Three Ways To Make Packaging Lines More Sustainable

By Andres Abreu, Packaging Business Development Manager, Assembly and Welding, and Mark Densley, Director Business Development Factory Automation, Emerson

Pneumatics and ultrasonic welding technologies can help consumer packaged goods companies optimize energy use and improve OEE.

Sustainability is a high priority for today's consumer packaged goods (CPG) companies. Driven by environmental responsibility, government regulations and customer preferences, CPGs are actively seeking ways to decarbonize their packaging lines and use eco-friendly packaging materials. Many have started monitoring the energy consumption of their equipment in real time and upgraded critical areas of their packaging processes using two key technologies: pneumatics and ultrasonic welding.

While companies have long relied on the proven performance of pneumatic technologies in their packaging lines, the latest pneumatic devices feature specialized capabilities and connectivity that can help optimize energy use, improve overall equipment efficiency (OEE) and maximize performance. Compared to traditional heat sealing, ultrasonic welding offers precision, reliability and efficiency that can minimize waste, improve packaging compostability and reduce energy consumption.

Here are three ways that CPG companies can incorporate these sustainability technologies to improve the environmental impact – and boost the OEE – of their packaging lines.

Optimizing Compressed Air Use

Compressed air is used to help operate equipment and power processes throughout packaging lines, including bottle production. While its prevalence can mean a high potential for energy loss, the right tools can turn it into a valuable opportunity for energy savings.

Not long ago, there was no reliable way to evaluate compressed air consumption. The digital transformation of pneumatics has changed that. Today's smart pneumatic devices provide a more complete picture of pneumatic system performance as well as actionable insights that give companies the ability to better understand and effectively control the energy use of their packaging lines.

Smart sensors, combined with an edge computing device, can continuously monitor system airflow and capture real-time flow, pressure and actuator speed. When properly analyzed, this data can help detect leaks and optimize compressed airflow. (Figure 1)

Using the edge analytics, operators can see the relationship between air pressure, flow and the speed of the actuator more clearly. By better understanding the true nature of this relationship, operators can determine the optimal consumption point of compressed air for their packaging processes.

If the analyzed incoming pressure is higher than process requires, and more compressed air is being used than needed, operators can reduce the pressure and modulate airflow while maintaining the same cylinder cycle time. By optimizing the amount of compressed air to meet operational requirements without affecting production, companies can minimize energy use.

Figure 1: By continuously monitoring pneumatic systems in real time, Emerson's AVENTICS™ Series AF2 Series flow sensor can help CPGs detect and address compressed air leaks early. (image courtesy of Emerson)

In addition to optimizing compressed air use, software monitoring can also help operators detect leaks in near-real time. Once it detects a leak, the monitoring system sends an alert to maintenance personnel, who can then investigate the equipment in question. In this way, operators can address compressed air leaks much sooner, preventing compressed air loss and reducing emissions. (Figure 2)

In analyzing individual companies that have implemented pneumatic solutions to control air leakages, their improved overall equipment efficiency (OEE) has shown that facilities can typically save 10-20% in compressed air energy costs and see a carbon footprint reduction of up to 10% through early leak detection and optimized air consumption.

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System monitoring can help reduce downtime and improve OEE, too. Companies no longer need to plan downtime and have technicians test each machine for leaks, and leaks are sealed before they can cause fluctuations in system pressure. Leak-related fluctuations can make machines cycle more than needed, and this extra work wastes energy, prematurely wears equipment and components and increases maintenance.

Perfecting PET Bottle Production

The polyethylene terephthalate (PET) bottle is the most widely used bottling product in the world. It is so popular, about 3,500 stretch blow molding (SBM) systems are built and deployed annually to meet demand. The latest systems combine the SBM process with the bottling process in one continuous production flow.

This combination production system obviously makes lines more compact and reduces a bottler's carbon footprint by eliminating the shipping step that occurred between bottle production and filling. Pneumatic technology is a key part of their construction.

Pneumatics power several key areas of SBM machines. Pneumatic air preparation systems improve efficiency and offer better control of the low- and high-pressure air that preform actuators and stretch blow bottle expansion steps use. And compact, high-performance blowing blocks provide bottle volume growth control through pre-blow, blow, recycling and exhaust functions.

Some suppliers have advanced SBM pneumatic performance, and sustainability, even further.

Figure 2: Operators can view pneumatics data and valuable insights on an easy-to-read local dashboard, making it simple to quickly respond to issues if they arise. (image courtesy of Emerson)

For example, one supplier offers a proportional control valve developed for the pre-blow expansion step in PET production that replaces an on/off high-pressure flow and, quite honestly, revolutionizes this bottle production step. Where the previous on/off high-pressure flow set a uniform flow rate throughout the blow process, the new control modulates the flow to fine-tune each bottle's expansion within the mold. (Figure 3)

This advanced proportional valve technology combines a specially designed proportional valve, control electronics and software, which can either store the blowing sequence setpoints in the valve or respond to control directions from the stretch blow molding (SBM) programmable logic controller (PLC) that directs the blowing process. The resulting bottle grow is intelligently modulated, giving end users the ability to perfect how the heated bottle expands within the mold. (Figure 4)

The system can also capture feedback results for the quality of each blow, providing critical data needed by bottle manufacturers to perfect the process and minimize the number of rejected, wasted bottles. It also provides condition monitoring data to support routine and preventive maintenance programs.

Proportional technology for PET blowing moves pneumatics to a whole new level of sustainability for this process. It offers the potential to reduce material consumption with the capability to fine-tune bottle wall and shape formation, to create thinner, more lightweight containers. It also saves energy by potentially reducing blow air pressure required for high-quality bottle formation and by reducing the heating temperature in the pre-blow oven.

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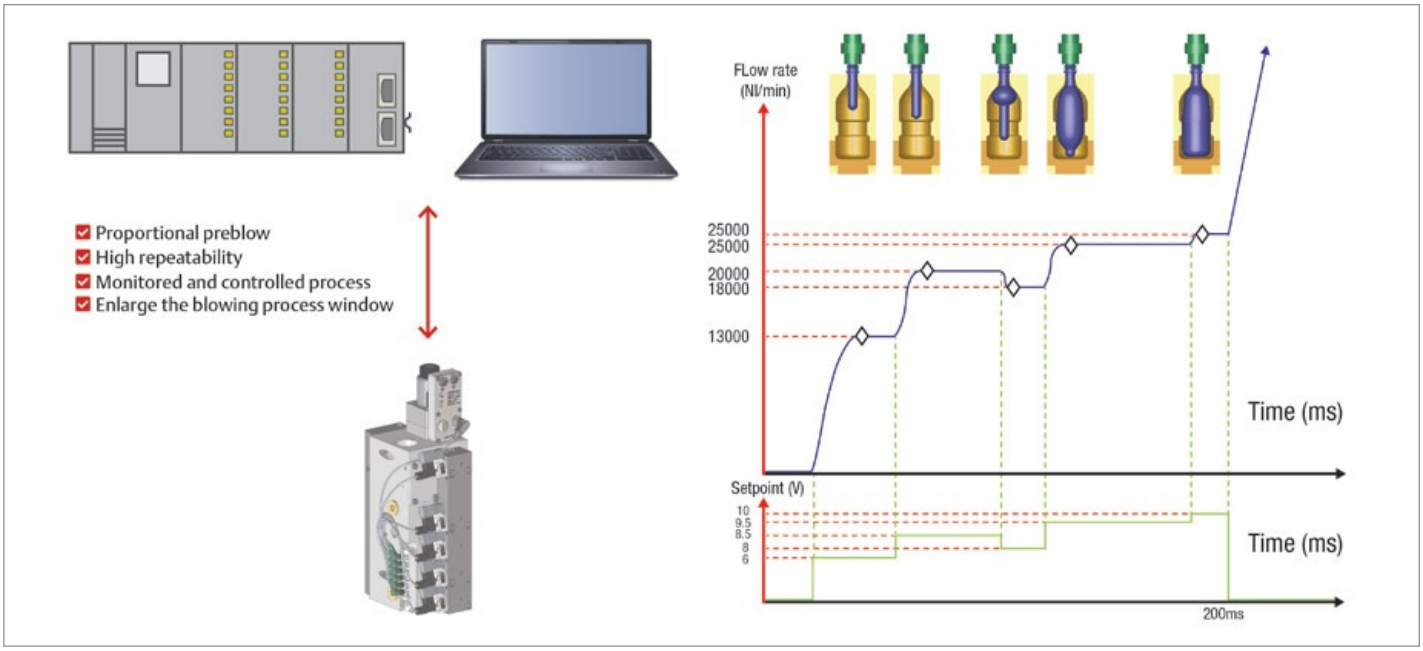

Figure 3: By integrating a proportional control valve instead of using on/off high-pressure airflow in their pre-blow expansion step, PET bottle manufacturers can better modulate bottle growth.

In addition to its energy saving benefits, proportional technology for PET blowing also enables the high throughput production of more complex bottle shapes, which is a critical goal for a bottler's marketing purposes. It also increases manufacturing flexibility, since the process can be easily changed via software/PLC formula specific to each blowing station on the machine and fine-tuned for further improvement without stopping production.

Implementing Ultrasonic Welding

To make sealing applications greener, ultrasonic welding offers many advantages compared to traditional heat sealing. Its precise, reliable capabilities and efficiency allow end users to reduce energy consumption, confidently use biodegradable packaging, minimize product and packaging waste and improve packaging recyclability and compostability. This sustainable technology can ultimately save energy by up to 25% and reduce carbon footprints by up to 75%.

Ultrasonic welding systems simply use less energy than conduction heat-sealing systems. Ultrasonic welding processes consume energy in short bursts compared to the continuous energy supply that conduction sealing processes require to complete the same production capacity. For example, to complete 100 welds/min over two eight-hour shifts per day, a typical conduction sealing process needs four, 500-watt cartridge heaters (2,000 watts/hour or 32,000 watts/day) to constantly maintain its operating temperature, while an ultrasonic welder of the same capacity would be equipped with a power supply rated at 1,500 watts but would use power in short bursts (e.g., ~200 ms/weld) totaling about 20 seconds/min of total power consumption.

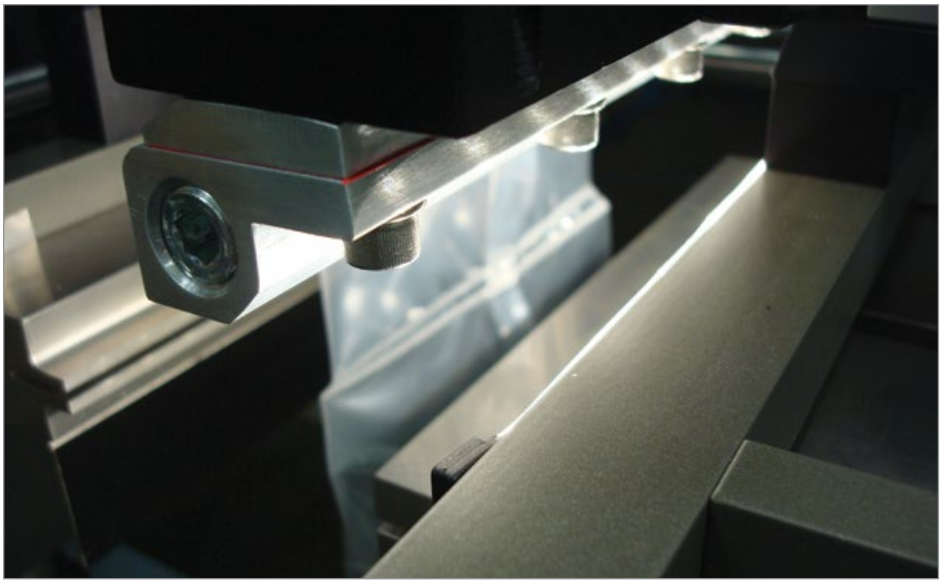

Figure 4: The precision and control of Branson ultrasonic welding components for vertical form fill and sealing (VFFS) systems by Emerson can hermetically seal bio-based materials more reliably than traditional heat-sealing tools.

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Ultrasonic welding is also more compatible with bio-based materials, such as polylactic acid (PLA), than traditional heat sealing. Because biopolymers contain significantly less polymer content, it can be difficult for the simple time, temperature, and pressure settings of a heat sealer to reliably bond this type of biodegradable, single-use packaging and achieve a commercial-grade, hermetic seal. However, the precision and control inherent to ultrasonic welding offers far more capability to manage the narrower processing windows of bio-based resins. (Figure 5)

Ultrasonic welding produces high-quality, consistent package seals without adhesives or consumables. The plastic-to-plastic bond it creates not only simplifies package design, but, since there is no contamination within the seal surface, it also improves material recycling and/or compostability.

In addition to creating a more reliable seal, an ultrasonic weld can reduce packaging material consumption as well as eliminate seal failures due to contamination. To reduce packaging material consumption, ultrasonic welds require only 0.25 inches of total package length when sealing the ends of small snack bags, while conventional heat seals consume about 1.0 inches. Comparably, ultrasonic welding returns 0.75 inches of package length.

To prevent seal failures, the high-frequency, vibratory motion (usually 20, 30 or 40 kHz) of the ultrasonic welding process vibrates potential residue out of the seal area that conventional heated tools often seal in. Because encapsulation of these residues results in contamination, leaks or failures, the clean weld that ultrasonic welding achieves reduces waste while improving seal quality and repeatability.

Achieving a More Sustainable Packaging Line

Consumer packaged goods companies have long counted on pneumatics as an effective, reliable machine technology to package items from soda bottles and cereal boxes to single-serve snack pouches and pharmaceutical blister packs. And

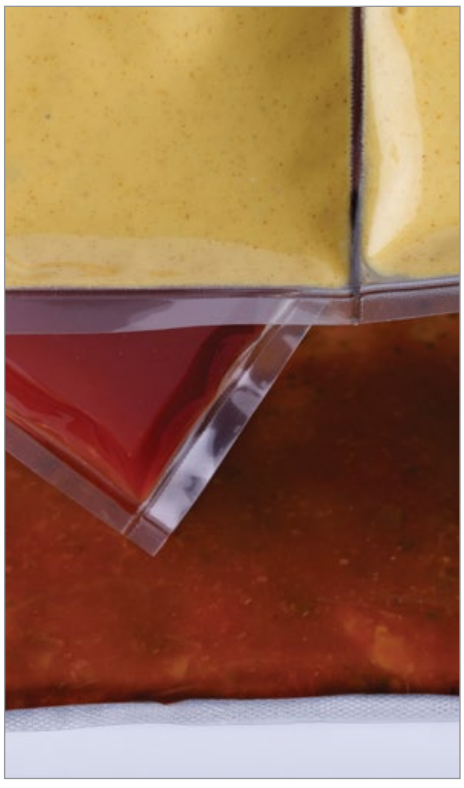

Figure 5: CPGs can eliminate contaminants, decrease waste and reduce weld failures using ultrasonic welding, which creates neat, hermetic seals between package contents — even liquids and purees.

the latest advances in pneumatics, including the digital transformation of the packaging line, promise even greater benefits.

While the right technology will power greener, more compact packaging lines, it's important that CPG companies work with an automation expert who understands smart pneumatics and the distinct characteristics of fluid power applications to achieve their most ambitious sustainability and performance goals. By using a range of pneumatic technologies, including smart pneumatics, companies have the potential to significantly reduce their carbon footprint – while considerably improving OEE. BP

About the Authors

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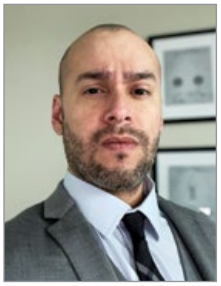

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