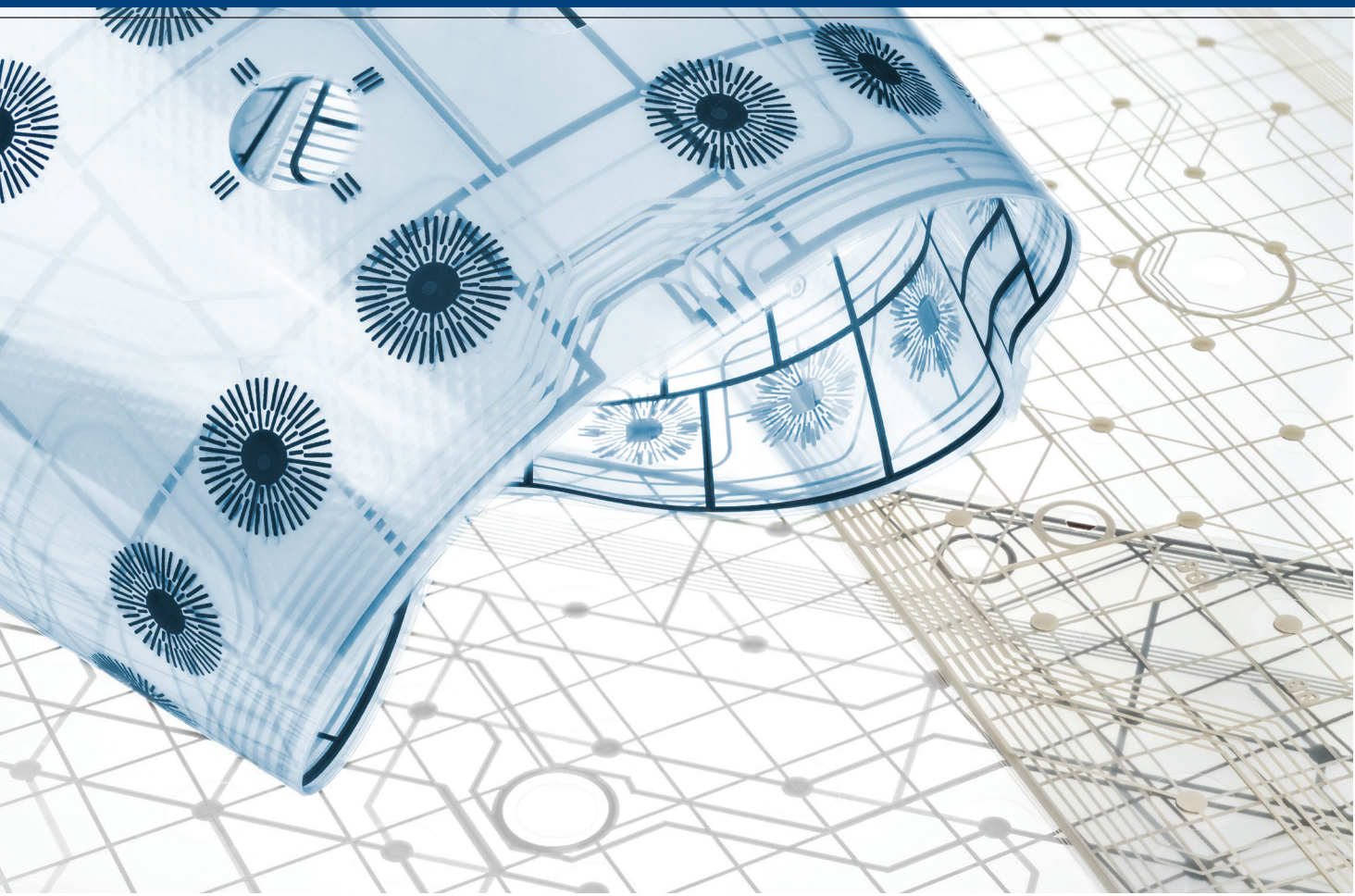


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# Converting to Printed/ Flexible Electronics

By **Dr. Matthew Dyson**, Principal Technology Analyst, IDTechEx

Asked to picture an “electronic circuit,” what comes to mind? Likely a rigid green rectangle with some resistors, capacitors, etc. soldered on top. While conventional printed circuit boards (PCBs) like this dominate the market today, there is an alternative approach that utilizes equipment and expertise from the graphics printing industry: printed/flexible electronics.

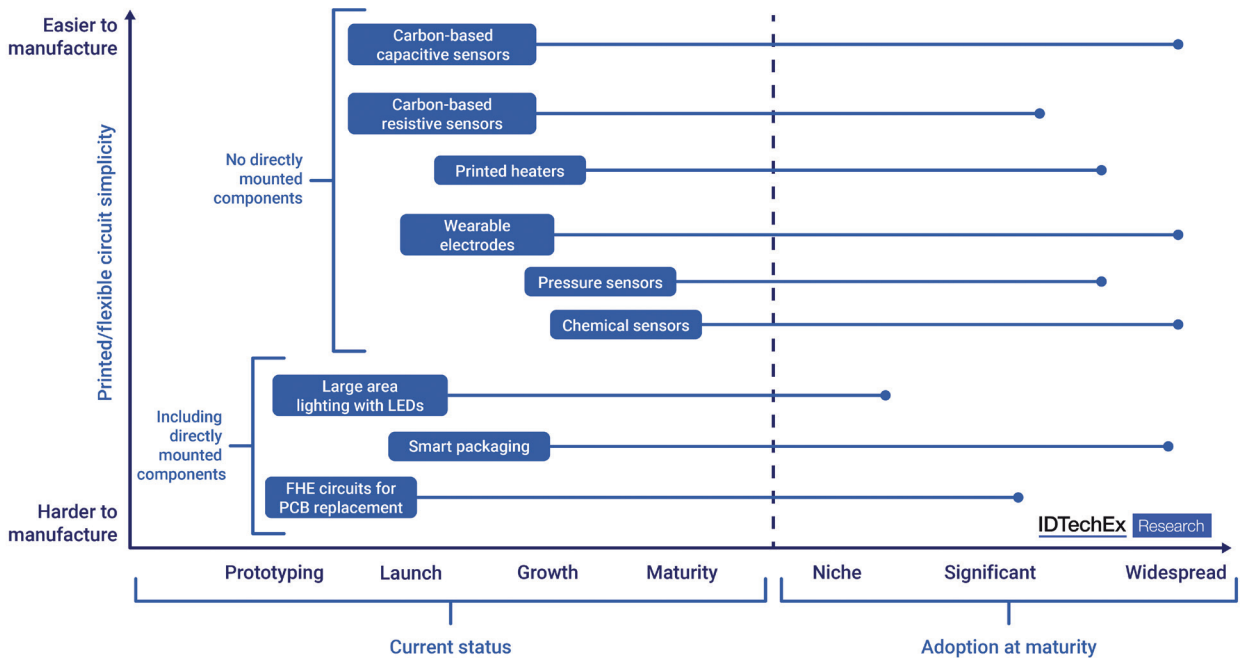
By replacing rigid with flexible substrates and etched copper with printed conductive traces, printed/

flexible electronics offer a distinct value proposition. Circuits can be lighter, produced more cheaply (using digital and/or continuous manufacturing methods), cover large areas, are more sustainable since manufacturing is additive not subtractive, and flexible or even stretchable. As such, printed/flexible electronics enable new applications where conventional electronics are either too costly or where the form factor of conventional rigid PCBs is inappropriate.

## Promising Applications

While printed/flexible electronics is often introduced as an “emerging technology,” it has actually been used for years in some common applications. Seat occupancy sensors in vehicles are a great example, since the pressure sensors need to cover a relatively large area and deform to ensure the seat stays comfortable. Glucose test strips used by diabetics are another large and established market for printed





**Figure 1** Current and potential status of applications for printed electronics, along with their suitability for manufacturing using existing graphical printing infrastructure.

electronics, with billions of strips sold every year.

Existing applications only represent a small proportion of the potential market for printed/flexible electronics. Arguably the biggest growth driver is increasing digitization and the associated demand for data from an ever-wider range of sources — sometimes referred to as the “internet of everything.” Printed/flexible electronics enable low-cost, flexible sensors to be attached to almost any object you can think of, enabling real time monitoring of almost anything you can think of, from the human body to buildings.

Healthcare/wellness is an especially promising sector for printed/flexible electronics, since the flexibility and even stretchability makes wearable sensors such as electronics skin patches much more comfortable. Some applications, such as

pressure-sensitive insoles that can analyze gait in real time, are already available, while replacing bulky wired sensors worn in hospitals with conformal wireless counterparts is an active development area.

### Manufacturing Methods

Given the wide range of length scales and throughputs required, an almost bewildering array of printing methods can be used to produce printed electronics. Analogue methods, which repeatedly impart an initial design and are suitable for high volume production, are broadly similar to those used in conventional graphics printing: screen printing, flexography, gravure, offset-lithography, pad printing. This commonality provides a great opportunity for companies with the relevant expertise and equipment to branch into the emerging printed/

flexible electronics industry.

There are also multiple digital printing methods that enable direct control of the printed pattern. While inkjet printing is well-known, other emerging methods such as aerosol printing, laser-induced forward transfer, electrohydrodynamic printing and impulse printing are targeted primarily at printed electronics. These methods typically bring a distinct benefit, such as the ability to apply ink without contact to 3D surfaces, handle a very wide range of viscosities or print extremely narrow (1µm) traces.

Screen printing is by far the most widely used of all the printing methods. Unlike most other approaches, it is compatible with high viscosity conductive inks, which enables sufficiently thick traces for the desired conductivity to be deposited in a single pass. Further-

## Segmenting the Electronics Manufacturing Space

	Additive	Subtractive
Digital	<ul style="list-style-type: none"> <li>• Inkjet printing</li> <li>• Extrusion</li> <li>• Laser induced forward transfer (LIFT)</li> <li>• Electrohydrodynamic (EHD) printing</li> <li>• Aerosol</li> <li>• Impulse printing</li> <li>• Print-then-plate</li> <li>• Laser direct structuring (LDS)</li> </ul>	<ul style="list-style-type: none"> <li>• Laser etching</li> <li>• Focused ion beam (FIB) etching</li> </ul> <p>IDTechEx Research</p>
Analogue	<ul style="list-style-type: none"> <li>• Screen printing</li> <li>• Flexography</li> <li>• Gravure printing</li> <li>• Offset printing</li> <li>• Reverse offset printing</li> <li>• Pad printing</li> <li>• Chemical and physical vapor deposition</li> </ul>	<ul style="list-style-type: none"> <li>• Photolithography (chemical etching)</li> <li>• Mechanical etching</li> </ul>

**Figure 2** Segmenting electronics manufacturing methods into additive (i.e. printed) vs. subtractive and analogue vs. digital.

more, the same technique can be used economically across a range of production volumes, with flat-bed screen printing for small batches and rotary screen printing for high volumes.

Of course, an electrical circuit is more than just the conductive traces. Some functional components, such as sensors, batteries or even photovoltaic panels can be printed directly onto the same substrate, but integrated circuits (ICs) that provide data processing capability typically need to be

produced separately. This requirement can be resolved with two competing approaches: flexible hybrid electronics (FHE) which utilizes pick-and-place technology from the electronics industry to mount components onto flexible substrates, and connecting a fully printed circuit to a conventional PCB. For companies looking to leverage printing expertise into the electronics space, partnering with a contract PCB producer to employ the second approach is likely to be more straightforward.

### In-line Quality Control

While quality control is of course important for graphics printing and converting, the demands for printed/flexible electronics are more stringent. Rather than just an aesthetic blemish, an issue with print quality could cause the entire device to fail, making any mounted components or other comparatively expensive parts such as batteries redundant. In-line quality control is especially important with continuous manufacturing, since an

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undiagnosed problem could lead to large volumes of material, including expensive conductive ink, being wasted.

To address this challenge, various quality control methods are utilized or proposed. Machine vision is arguably the most straightforward, with video of printed conductive traces automatically checked for cracks or defects. If the circuit is stationary, perhaps only temporarily, electrical connectivity can be tested with flying probes that are controlled from above to contact specific locations. A particularly innovative quality control method is applying spectroscopy to determine conductivity without electrical contact. Similar to CMYK calibration bars used to check conventional print quality,

a “test pattern” is printed and the reflected radiation analyzed.

### Leveraging Existing Capabilities

Printed/flexible electronics provides a great opportunity for printing companies to leverage their existing capability to produce new, often higher-value products. Indeed, some companies with a background in graphical screen printing are employing this strategy, with sensors a common application.

Arguably the best approach, at least initially, is to focus on producing circuits where all the functionality can be printed, rather than introducing the complexity of integrating pick-and-place of electrical components. For companies

with high volume roll-to-roll capabilities, focusing on the simplest applications (such as moisture or touch sensors) or those where large areas are required will likely be the most promising. ■

#### ABOUT THE AUTHOR

Dr. Matthew Dyson is Principal Technology Analyst at IDTechEx ([www.IDTechEx.com](http://www.IDTechEx.com)), which supplies market research and intelligence via reports, subscription and consulting services covering a wide range of emerging technologies. Matthew focuses on printed/flexible/3D electronics and how these manufacturing and material innovations facilitate disruptive technologies such as electronic skin patches, smart packaging, digital manufacturing and smart surfaces.

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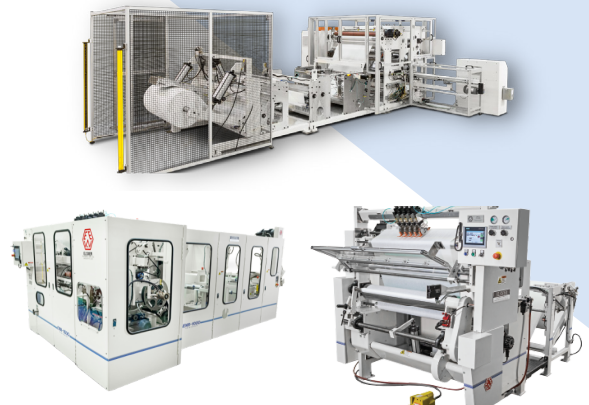
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# An OEM Perspective on Industry Changes and Trends

Q&A with Nordmeccanica's Giancarlo Caimmi, Corporate Commercial Director

**The converting industry is experiencing higher demand for packaging, sustainability along with shortages in raw materials and the workforce making capital equipment investment decisions difficult for the converter. What is Nordmeccanica's perception regarding current market demand?**

As the largest global provider of coating and laminating machinery to the industry, we install more than 250 new units every year — more than one new machine every work day of the year. This is, by far, the largest data base in our industry and, consequently, the one that reflects with the highest degree of reliability the state of the industry.

At primary level of analysis, two main factors influence current market demand for machinery: Capacity (the number of new installations in the high productivity range and the increased number of orders for new machines) and sustainability (the growth in the segment of low energy consumption and low emissions machines to include machines intended for new packaging technologies).

**What is intended for high-productivity machines?**

In coating and laminating



there are two main categories of converting equipment to serve the industry: What can be described as “full automatic” range and the category of “compact equipment.” The first includes all machine configurations that, starting with full automatic unwinds and rewind and based on machine technology set up, are intended to serve the segment of long runs; High production speed, non-stop operations, single pass for multi-stage conversion processes.

The second group includes stop-and-go set up — a category introduced to the industry by this firm back in 1992 and intended for compact dimensions, single operator, quick ROI to serve for short-medium runs and flexibility. The significant growth recorded in the full-automatic segment on a global scale but primarily in North America testifies to a market trend: The trend

of capacity within the high-tech segment of packaging that includes multi-layers lamination, lamination, in line-coatings, etc.

Complexity of the packaging grows as brand owners target longer shelf life and better product protection. In fact, while in the industry, we all are working toward sustainability, the market reality is more conservative and focused on practical goals.

There is a logical explanation behind why converters are investing in configurations that allow production of three-layer laminate in highly automated conversion lines: A multi-station coater-laminator offers a significant degree of flexibility. Consequently, not only three-ply single pass but also two-ply and a coat in a single pass or two coats in a single pass.

The projection of flexible packaging toward a reduced number of layers is now switching to a process where coated layers are replacing substrate layers. This firm conceives every multi-station machine be set up as a flexible device that can laminate or coat in each station, in order to quickly adapt to whatever flexible packaging evolution the industry may conceive ... A class of machines to serve the current market demand but ready to serve every future evolution of the industry.

**Can you address sustainability pertaining to covering many aspects of machine design?**

Sustainability in flexible packaging covers both machine design and product specifications. In machinery we are looking into energy savings, scrap reduction



One of the Tandem Coating and Laminating lines installed during the pandemic.

and the ability to handle thinnest webs. Among the contribution of this firm to sustainability we can start with solvent-less lamination, a technology that has grown to cover most of the lamination conversion globally.

Primarily, we developed and patented the coating head handling high viscosity adhesive, then engineered the web handling technology offering an unsurpassed level of reliability ... Technical solutions that allowed solvent-less lamination to grow to the current market share with sustainability-related benefits being: No emissions, very low energy consumption and high productivity.

We then introduced high-efficiency ovens for emission-based processes requiring drying, for low energy consumption, higher productivities, lower solvent retention and, consequently, lower scraps. In a wider approach the web handling technology we developed serves not only the solvent less business. All the know-how developed during these past 45 years is reflected in the ability to serve the industry with machinery suitable to run a large range of webs and thicknesses down to the thinnest ever used in the industry. I like to mention foils down to .000196" and sealants down to 1/3 mill (demonstrated to customers at live events and at trade shows) and by far the most advanced set up available.

Toward energy saving, we must list technologies to reduce power consumption while optimizing process handling; Technologies we adopt in our standard set up and that we engineer through partnership with leading suppliers. Siemens has rated Nordmeccanica as a trend setter in the converting industry and we are used as a part-



Installing a Tandem line at Constantia Mexico by remote connection.

ner in the development of specific applications.

### **What about the development of sustainable packaging solutions?**

On the flexible packaging product specification side, an OEM needs to partner with other players within the supply chain to conceive, engineer and implement not a single machine but an entire innovative process. Current targets are toward recyclability ... not only the reduction of layers but also the reduction of polymers involved, all the way down to "single material" pouches.

We are involved in some of the most advanced R&D projects: One featured the public distribution of pouch samples made out of two layers of a single material and a few coatings, at K show in Germany and at Pack Expo Chicago. This fully recyclable pouch offers three-layer like barrier properties.

Such technical solutions are still quite expensive to convert and are influenced by the lack of clear governing authority guidelines. Consequently, commercial applications are still few. What is not in discussion is that such set up will be the base of future sustainable flexible packaging development.

Last but not least, we must mention the constant growth in the use of paper in flexible pouch manufacturing. Paper requires not only alternative approaches in web handling but also the implementa-

tion of technologies (for example, laser die-cutting) to make the paper-based pouch competitive to standard film-based ones. We have provided the industry with such applications and have to register a constant increase in installations for coaters and laminators.

### **How did you address pandemic-related challenges?**

We actually kept our production schedule free of any delay, including installation and startups. Our production enjoys the benefits of integration. We work on long-term supply chain agreements, with even the shortage of micro-chips having no impact.

On the startup and installation side, we were helped by our totally digital set up. Even complex tandem and Triplex installations have been successfully handled remotely. We had some significant delays in freight, especially to North America, but our customers understood that it was not our fault.

For service calls that required the presence of an engineer (because of the age of the machine or because of the mechanical content of the call), we had a few travel restriction delays that were still understood by our customers. We cannot express how grateful we are for their continued support, as well as for our Nordmeccanica employees who go beyond the call to best serve our valued customers. ■



# How Flexographic Printing Can Unlock New Packaging Potential

By **Michele Laird-Williams**, Director, Regional Field Marketing, Miraclon

It's a challenging business climate right now, and the world of packaging is no exception. Stretched supply chains, rising material costs, increased regulation and sustainability concerns — there's no shortage of headwinds facing the industry, and like all other sectors, flexo trade shops

and converters are having to adapt to a fast-changing, increasingly unpredictable world.

According to the latest assessment from print industry specialists Smithers, despite the challenges, the future of flexo still looks bright. In their *Future of Flexographic Printing to 2027* report, flexo is

forecast to grow at 2.1 percent over the next five years, with the market totaling \$205 billion by 2027<sup>1</sup>.

In 2022 alone, global output will reach 449.7 billion square meters<sup>2</sup>. Sales of flexo presses will increase by 1.4 percent per year to 2027<sup>3</sup>, with further growth from rising demand for flexo inks, consumables, plates and sleeves<sup>4</sup>.

But if there's one area where flexo looks set to flourish even through the toughest of times, it's in packaging innovation — an ever-growing focus for brands where flexographic printing can press its advantages.

## Packaging Prioritized

Globally, flexible packaging is the fastest growing of the nine major applications tracked in Smithers' analysis — and for Laurel Brunner, Managing Director of Digital Dots and a Global Flexo Innovation Awards (GFIA) 2021/2022 judge, that comes as no surprise.

"In today's retail environment, packaging has become so important because the package is the primary interface between a brand and their customer," explained Brunner. "It's the only part of print that cannot be replicated online: You have to have something to hold your product and deliver your goods. But nowadays, brands face complex choices. They need to think about sustainability and environmental impact, for example, as well as the need for financial viability and cost control."

In Brunner's opinion, that's why packaging is witnessing an exciting new wave of innovation.

## Flexo's Shifting Substrates

"There's tremendous innovation happening around substrates, espe-



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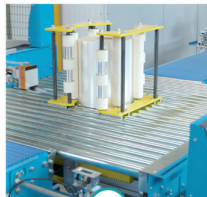
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cially more sustainable substrates, which are crucial in developed markets,” Brunner said. “But you also have to consider factors like supply chains, material sourcing, efficiency, food safety, standards, regulation. Finding a substrate that can deliver in all these areas is really complex, and it’s fascinating to see how science and research are driving things forward.”

For some flexographic printers and brands, the search for new substrates has manifested as part of the transition away from plastics towards paper. For others, it’s meant moving away from multi-layered, laminated substrates (which usually aren’t recyclable) towards single, PE-based ones (which often are).

Biodegradable pouches, compostable bags, ever-thinner plastics, lighter substrates: The innovations have come thick and fast — and for Rodney Pennings, Director of Sales at PCMC, a global converting equipment producer founded in the U.S., that’s where flexo presses have

the edge. Their capacity to handle unusual substrates, at high speeds, over variable volumes and with complex ink coverage, has allowed his customers to achieve results that continue to surprise even multi-decade print veterans like him.

“There are things we’re doing now that two years ago I would have never thought were possible,” Pennings noted. “More than that, actually — we’re doing things I wouldn’t even have known to ask for! Whether it’s working with thinner substrates, or PE structures or even paper pouches, we’re creating packaging solutions today that just wouldn’t have been achievable even a year or two ago.”

### Meeting Change with New Flexo Technology

But as always, progress inevitably brings challenges. Working with many of these new substrates, Pennings explained, has required printers to come up with new ways of working — whether that means

using more AI and automation to enable a printing press to automatically adjust for consistent output, or experimenting with different inks, plates and drying processes to better regulate color and coverage.

While the adaptation hasn’t always been easy, flexo presses have played an important role in making the transition viable. Pennings points to the better opacity, lower ink usage and lower drying times as financial gains from flexographic printing, without losing out on quality.

“The innovations that Miracron has made with their KODAK FLEXCEL NX Plates, FLEXCEL NX Systems and Software are just incredible. We’re now able to dry at lower temperatures; we can achieve better opacity results with lower ink usage; and most importantly, we can still get that all-important ‘pop’ with our imagery — the vibrant graphics and even surface coverage that means a strawberry still looks like a strawberry you’d actually want to eat.”

### Delivering Results

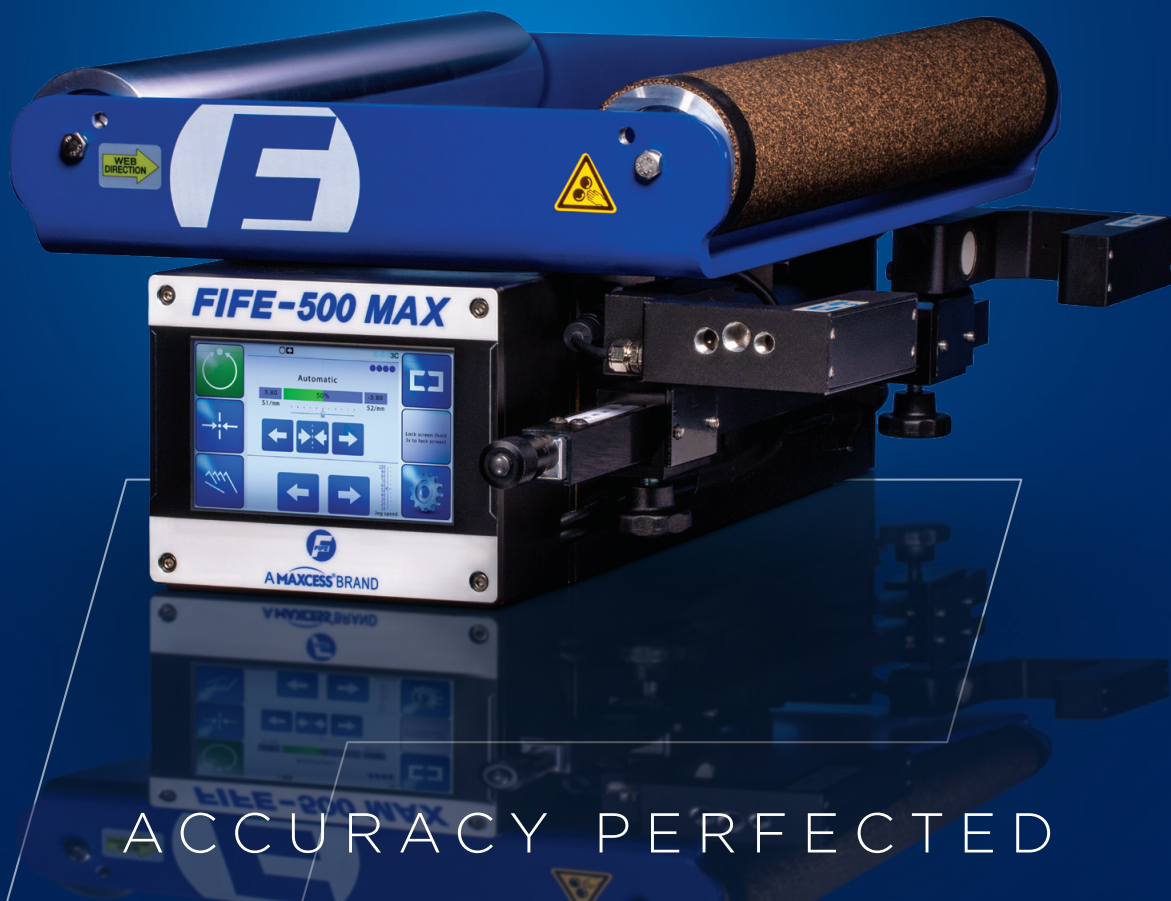
Flexographic printing’s ability to deliver high-quality results on unusual substrates is something that’s crucial for Anand Patel, director at Pentaflex, an Indian flexible packaging specialist.

For his customers, recyclability is the major concern: A raft of new industry regulations are forcing brands to transition away from traditional plastics towards thin polyethylenes (PE) that are more easily recycled. In this kind of application, gravure and offset machines can struggle.

“For me, flexo really comes into its own when you’re working with PE,” Patel explained. “Here



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in India, when this big shift started to happen, we were in the right place at the right time with the right machines.”

Pentaflex moved into flexo printing technology with the FLEXCEL NX System and CI flexo presses from German press manufacturer Bobst several years ago.

“This opened up a lot of avenues for working with these new recyclable substrates,” Patel said. “When clients came to us demanding flexo-printed polyethylene film with a quality that matched gravure, we were absolutely able to help them with that.”

So whether it's using recyclable plastics, paper-based products, reduced inks or less resource-intensive materials, flexo is allowing printers to make big strides towards a more sustainable future. Laurel Brunner is excited about what's to come.

“Print has always been an industry that has faced challenges, and managed to change and adapt in order to meet them. But science is where the innovation really happens,” she noted.

“Think about a package that looks phenomenal on white paper, but then you want to use cardboard. How do you manage that so the content looks the same on both substrates? That comes down to science. And in my opinion, the most interesting science of all right now is happening in the world of substrates. I really can't wait to see what comes next.” ■

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- 2 <https://www.flexography.org/industry-news/data-from-smithers-latest-five-year-industry-outlook/>
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### ABOUT THE AUTHOR

As Director, Regional Field Marketing at Miraclon, Michele Laird-Williams is responsible for leading the global field marketing team, demand generation campaigns and field marketing strategies. With more than 30 years' experience in the print industry, Michele's career spans roles in Sales and Marketing management and leadership in the U.S. and Canada. She holds a BA in Economics from State University of New York, Potsdam and Master's in Business Administration, Marketing & Finance from University of California, Irvine.

# Understanding Corona Treating with QC Electronics

## What are factors that affect corona treatment that should be observed and understood?

Several factors can affect corona treatment and should be observed and understood to achieve the desired surface modification. Here are some factors that can affect corona treatment:

**1. Material Type:** The type of material being treated can impact the effectiveness of corona treatment. Non-porous materials like plastics and metals are more suitable for corona treatment than porous materials like fabrics and paper.

**2. Surface Characteristics:** The surface characteristics of the material, such as its roughness, porosity and composition, can impact the corona treatment process. Surfaces with low surface energy, such as those containing low surface tension additives, require higher power settings.

**3. Treatment Conditions:** Treatment conditions such as the corona discharge power, frequency and exposure time can significantly impact the surface modification of the material. The optimal conditions for corona treatment depend on the type and characteristics of the material being treated.

**4. Atmospheric Conditions:** The atmospheric conditions, such as temperature, humidity and air composition, can impact the corona treatment process. High humidity can reduce the effectiveness of corona treatment, while dry air can improve the treatment. It is important for corona treaters to be able to accommodate high humidity environments.

By understanding and observing these factors, it is possible to optimize the corona treatment process for specific materials.



**Alyxandria Klein**  
Marketing and Sales Director  
QC Electronics

What are key factors converters should pay attention to when choosing a corona treater manufacturer or supplier?

When choosing a corona treater manufacturer or supplier, converters should pay attention to several key factors to ensure they get the best product and service. Here are some factors to consider:

**1. Expertise and Reputation:** Look for a manufacturer or supplier with a good reputation and expertise in corona treatment technology. Consider their experience in the industry, the quality of their products and their level of customer service.

**2. Customization and Flexibility:** A good corona treater manufacturer or supplier should offer customizable solutions that can be tailored to the specific needs of the converter's operation. They should be able to provide solutions that are flexible enough to accommodate different materials, applications and production requirements.

**3. Technology and Innovation:** Look for a manufacturer or supplier that can provide innovative solutions that can enhance production efficiency and reduce costs.

**4. Technical Support and Service:** A reliable corona treater manufacturer or supplier should provide technical support and

service to help converters install, operate and maintain their equipment. They should offer training and troubleshooting assistance, spare parts availability and on-site service if necessary.

**5. Cost-effectiveness:** Cost is always a consideration when choosing a corona treater manufacturer or supplier. Converters should compare the pricing of different suppliers and consider the overall value they provide in terms of quality, customization, innovation and service.

## How can I accurately measure surface energies?

Surface energy is a key property that determines how well a material can bond with another material. Dyne testing has been a commonly used method to measure the surface energy of a material. However, the accuracy of dyne testing has been widely debated, and it is now understood that surface analyzation devices should be used instead. Surface analyzation devices use objective and automated methods to measure the surface energy of a material. These devices use a variety of techniques, such as contact angle measurement or surface energy mapping, to provide accurate and reliable results. These devices can also measure the surface energy of a wider range of materials, including metals, ceramics and polymers. QC Electronics offers free surface analyzation and reports. This service provides valuable information to companies and manufacturers, helping them to optimize their printing, coating and adhesion processes.

*More questions? Struggling with adhesion and need advice? Contact [sales@qcelectronics.com](mailto:sales@qcelectronics.com).*

# Winding: Part 5

## *Solutions for Common Wound Roll Defects*

By **Neal Michal**, Principal, Converting Expert, LLC

Wound roll defects are anything that results in a disappointed customer. Seven common defects will be presented here based on severity. Tacky webs tend to block. Narrow slits tend to dish. Slick webs tend to telescope. Larger rolls tend to be floppy. High loft webs will experience caliper loss. Web width will vary on webs with high Poisson ratio. Concentric rings are one example of a visual defect.

Roll defects are a result of the physics of winding, the resulting wound roll structure and web properties. Review the previous articles in this series: Part 1 - Wound roll structures; Part 2 - Document thru-roll stress and strain; Part 3 - Winder TNTs and Wound-On-Tension; Part 4 - Best Practices. My previous series on Material Properties provides information on important material properties and how to document the entire roll.

### Blocking

Blocking is common on tacky films, adhesive laminates, elastics and foam. First, identify the root cause. Is it the chemistry, high temperature or simply wound too tight? If blocking is only near the core, reduce local TNTs or wind on larger cores. Reduce web

temperature entering the winder. Increase topography on a film to introduce air into the roll. Ask for different chemistry. Try different lay on nip roll covers and nip load. Consider winding in a sacrificial layer or refrigerated shipping for high value webs.

### Dishing

Dishing is common on narrow slits. Identify the root cause. Does it occur during winding, in storage or after shipping? A detailed study of roll handling, packaging, shipping and aging may be required. Increase the width-to-diameter ratio. Loosely wind web into wide parent rolls, age and then slit, rewind. Reduce tension or nip. Add center assist torque. Develop improved packaging and handling techniques.

### Telescoping

Telescoping is common on slick webs. This defect is a result of low torque capacity which is a function of Web-Web COF, Interlayer pressure and the Roll OD/Core OD ratio. The minimum torque capacity will typically be 1-2 inches from the core.

Telescoping during unwinding is more common compared to winding. Document the slip

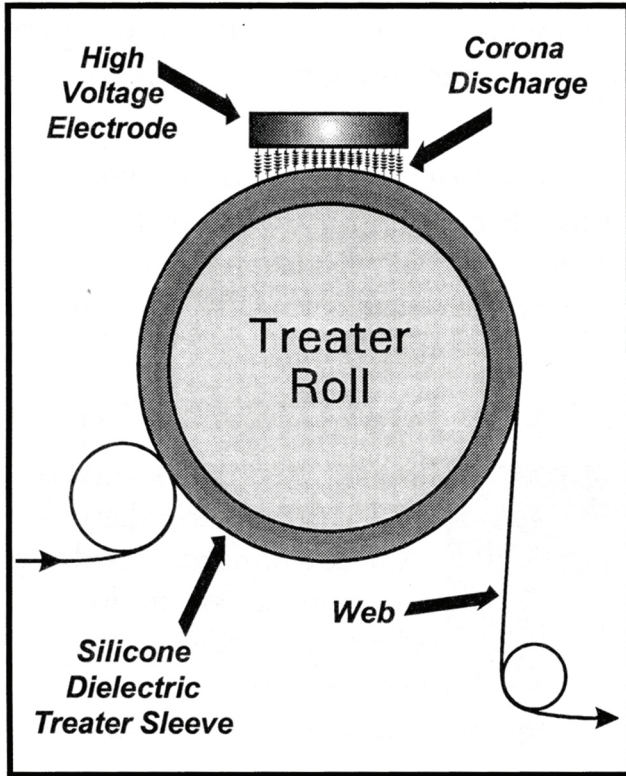
plane diameter. Strike a line across the roll before unwinding. Note the diameter where the roll slips. Document your interlayer pressure. Determine if there is a discontinuity in the winding process at this diameter. The standard approach is to increase Winder TNTs out beyond this location. Try reducing tension or acceleration rate on the unwind. If your roll is heavy, add a motor to start the roll from a dead stop.

If the roll slips during winding, try increasing nip load, then tension near the core. Add center assist to provide torque to the building roll. On a continuous winder, bring the roll to a more gradual stop. Eliminate any sudden TNT changes near the slip plane. Don't stop and restart in the middle of a roll. Consider winding on larger cores or winding a smaller roll OD. If possible, increase the web-web coefficient of friction.

### Floppy Edges, Baggy Lanes, Web Camber

Poor "Lay Flat" is the most common cause of wrinkles. It is ubiquitous across all web processes. The root cause will be a persistent cross deckle (CD) variation. Most likely suspects include caliper, basis weight, moisture or temperature. Identify and reduce cross deckle variations. Reduce roll

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96252	2.5"	64 mm	59 mm	Orange	.118" (3.0 mm)	\$1.85
96302	3.0"	76 mm	70 mm	Orange	.080" (2.0 mm)	\$1.85
96402	4.0"	102 mm	95 mm	Orange	.080" (2.0 mm)	\$2.25
96602	6.0"	152 mm	141 mm	Orange	.095" (2.4 mm)	\$3.15
96802	8.0"	203 mm	190 mm	Orange	.102" (2.6 mm)	\$4.55

\*These sleeves will fit any treater roll OD within +/- 0.125" (3 mm) of listed size.

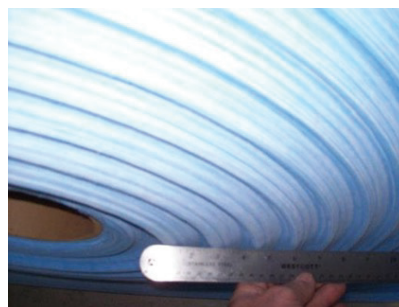
Wall thickness variance: +/- .006"  
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Visual Defect Examples

density. Reduce web temperature before entering the winder and in storage. If possible, wind the web loose; allow it to age and rewind it to final dimensions.

### Caliper Loss Near the Core

It is common for high loft webs to experience 25-60 percent caliper loss near the core. Thru-roll caliper is a function of the interlayer pressure profile (ILP). Measure ILP and correlate to average roll density. They will be related. Implement coreshaft relieving for surface winders. Trial three increments of lower roll density. Repeat measurements. Increase core OD or reduce Roll OD. Reduce the web temperature or moisture before the winding process. Control temperature or moisture in storage.

### Slit Width Growth

Webs with high Poisson ratio will tend to grow laterally. The width

thru the middle of the roll will increase. Document how width varies as a function of diameter and after aging. Reduce wound on tension. Replace draw control with tension loop control. Reduce web temperature before the winding process and in storage. Consider refrigerated shipping when called for. Use a large taper tension on the last 10 percent of the roll length to salvage the material near the outside diameter.

### Concentric Rings

Concentric rings on the slit edge of the roll is one example of a visual defect. It may not cause a converting issue. Concentric rings are common when nip load changes. Measure friction in your winding arms and coreshaft rolling resistance on the kitchen rail. Remove debris from or replace damaged kitchen rails. Lubricate the pivot points. Replace worn or damaged parts. Surface winders

benefit from sloping the kitchen rails away from the winding drum. If the rings only appear near the outside of the roll, increase drum to web traction or nip load. Adding a center assist motor to provide torque to the coreshaft is a proven solution to building larger rolls with improved consistency.

This concludes our five-part winding series. Thank you for reading and please do not hesitate to contact me at the email below with any questions. ■

### ABOUT THE AUTHOR

Neal Michal of Converting Expert is a well-known authority in web handling, process design and optimization. He worked with the Web Handling Research Center for 20 years. Currently serving as a technical advisor with AIMCAL, he can be reached at [neal@convertingexpert.com](mailto:neal@convertingexpert.com) or through [www.convertingexpert.com](http://www.convertingexpert.com).

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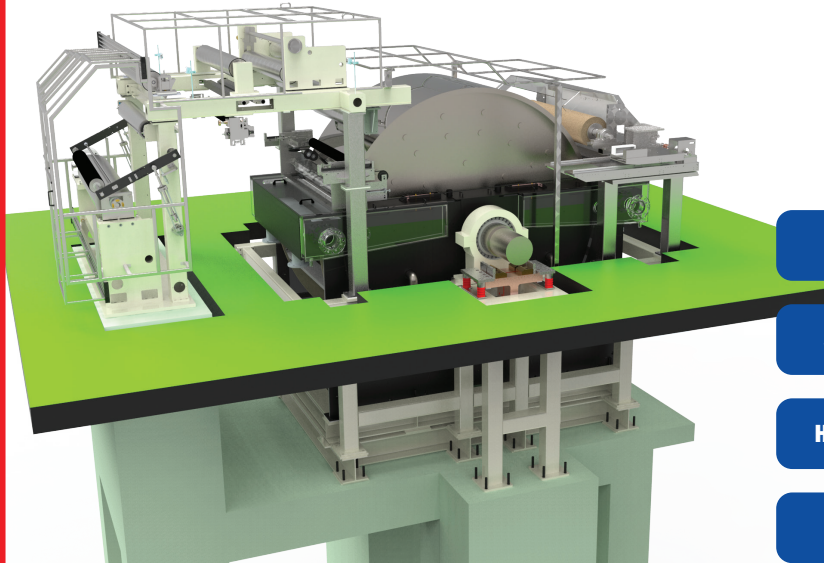


Ultra Thin Battery CU Foil: 4.5 $\mu$ m

Super High Temp. Elongation: 15%

HVLP (High Very Low Profile): 2.0 $\mu$ m

RCC (Resin Coated Cu Foil)



**Machine Name:** Lithium Battery Copper Foil Electro-deposition Machine

**Web Thickness:** 4.5 $\mu$ m ~ 15 $\mu$ m

**Electric Current:** Max 60,000A

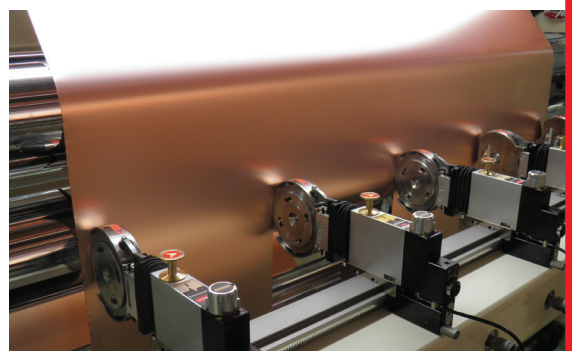
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# The Importance of Roll Cleaning and Maintenance

A question-and-answer with Joe Walczak, President of Sonic Solutions.

## What are the main types of roll cleaning methods and the differences between them?

**Walczak:** There are really three types of cleaning processes in the marketplace: wash/blasting, laser and ultrasonics methods.

With wash/blasting methods you're taking a cleaning solution or other particle like sodium bicarbonate and forcing it under high pressure against the roll. The hope is that the pressure will chip or wash away built up dirt. These systems are typically big, bulky and expensive. With bicarbonate blasting systems you need to be careful about the white powdery substance getting all over the plant in case of a leak in the pressure system. They're not that common anymore.

Laser cleaners basically burn dirt and debris off the roll. At these high temperatures, contaminants are basically evaporated off and turned into dust. These systems are the most expensive in the marketplace and have a good niche with the largest of anilox rolls – 7 feet or longer – as well as rolls that don't come off the press easily. Repairs to these systems can be quite costly due to the type of technology used, easily exceeding \$100,000.

Ultrasonic systems have evolved into a great way to thoroughly clean anilox rolls. The cleaning solution works to soften debris in the cells of the anilox and then the ultrasonics gently and safely vacuums dirt off the anilox. Ultrasonics is a proven technology used in numerous industries where precise cleaning is needed and required, such as, hospital operating rooms, NASA and the space industry. It's a simple but effective way to clean an anilox. Ultrasonic cleaning systems for anilox rolls vary in cost depending on size of rolls. They can range from under \$10,000 for small 16-inch anilox rolls to under \$40,000 for a 72-inch sleeve.

## What problems are associated with inconsistent or improper roller maintenance and cleaning?

**Walczak:** Maintaining an anilox roll is of great importance. Every label company has as its highest priority to get label customers, print labels and keep that customer coming back. Maintaining your anilox rolls won't necessarily help get customers, but it can impact printing labels and keeping customers.

The anilox roll is one of a few factors with a direct impact on labels. If an anilox is dirty then it's not delivering the right amount of ink to the label. That will impact colors. If press operators aren't getting the right density of color, then that press is running bad labels or



sitting idle while the operator is hunting for the problem. Those bad labels and idle time cost the company money. Using clean anilox rolls each time a press is set up to run a job will be one big headache operators will avoid. Keep your rolls clean!

## What solutions can your company provide to address these problems?

**Walczak:** Well that's specifically what Sonic Solutions provides. For over 20 years we've provided quality, durable, safe and inexpensive cleaning alternatives for anilox rolls. Thousands of customers throughout the world rely on our equipment daily to keep their anilox rolls clean. Some larger customers have several units side by side with rolls going on and off the system all day long. They'll clean rolls after every press run so they know colors will come out right on target each time.

## What key factors should converters keep in mind when choosing roller cleaning solutions?

**Walczak:** When seeking a solution to keep anilox rolls clean, consider lots of factors: Reliability. Safety for your anilox. Price. Ease of use. What have your operators used in the past? And service.

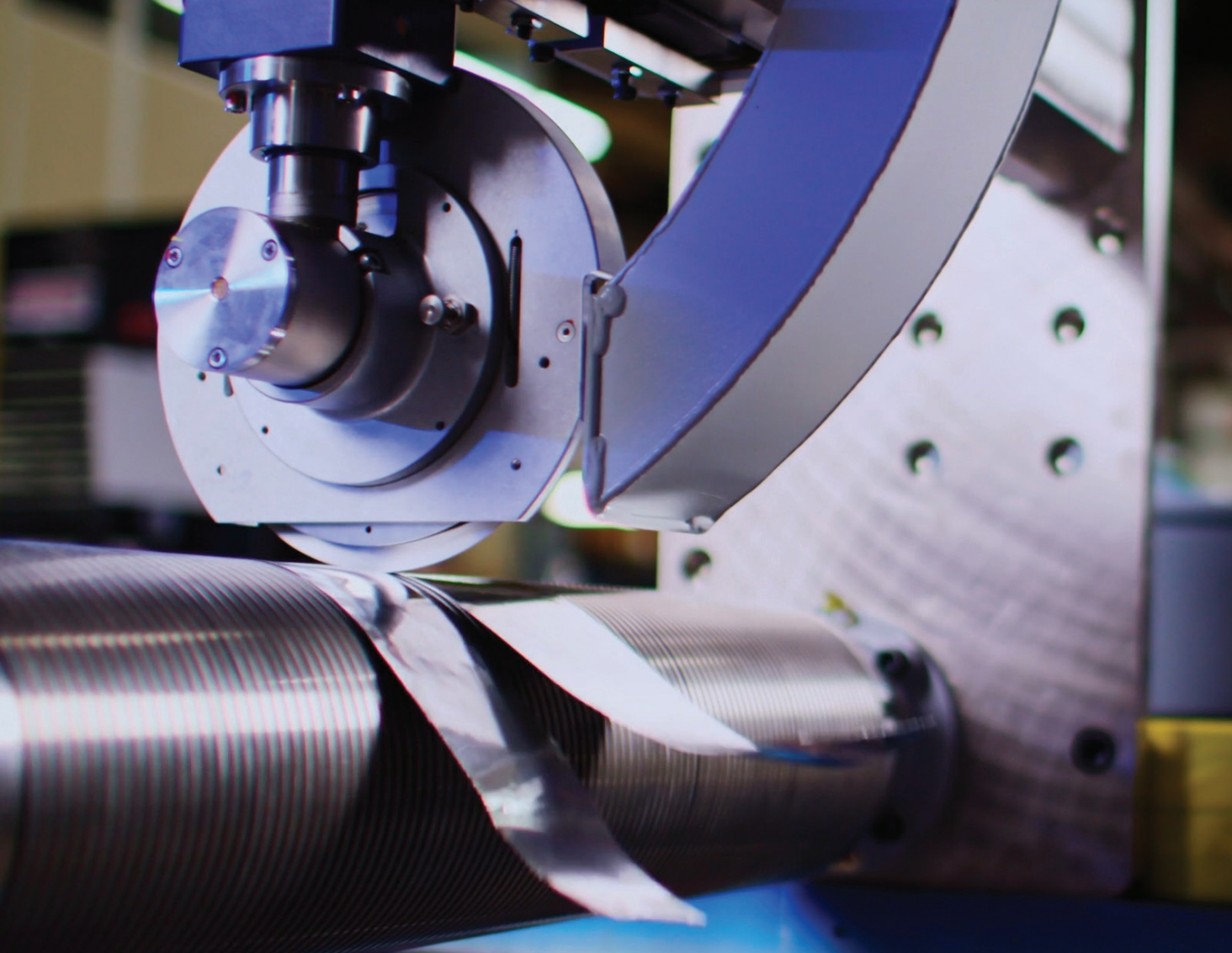
Sonic Solutions scores an A+ in each of these categories. Customers come back to us time and again to help them. We take pride in providing the most personal service we can and solving cleaning problems, big or small.

## Anilox sleeves are becoming prevalent in the wider web presses. Does Sonic Solutions have a product to service these?

**Walczak:** Our Phoenix line of cleaning systems is uniquely designed to work exceptionally with anilox sleeves. We can custom make a system to clean either one or two sleeves at one time. These systems' quality is equivalent to the standards we keep with our smaller systems. But the most impactful part of our sleeves systems is price. Our prices are less than half the cost of wash or laser systems. When wash and laser systems for sleeves can exceed \$100,000 easily that means a lot.

*Joe Walczak co-owns Sonic Solutions with his wife, Marie, and they have been helping flexo printers for more than 25 years. They can be reached at [Joe\\_Walczak@SonicSolutionsUSA.com](mailto:Joe_Walczak@SonicSolutionsUSA.com), [Marie\\_Walczak@SonicSolutionsUSA.com](mailto:Marie_Walczak@SonicSolutionsUSA.com) or (877) 654-7800.*





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# A New Slitter

*An Often-ignored Way to Improve Packaging Productivity*

By **Garrett Taylor**, Sales Director, SOMA North America

The introduction of faster, wider and more automated printing presses creates a challenge for the printer/converter when it comes to supporting equipment. From plate mounting to clean up, the printer/converter needs ways to be more efficient. A sometimes overlooked area is slitting, where an operator takes multiple lanes of printed or unprinted film and “slits” them down to single lanes.

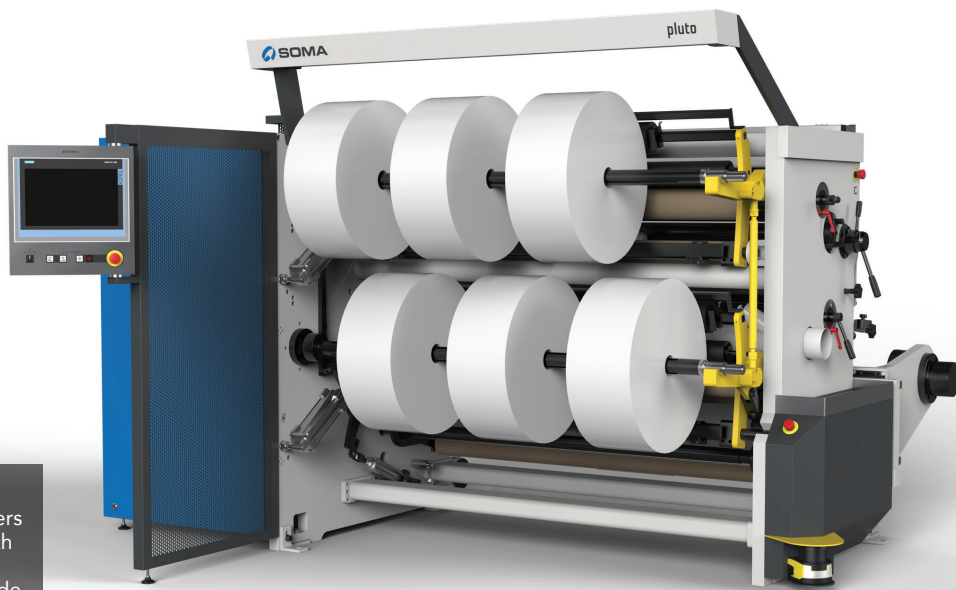
Any company can benefit from an upgrade to its slitter, but often hold off, investing their

funds in other, albeit worthy, software or hardware investments. Like anything else, sometimes the slitter becomes the piece of equipment that chokes the speed of production through the rest of the plant. However, on a basic level, a job can be printed four-, five-, or even more-up, and cut after printing on a slitter, in a fraction of the time.

Today’s, newer, automated slitters can keep up with faster presses — even on a wide range of substrates. Automated features make it easier for short runs

and quick changeovers, even for inexperienced operators. This can be done whether the film is laminated or complex, printed or unprinted, adapting to both the width of the reel and the weight of the substrate. Automatic knife/blade positioning can ensure quick and precise knife settings, and automatic laser core guiding offers precise and very quick settings on new jobs.

Some systems deliver precise unwind and rewind tension control during the entire operating cycle. Thus, they are able to



Today’s, newer, automated slitters can keep up with faster presses — even on a wide range of substrates.

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cleanly slit very thin and difficult substrates. Some can even operate in two modes. One is based on tension preference, automatically adjusting the speed to reach the highest possible tension. The other is based on automatically limiting the tension to reach the desired speed.

Because tension is easier to control, slitters can be used on more, different materials with greater cutting capacity. Newer slitter rewinders have been developed to allow slitting of difficult materials such as diaper membrane, thin filtration nonwovens or rigid PET materials up to 700 microns. Process materials can be as varied as PET, PE, LDPE, HDPE, paper and laminates — among others.

## Slitting Techniques

There are different ways to slit materials. For example, a variable knife shaft can permit tangential slitting with lower and upper rotary knives or with “razor blades” cutting against grooved segment, or in air. For more difficult, thinner substrates, it is possible to wrap around a female knife, slitting with rotary knives or with razor blades. It is also possible to have edge trimming with an exhaust using additional razor blades.

Slitter controls have even progressed. Machines can be delivered with a few intuitive panels to help operate the machine — for example, touch screen panels for rewinding and slitting, and a panel in the unwind section of the slitter

for parent roll loading. With the addition of intelligent data delivery systems, working parameters for different jobs can be stored in memory, such as speed, tension, lay-on pressure, knife or blade settings, and laser core guiding position information. This puts less reliance on the operator, reducing manual error.

Ease is not exclusive to control panels. Many slitters use a cart to load rolls, with the potential for one to drop, causing an accident — not only damaging the material but, much more important, causing serious injury. Some slitters offer devices to easily transport finished rolls from the rewind shaft to the cart using arms that rotate out. That way, no one has to pick up the roll itself, and opera-

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tors don't have to stress and hurt themselves with large, heavy rolls. The unique design of the rotary support arms for each rewinding shaft during change-over allows heavy reels to be handled without the risk of overloading the rewind shafts. The unloading mechanism delivers the finished slit rolls to a stand that rotates so rolls can be taken off a machine and put aside, making it much easier to move on to the next roll and deal with the finished rolls when time allows.

## On or Off?

There is an interesting debate about inline (on a press) or offline slitters. The benefit of an inline slitter is that the job is printed and cut concurrently while the job is

being printed on the press. However, some companies consider an off-line slitter to be more efficient and sort of an insurance policy. They have decided that if there is a problem with the press, they don't have to stop production completely. The slitter can still run while press issues are resolved.

Those companies who work with pharmaceutical and food packaging, where strict hygiene with clean room standards is imperative, can even decide to install an overhead web path — away from handling and dirt.

In summary, most companies find that investment in a new slitter has been worth it. Besides accelerating production speeds, they offer the printer/converter two attractive options: One is a

more productive, cost-effective means to produce their packaging. The other, for many customer-oriented thinkers, is to pass on a good part of these savings to the brand owner, creating even greater loyalty. ■

## ABOUT THE AUTHOR

As SOMA North America Sales Director, Garrett Taylor has 25 years experience in the printing and packaging industry; and specifically with flexographic printing. He plays a significant role in developing SOMA's operations in North America, confirming SOMA's commitment to bringing the latest flexo technology to the U.S. and Canada, with real benefit to customers. He can be contacted at [taylor@soma-eng.com](mailto:taylor@soma-eng.com).



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# Interview with Ryan Schuelke Enercon President & Chief Sales Officer

## 1. What has it been like to take on the role of President of Enercon at a time when the company is experiencing rapid growth?

It's extremely gratifying that our customers have put their trust in us and rewarded our employees' efforts with record sales and shipments. Enercon is widely recognized as the number one brand in surface treating and our team is steadfastly focused on ensuring our customers' success. We have an amazing team that knows surface treating applications inside and out, understands the importance of ease of use & reliability, and most importantly has a passion for customer support. I've never been more excited about the future of the company.

## 2. How is Enercon keeping pace with the tremendous growth the company is experiencing?

That's a great question. We are making significant investments in our facilities, people and structure. Our manufacturing operations are being scaled so that we can increase capacity for our customers' high level of demand. We've also added specialized talent in the manufacturing, quality, R&D, sales and customer support areas as we build for the future. This is all driven by our goal to ensure our customers enjoy the highest level of uptime and a remarkable customer experience.



## 3. What separates Enercon from other surface treating suppliers?

Enercon was founded on the premise that you need to understand your customer's application, commit to building the highest quality products, and invest in supporting customers long after the sale. We know that each customer has unique needs and we're passionate about providing them with the highest quality products and the best service possible. In solving thousands and thousands of printing, coating, laminating, and blown-film surface treating applications we've amassed an unparalleled database of knowledge. With this expertise our application engineers customize equipment for each OEM, converter and extruder to optimize performance for their specific needs. And, our laboratory is the only one that offers corona, plasma & flame making it the ideal place for customers to prove their newest applications and troubleshoot existing issues.

## 4. How is Enercon's technology different?

Enercon is recognized both for its reliability and innovation. We pioneered the use of atmospheric plasma technology for film applications. We developed High Definition Corona and our power supply technology has always

been legendary for its reliability. In fact, when our customers have a competitive piece of equipment on their line we are often asked to replace the power supply with ours until they can budget for a new treater station. Reliability is important, but we also focus on how our customers use our equipment. That's why our Compak Pro line of power supplies incorporates artificial intelligence, integrated troubleshooting, maintenance reminders and capabilities for remote diagnostics and support.



## 5. You mentioned Enercon is passionate about support- can you tell us more about that?

I encourage anyone with a question about surface treating and related topics to call Enercon. It's the best way to discover how our employees are just wired differently. You don't even need to be a customer, we're happy to help and share our expertise. Whether it's about a new application or troubleshooting an issue, our team is here for you. It's why we staff the industry's largest support team. It's who we are and we consider it our responsibility to give back to the industry by sharing our insights and learning from our customers.

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## Peters Automates Cup Printing Line with Martin Automatic

By **Nick Coombes**, Marketing Adviser, Martin Automatic

Radebeul based Papierverarbeitung Peters GmbH has retrofitted a Martin Automatic MBX unwind/splicer to its Omet VaryFlex 670 press to improve efficiency and reduce waste on its paper cup printing line. The result has been “amazing” according to owner and Managing Director Achim Peters, who said that automating the handling of 400 rolls per month of up to 400-micron stock has not only improved productivity but boosted the morale of his press operators.

The company, which specializes in the manufacture of paper cups, paper bowls and more recently labels, has an interesting history. Established originally in 1901 as Sächsische

Blechwarenfabrik by an American company to produce paper buckets, the plant fell behind the Iron Curtain in 1945 and survived under the GDR regime until 1989.

Uniquely, the U.S. company had retained ownership of the land and buildings during the Communist era, so when Paul Peters acquired the business for his family from the Treuhand in 1991, only the machinery was included in the deal. Sadly, Paul passed away in 2018, but his son, Achim Peters, and grandson, Christian Peters, continue to run the company today.

During the GDR days the plant had been producing waxed paper ice cream cups for West Germany so had been able to secure West German technology. After the acquisition, production was switched to single-use PE-coated paper cups.

“When we took over the business it employed 240 people under the old regime – we trimmed this down to 36 and doubled output almost overnight,” Achim explained. “Today we have 75 staff working triple shifts Monday to Friday and produce around 350 million cups per year.”

With a strong sustainability ethic, Peters was the first to offer PLA-coated cups in 2009. These featured a corn starch-based texture and were fully compostable, and since 2016 the company has been FSC approved and works solely with paper manufactured from sustainable forests. Peters’ latest product is the PAPUR cup, which requires no plastic coating and can be recycled

as paper waste or composted.

In addition to the Omet presses at Peters, the company also has a six-color Arsoma EM410 and six-color Gallus EM510 both printing water-based flexo. But it was the installation of the Omet VaryFlex in 2020 that prompted Peters to look at automation. “We had first made contact with Martin Automatic back in 2014 so were familiar with their technology and what it offered in terms of increased productivity. This was highlighted by the 670mm web width of the Omet which required considerably more effort for manual roll changes and persuaded us to invest in a Martin,” Achim noted.

The Omet press is a VaryFlex V2 designed for folding cartons, which makes it an excellent choice for paper cup production. It features a servo-driven infeed and outfeed pull roller and is fitted with six flexo print stations and hot air drying for use with water-based inks. It has automatic electronic register control with Omet’s Vision system for advanced register adjustment and is fitted with a BST web video system that includes a monitor and motor-driven camera. For cup blank handling, it has an accelerator and batch separator with de-nesting capability, with delivery onto a shingled conveyor.

“One look at the production line here and it’s obvious how much difference automating the roll changes can bring. Rolls of 60-inch (1520mm) diameter 400-micron paper are heavy and slow to manipulate, and with



Martin Automatic’s Sales Manager with Achim Peters who claims the MBX saves 10 minutes per roll change, with typically 16 changes per shift.



Peters making typically two changes per hour that took 10 minutes each when done manually — it's easy to assess the improvement in productivity that our MBX unit has made," Martin Automatic European Sales Manager Bernd Schopferer stated.

In addition to reducing downtime and cutting waste material by 10 percent per roll, Peters has also found that continuous operation produces a better all-round product, especially when cutting inline with material that retains a curve. "We are giving serious thought to the next project being a Martin unwind splicer fitted to the Gallus EM510 press. The numbers all make sense in terms of productivity, reduced waste,

and improved operator conditions, and the ROI is relatively short," explained Achim.

With demand for paper cups continuing to grow as more people opt for a green solution to one-time consumables, the company is looking at a bright future. Last year's 350 million cups were split roughly 50:50 between drinking and ice cream/food/baking/wraps.

"Did you know that the wood needed to produce all the coffee-to-go cups in Germany for one year grows in a forest in Finland in just eight hours — and that it takes only 100 ml of water to produce each one-time cup — far less than you would use to wash up a reusable cup? Not many people know that," Christian stated, with

sustainability in mind.

With demand for its paper products continuing to grow and the company's production floor full to capacity in its current location, Papierverarbeitung Peters appears well set for a successful future in which Martin Automatic will play a significant part. ■

#### ABOUT THE AUTHOR

Nick Coombes is a 45-year veteran of the printing industry, and independent marketing adviser to a number of global technology suppliers. He is also an editorial consultant to many of the leading international print media owners and a regular contributor to B2B titles.

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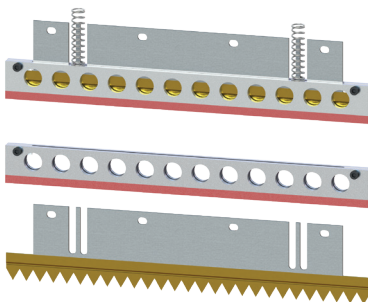
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# Achieving Sustainability: Q&A with Sun Chemical's Dr. Nikola Juhasz

## What are the current eco-trends you're seeing in the packaging market at large?

For many brand owners and converters, their sustainability practices and environmental commitments are informed by the steadily-growing movement toward a circular economy. Considering the end-of-life for a package from the outset, at the design stage, is now an important priority.

To deliver on their sustainability initiatives and environmental goals, brands and converters increasingly focus on three aspects when designing and producing packaging:



- 1) end-of-life, including recyclability and compostability;
- 2) source reduction and light-weighting; and
- 3) transition to non-fossil fuel based raw materials, that is, use of more

bio-renewable and natural materials. Inks, coatings and adhesives can play a critical role in enabling packaging designs that align with these eco-trends.

## How does Sun Chemical support customers' efforts to improve recyclability?

Sun Chemical's sustainability approach is a full value-chain and life cycle-oriented approach, meaning that we collaborate up, down and across our various supply chains to deliver solutions. How our products affect the waste management community, which ultimately must collect, sort and process finished products after their useful application lifetimes, is increasingly important for achieving the vision of circularity. We are active participants in several global cross-industry organizations, such as the Association of Plastic Recyclers (APR) and Sustainable Packaging Coalition (SPC), which are focused on the future of packaging from a sustainable and recyclable design perspective. Members work together to understand and define the unique requirements to manage a more circular end-of-life strategy, including by effective recycling.

At Sun Chemical, a 5R framework guides our product development activities and roadmap — Reuse, Reduce, Renew, Recycle, and Redesign. Recycle is about our various products that enable enhanced recyclability, including repulpability and compostability, of a range of packaging structures. We have ink products that are designed to be compatible with recycling processes to produce premium quality materials that can be used again in

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We recently introduced our latest recycle-friendly offering for shrink and non-shrink applications, SolarFlex™ CRCL UV-curable flexographic ink technology. Just like our previously launched Solvawash solvent-based ink products, SolarFlex™ CRCL inks are designed to be used without requiring primers and to wash-off or to be retained on the printed labels, depending on the material to be recycled and according to recyclability design guidances, with no discoloration of the wash water or recycled plastic.

**How does Sun Chemical support customers' efforts to improve compostability and bio-renewability?**

A key factor in creating a

compostable package is ensuring that the inks, coatings and adhesives used do not interfere with the overall product compostability. To that end, Sun Chemical offers the most extensive portfolio of certified compost-compliant inks and compostable coatings and adhesives products on the market, including our SunUno Solimax solvent-based and SunVisto AquaGreen water-based ink products, and our SUNLAM SFC-100 + HAC 306 solvent-free laminating adhesive, which is the only product of its type to achieve both industrial and home compostability certification.

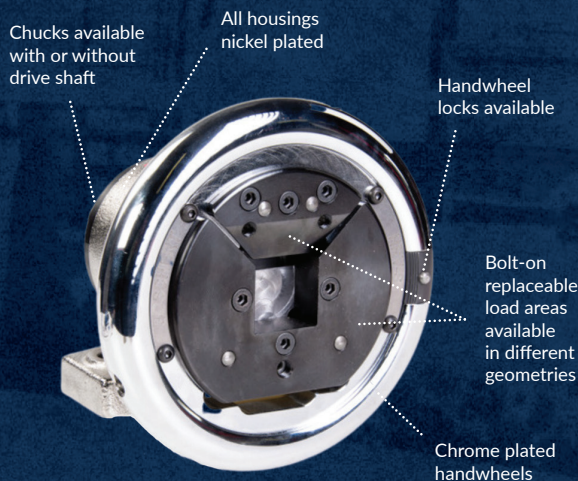
The certifications are provided by independent entities in accordance with the relevant regional compostability standards (ASTM standards in the US, and EN stan-

dards for Europe) to ensure package compostability can be achieved without leaving behind ecotoxic, heavy metal or plastic residues in the soil.

In addition, the use of bio-renewable inks can play a significant role in sustainable packaging strategies. Utilizing inks that are made with renewable and naturally-derived materials such as plants, rather than with fossil fuel-sourced materials such as conventional polymers, contributes to the sustainability and carbon footprint reduction of the printed package. Sun Chemical has a full portfolio of inks and coatings across different print technologies that are formulated with significantly higher levels of bio-renewable resin content as compared to standard market offerings. One example,

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**What other things can printers do to achieve their sustainability goals?**

Lightweighting, that is, reducing the total material and weight in packaging structures, is another way that packaging producers can achieve their sustainability goals. Barrier coatings and adhesives can enable this transformation by allowing film layers to be removed without loss of critical functional properties. For example, Sun Chemical's SunBar (Aerobloc) oxygen barrier coatings allow for down-gauging of packaging and a

reduced carbon footprint, while also being cost-effective and press-ready, not requiring changes to current print equipment.

As brands and converters choose packaging partners who contribute to their sustainability goals, they are searching for printing product manufacturers who not only offer guidance, but who also offer expertise and support their push for sustainability.

Sun Chemical is a partner that offers sustainability-enabling products, provides technology to minimize operations waste, develops with eco-efficiency in mind and offers customized R&D support. Such a partnership can help converters and brands put their consumers' minds at ease and offer packaging that aligns with their sustainability objectives. ■

**ABOUT SUN CHEMICAL**

Sun Chemical, a member of the DIC Group, is a leading producer of packaging and graphic solutions, color and display technologies, functional products, electronic materials, and products for the automotive and healthcare industries. Together with DIC, Sun Chemical is continuously working to promote and develop sustainable solutions to exceed customer expectations and better the world around us. With combined annual sales of more than \$8.5 billion and 22,000+ employees worldwide, the DIC Group companies support a diverse collection of global customers.

Sun Chemical Corporation is a subsidiary of Sun Chemical Group Coöperatief U.A., the Netherlands, and is headquartered in Parsippany, New Jersey, U.S.A. For more information, please visit our website at [www.sunchemical.com](http://www.sunchemical.com) or connect with us on LinkedIn or Instagram.



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