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REDESIGNING PACKAGING SUSTAINABLY TO MAINTAIN PERFORMANCE

Jim Felsberg & Rick Stokes

or the packaging industry, today's buzzword is sustainability.

Brands and their supply chain partners focus on it. Government regulators list it as an important issue. Consumers and non-governmental organizations, like the Ellen MacArthur Foundation, see it as a critical concern. Clearly, the most important issue is plastic waste, especially plastic in the oceans. Attesting to that fact is an April 2023, survey conducted by McKinsey & Company.

Furthermore, a recent report from The Organization for Economic Co-operation and Development revealed that the amount of plastic waste generated each year has doubled during the last two decades, with about 40 percent of that coming from packaging. It's projected to more than double again by 2040 if significant changes aren't made.

Major brand owners have joined various regional plastics pacts around the world to address this issue, including the US Plastics Pact, and made public commitments to increase the rate of recycling and recycled material use in their packaging by 2025.

5RS & OTHER TACTICS

Supplier partners, like Sun Chemical, are supporting the brand owner plastic goals through innovative product technologies, while at the same time advancing internal sustainability programs. Sun Chemical organizes its sustainability initiatives with a "5R" framework. The framework guides Sun Chemical's roadmap for existing and developing technology and product "To achieve both the sustainability and performance attributes required for packaging requires inks, coatings and adhesives to work together seamlessly."

portfolios, as well as its sustainable operational activities.

The 5Rs referenced are reuse, reduce, renew, recycle and redesign, all of which support a circular economy and reductions in carbon footprint, which can be applied from either an operational or product-oriented point of view.

Single-use plastics are a focus of legislation around the world to address the plastic waste problem. Canada, for example, published the Single-Use Plastics Prohibition Regulations, designating six single-use plastic product types as toxic and banning them under the Canadian Environmental Protection Act (CEPA) in a staggered timeline from 2022 to 2025.

All of these trends mean that packaging producers must redesign to avoid single-use plastics designations, while also enhancing recyclability or reuse, but while doing so, maintain all the packaging performance and appearance attributes required by the brands.

In fact, performance and appearance attributes matter the most to consumers. While sustainability is a key driver



"5R" framework—reuse, reduce, renew, recycle and redesign—supports a circular economy and reductions in carbon footprint, which can be applied from either an operational or product-oriented point of view. ALL ART COURTESY OF SUN CHEMICAL

for packaging, U.S. consumers are most concerned about the hygiene, food safety and shelf life of packaging, according to the April 2023 McKinsey & Company study.

As brands explore ways to reduce or eliminate plastic from their packaging and maintain packaging structural performance, there are four redesign tactics they are considering—mono-web, washable/recyclable, compostability, and high biorenewable content.

MONO-WEB STRUCTURES

Lamination has been and continues to be a very popular way to protect consumer goods in packaging. It certainly protects and improves the longevity of the packaging substrate from general wear and tear. Inks and coatings adhere to it relatively easily. It is reliable. The challenge now is that it isn't sustainable. Many lamination structures combine multiple layers of plastic films together that are hard to separate, making it virtually impossible to recycle, compost or use again in any meaningful way. Mono-web inks and coatings have been developed to replace multi-ply laminate structures using surface printing inks and an overprint varnish. Concern about mono-web packaging structures is that it could give up the protections that lamination offers.

New coatings, however, can be very effective at providing many of these same properties of laminated structures. Although not readily visible and seldom recognized by consumers, these coatings bring unique attributes which allow mono-web packaging to replace less sustainable laminated structures.

Not only can these coatings provide the scuff and scratch resistance needed to replace a protective layer of film, they can continue to provide the benefits that coatings provide in laminated structures.

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defects downstream is safe and easy with the Novation AF3 WebFlagger. With the push of a button, the AF3 accurately marks webs moving at speeds up to 4,000 fpm (1,200 mpm). Flag options include various colors, alternating color, metallized, and bar coded for tracking and reporting—so now you can leave flaws on the floor, not out the door!

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Shelf appeal can be improved through matte and tactile effects which can attract customers and promote sales.

Slip packages within the coatings provide proper frictional properties to allow for high-speed filling, which reduces waste and production time. Oxygen barrier coatings can be incorporated to improve the shelf-life of the packaged foods. The protective coatings can also pull double duty as a release coating so that cold seal adhesives can be used to facilitate high speed package filling.

To achieve both the sustainability and performance attributes required for packaging requires inks, coatings and adhesives to work together seamlessly. Being able to provide the full scope of solutions from one source, such as Sun Chemical, can lead to synergistic benefits where the layers work together for a sum greater than the parts. A mono-web packaging structure, for example, must use inks and coatings designed specifically for that mono-web material.

As noted in *Chart* 1, the application and recyclability specifications of Sun Chemical's mono-web inks and coatings pass all the protection and performance requirements of a laminated structure.

Transition from lamination to mono-web structures, such as wrappers and pouches, can save on the use of adhesive, film, processing time and final label weight—all of which reduce the environmental footprint and use of virgin resources. Monoweb structures can also decrease the

			Trial Prints
Adhesion		3M/610	100%
Scratch		Fingernail	Pass
Gloss		60°	58.3
Crinkle	Ambient	20x20	Pass
	Ice Water	30' in IW	Pass
Rub Resistance		500x/Ink to Paper	Pass
Water Resistance		10'	Pass
Heat Resistance		350/40psi/1"	Pass
COF	OPV-OPV	S/K	.276/.207
	OPV-Film	S/K	.306/.283
Coating Weight	OPV 2X	lbs/ream	0.24
	Total	lbs/ream	0.67
Transit Testing		90' Paint Shaker	Pass
Blocking		50psi/80%RH/49°C	Pass
APR	ΔL [84.19]	APR < 5.0	2.45
	∆a [-0.45]	APR < 2.0	0.19
	Δb [3.15]	APR < 2.0	1.00

Chart 1: Example of mono-web inks and coatings properties.

weight of a package, ultimately increasing transportation emissions.

WASHABLE/RECYCLABLE

While a packaging substrate itself may be sustainable, the sustainability of the printed components contributes to the overall design, functional integrity and performance of the package. These components can determine whether a package ultimately is recyclable, compostable, and/or biorenewable.

For example, in the plastic packaging market, developing ink technology that delivers all the required performance attributes on-press and then is removable without leaving ink residues or color in recycling processes and/or in the recovered material, is a significant technical challenge.

This challenge has been met through the SunSpectro SolvaWash FL and SolarFlex CRCL UV Flexo product lines—without requiring any adaptation to converter processes or adjustment of end application requirements.

Washable ink technologies are a very promising new approach to enable circularity, allowing converters to address the demands of brand owners, while delivering an immediate and measurable impact for the plastic packaging market, to reduce waste, increase recycled material availability, and minimize environmental footprint.

The inks were designed to be removed and separated from recoverable plastic substrates in today's mechanical recycling processes, which improves recyclability of packaging and enables industry certifications that are important for brand owners. The wash-off technology is an enabler for higher quality recycled plastics, to increase demand and value, as well as higher quantity, given that it allows some plastic components to be recovered rather than landfilled (See *Figure 1*).





Figure 1: Special ink formulation is required to produce filterable non-bleeding ink particles in caustic solution. Resistant pigments and careful resin selections are key. Washable inks allow filtration of the ink residues, leaving clean plastic flake and clear wash solutions.



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design, prototypes, prepress, plates and ITR sleeves www.cybermemphis.com Substituting conventional water-based inks with more bio-based options that deliver equal or superior performance is an easy way to help reduce greenhouse gases. In fact, with full adoption of current commercially available solutions, global CO₂ emissions due to inks and coatings can be reduced by over 30 percent, or approximately 700,000 tons per year."

To maintain the required performance attributes, coatings are used. For example, in shrink-sleeve-label applications, it is common to apply slip-coatings behind the inks; when sliding sleeves onto the bottle, there must be the correct coefficient of friction (COF). When using washable inks, the overprint varnish has to be able to be washed off the bottle just like the inks, so it is important to select an appropriate coating.

Sun Chemical's recycle-friendly ink solutions like the SolvaWash FL and SolarFlex CRCL product lines are drop-ins for today's flexographic printing processes to enable more recyclable, sustainable plastic packaging. The inks do not require primers and therefore do not diminish sustainability by adding additional weight or reduce converter profitability by adding cost. The inks are versatile and can be used on all the major film types.

The Association of Plastic Recyclers is an organization that can provide guidance for a plastic packaging's recyclability.

COMPOSTABILITY

Compostable packaging is another route that many brands are exploring to improve sustainability as composting allows for a different path for circularity, one that can be easier for some packages, particularly if food waste cannot easily be separated from the package.

But ensuring the package is compostable is difficult as the package must become something in which plants can grow and produce food safely. This means the package must disintegrate and biodegrade while having no adverse chemical characteristics or ecotoxicity. Collaboration between packaging converters and the manufacturers of the inks, coatings, adhesives, and substrates is important to ensure the full package can be certified as compostable.

When a packaging converter is designing a compostable package, they usually base the design on a compostable substrate (like a bio-based plastic film), but it is imperative that the inks, coatings, and adhesives are also approved for use in compostable packages. All materials used on the package—inks, coatings, adhesives, substrates—must also be compostable or compostable enabling. In addition, the design of the package and application of various components must comply with specific standards.

To ensure that packaging components conform to the compostability standards, companies rely on certifications provided by independent entities such as TÜV Austria in Europe and BPI in North America (*Figure 2*), which carry out laboratory tests on the finished packaging product or on its separate components (including the inks) to prove that they fully meet European EN 13432 or North American ASTM D6400 and D6868 protocols.

If certified, the material used would be considered compostable or compliant with compostability without leaving excessive levels of toxins, heavy metals or plastic residues in the soil.

As a manufacturer of inks, coatings, and adhesives for compostable packaging, Sun Chemical is in a unique position to produce a variety of solutions that work together as one in a compostable package—a one-stop shop that could greatly benefit consumer product companies (CPCs) in reaching their sustainability objectives.

BIORENEWABILITY

Brands are also prioritizing sustainability through the use of biorenewable inks. Utilizing inks that are made with renewable and eco-friendly materials, such as plants, rather than materials such as petroleum, contribute to the sustainability of a package.

Various coatings that are used with these inks comply with FDA regulations for direct food contact providing grease, water and heat resistance to paper products for applications in paper plates, cups and paperboard packages. These coatings can provide resistance to staining, provide release characteristics, and can provide heat-sealability, allowing the paper product to offer high performance while still being easily recycled and repulped. Some of these coatings are effective in replacing extruded polyethylene and therefore reduce complexity, costs, and recycling issues.

As their platform for sustainability, the fast-food market has taken a strong interest in biorenewable inks. By incorporating biorenewable inks for paper packaging such as paper bags, wraps, clamshells and paperboards, fast food companies are reaching their sustainability goals in an alternative way.

Unlike compostability and recyclability initiatives, which typically use solvent-based inks, many fast-food companies work with water-based printers and are turning to water-based inks that have a higher biorenewable content (BRC) to contribute to their packaging needs.

Substituting conventional water-based inks with more bio-based options that deliver equal or superior performance is an easy way to help reduce greenhouse gases. In fact, with full adoption of current commercially available solutions, global CO₂ emissions due to inks and coatings can be reduced by over 30 percent or approximately 700,000 tons per year.

However, it's important that claims of biorenewable materials are verified by a separate third-party lab to avoid misconceptions and false claims. The National Association of Printing Ink Manufacturers (NAPIM) has a comprehensive program to verify biorenewable claims and help ink manufacturers with their verification needs.

According to NAPIM, biorenewable inks are derived from tree, plant, insect, and/or animal materials. These include gums, resins, waxes, solvents, oils, and other polymer building blocks.

Independent verification that an ink contains a certain percentage of biorenewable content can be achieved through NAPIM's bio-renewable content program, which assigns inks with an index number. This is a universal program for the printing ink industry for calculating and reporting the BRC of an ink as delivered to the printer. An index number of 60, for example, means that the ink contains 60 percent renewable content.

TRANSITION CONFIDENTLY

There is a clear environmental focus right now to reduce or eliminate plastic from packaging by consumers, brands, government regulators and nongovernmental organizations. This means that brands need to redesign their packaging structures in a way that better achieves sustainability goals while also maintaining the performance attributes of previous, reliable structures.

Inks, coatings and adhesives have been designed in a way that allows brands to feel confident that they can transition to new sustainable packaging structures—mono-web, washable/recy-clable, compostable, and biorenewable— while maintaining the high level of performance their customers have come to expect.



Figure 2: Inks, coatings and adhesives must conform to compostability standards with certifications provided by organizations such as TÜV Austria in Europe and BPI in North America.

ABOUT THE AUTHORS: Jim Felsberg is the director of product management and Rick Stokes is the vice president of the Coatings

Group at Sun Chemical. Jim began his career with Sun Chemical in 1987 in the Daniel Carlick Research facility in Carlstadt, NJ. Throughout the last 33 years, he has worked in various liquid ink technical positions from formulator to technical director.

As the vice president of the coatings group in North America, Rick advances and diversifies the company's portfolio of coatings, adhesives and sealants by leading an experienced and accomplished team of product management, business development, and application professionals.

Sun Chemical can be a valuable partner

when brands are exploring mono-web packaging structures, recycling, composting or biorenewability. To learn more, visit www. sunchemical.com/flexpackaging-transform.

Editor's Note: Jim Felsberg and Rick Stokes will deliver a FLEXO Tech Talk, "Redesigning Packaging Sustainably While Maintaining Performance," Tuesday, Sept. 26. At press time, registration was open for the one-hour presentation. The Tech Talk is viewable at flexography.org and will soon be achieved to MemberConnect, affording FTA members access to the briefing whenever convenient.



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Stokes