Emerson

The ultimate Bio-Based ultrasonics

Ultrasonic welding advances enhance bio-based packaging applications, says David Devine, Business Development Manager at Emerson.

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The regulatory push is on in major packaging markets, led by the European Union's (EU) Circular Economy Action Plan, which seeks to create a structured transition away from single-use plastics and packaging to circular, sustainable and bio-based or recyclable packaging and products. The initiative targets "plastics pollution" with a phase-out of certain single-use plastic items, and development of a policy framework to guide understanding, use and recovery/recycling of bio-based plastics (BBP) and biodegradable and compostable plastics (BDCP). Ultimately, the EU hopes to move beyond the reduction of petroleum-based plastics toward sustainable plastics uses that are beneficial to the environment.

Overcoming confusion

One key step in the effort, not only in Europe but also worldwide, is overcoming customer confusion about what bio-based and biodegradable/compostable plastics — and their benefits — really are, because they vary so widely in terms of their characteristics. For example, any plastics that use at least 20% biological feedstock — whether starch, soy meal, sugarcane bagasse, coconut shell extract or other plant-based material — qualify as BBP, though there are no requirements to further explain their content.
Some BBP are biodegradable as well, though others are not. Similarly, all BDCP are biodegradable, but this term is not specific as to how: Is industrial composting required, or does the material break down in soil or water — and how long does it take to biodegrade? In 2022, a new EU policy framework is expected to provide additional guidance on these and other questions.

While the EU proposal is the world's most advanced to date, state legislators in the U.S. have been focusing on Extended Producer Responsibility (EPR) initiatives. EPR programs would require manufacturers to assume greater life-cycle responsibility for the products and packaging they offer — greater assurance that their products can be reused, recycled, composted or biodegraded.

EPR bills in numerous states aim to:

- Maximise recycling potential, including regional or statewide collection of recyclable items
- Minimise manufacturing and use of single-use plastics
- Drive participation in new "producer responsibility organisations"
- Increase beverage bottle recycling and boost recycled content in new packaging or products

In addition, more than 250 manufacturers, representing 20% of all plastic packaging produced worldwide, have made a global commitment to eliminate plastic waste and pollution at its source, pledging that 100% of their plastic packaging must be reusable, recyclable or compostable by 2025. Signatories to this pledge include a who's who of major global corporations: Mars, Nestle, Walmart, SC Johnson, Unilever, Colgate-Palmolive, Apple, Coca-Cola, Johnson & Johnson, PepsiCo and many more.

The message is clear: Everyone in the plastics packaging value chain — resin producers, package and film producers, manufacturers/brands, and technology suppliers — is feeling the need, or the pressure, to adopt new and effective sustainable package solutions that use BBP and BDCP.

Rapid technological evolution

For companies like Emerson that provide joining technology used in plastics packaging — bags, pouches, clamshells, cartons, coffee canisters, caps, filters, seals and more — the ongoing shift from traditional plastics to BBP and BDCP spells a rapid evolution in technology. Together with resin makers and packaging manufacturers, we are working to adapt the joining profiles developed to provide commercial-grade performance for traditional materials to deliver similar performance for new and rapidly evolving BBP.

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Technically speaking, this is a challenge. Newer bio-based plastics contain less polymer, process at lower temperatures, and have a "narrower" processing window. There is a much smaller difference between the temperatures at which bio-based plastics melt and seal effectively and those at which they begin to degrade and lose strength or seal integrity. Therefore, producing commercial-quality packaging and sealing demands a greater degree of temperature and process control.

So, as more manufacturers consider packages made of BBP, they are also considering whether traditional thermal sealing equipment can deliver the process control and repeatability they require. Made by compressing opposing plastic layers between heated bars, this process relies on control of three simple factors — temperature, pressure and dwell time — to produce repeatable quality. However, BBP with narrower processing windows and sensitivity to excess heat can make it very difficult for package producers to hit the "sweet spot" essential for repeatable package strength and performance with traditional thermal seals.

As a result, more packaging-machine builders are offering, and packaging manufacturers are considering, ultrasonic plastic welding. Ultrasonic welding not only offers far more sensitive and responsive process control but also generates heat to create the seal in a much different way. Thermal sealers drive high heat from the outside in, through the plastic layers, to the seal interface. Ultrasonic welders use high-frequency vibration to create frictional heat within the plastic-to-plastic interface. This "inside-out" melt seal focuses heat at the seal interface — where it is needed most. Further, the ultrasonic process delivers energy savings of 25% to 75%, relative to thermal sealing equipment, because it consumes energy only during repeated, brief weld cycles (< 1 sec), while thermal sealing bars consume energy to maintain surface temperature whether they are sealing or not.

Worldwide, manufacturers and packagers are responding to the challenges of sustainability by adopting bio-based plastic materials and ultrasonic welding technology to implement a growing range of innovative products made with bio-based plastic materials. These include compostable coffee pods, standup pouches and bags, sustainable VFFS (vertical form-fill-seal) food packages, and e-commerce packages that utilize high percentages of recyclable or compostable content.

New, single-use teabag designs place leaf tea between two discs of porous, nonwoven PLA (polylactic acid) mesh that are ultrasonically plunge-welded together. PLA is an industrially compostable BDCP.

This coffee capsule incorporates a compostable, two-piece bio-based PP ring frame sealed to an air-laid, nonwoven paper filter basket. While heat-sealing tooling caused material degradation and seal inconsistency between the ring and basket, BransonTM ultrasonic welding technology from Emerson solved the problem, meeting seal integrity and cycle-time requirements.