TELSONIC ULTRASONICS

The Influence of Sustainable Materials on Ultrasonic Plastic Joining Applications

PLASTIC WELDING | METAL WELDING | CUTTING | CLEANING | SIEVING

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The effects of global warming and climate change are the driving forces behind an increased focus on the topic of sustainability. If we are to maintain health and wellbeing not only now, but in the future, we must take greater steps to protect and conserve the worlds natural resources and ecosystems. This applies to all areas of our lives, including reducing our reliance on products manufactured from fossil fuels. If the world is to achieve the targets set for reductions in CO2 emissions, and those of increased recycling, re-useability, and sustainability, then we must continue to develop and use alternative, more environmentally friendly materials.

01 Similar trends, as being established in Flexible Packaging are being seen in relation to Bio Polymers or recyclable materials.

Plastics have become an essential part of many industries and the products they manufacture, none more so that the packaging sector, where a large percentage of the plastics generated every year are used. Not only are plastics largely made from the hydrocarbons found in fossil fuels, but they do not degrade quickly in landfill and will continue to have an impact on the environment for many years to come. The negative aspects of plastics are also clear to see in our oceans, where plastic waste poses significant risks to aquatic wildlife and ecosystems.

Transitioning from traditional plastics-based packaging materials to more sustainable alternatives has resulted in a move away from Rigid Packaging and more towards Flexible Packaging options. These moves are intended to both increase the possibilities for recycling and also reduce the carbon footprint of the packaging used. Where rigid packaging is still required, the trend is towards a reduction in the use of polymer materials and an increased use of paper-based packaging materials.

Sustainable materials generally fall into two distinct categories, those which are produced from recycled materials, either following use by the consumer, recycled

as part of the original material production process, or following chemical recycling processes which are often only appropriate for specific and limited numbers of material types. Biobased polymers on the other hand, are defined as materials for which at least a portion of the polymer consists of material produced from renewable raw materials. For example, from corn or sugarcane. The remaining portion of the polymers may be from fossil fuel-based carbon. Bio-circular polymers are bio-based materials that can be recycled mechanically.

Challenges for Joining Technologies - Thermal versus Ultrasonic

Heat Distribution within the areas being joined is different depending upon the process used. Using a thermal sealing process, the heat is applied from the outside, meaning that all of the polymer material needs to be heated up. This is a very common and generally cost-effective sealing solution; however, it does require high energy levels and the speed of the process is highly dependent upon the material being joined, its thickness and capacity for heat conductivity.

By comparison, the ultrasonic sealing process introduces the heat from within, therefore the plastic part will generally not heat up or perhaps heat up only slightly on the outer surface. Unlike thermal sealing, the ultrasonic process is a very fast and smooth solution which requires low levels of energy consumption. Although the initial investment for ultrasonics may be higher, when other factors such as reduced energy consumption, and greater levels of performance and productivity are taken into account, the total cost of ownership for the ultrasonic process is better.

Material Challenges

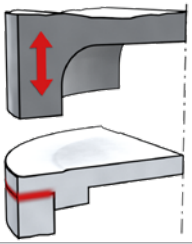
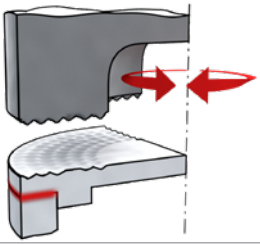
One of the problems associated with recycled material is that its content very often has slightly different melt characteristics to that of the virgin material. For that reason, in some instances only partial melting of the polymer occurs, leading to reduced strength within the joint. The solution to this issue, and in order to guarantee a secure joint, more energy needs to be applied to melt the polymer. Thermal sealing technology offers only limited potential in this instance and if the energy level is increased too much, there is potential for damaging the outer surface of the part.

Bio-materials also pose their own problems when it comes to joining as Bio-Based polymers require higher levels of energy input to melt the polymer, and when using ultrasonics, the design of sonotrode and anvil is important. Also, semicrystalline polymers absorb more energy the softer they are. Mono Films require higher melt temperatures at the joint location, and there is also a greater requirement on how the energy is focussed. For these materials, the higher the melt temperature, the better ultrasonics is when compared to thermal sealing technology. In applications where laminated paper is being used, ultrasonic sealing works well if there is enough thermoplastic content.

Ultrasonic Welding Technology – Longitudinal or Torsional?

One further advantage of the ultrasonic welding process is the ability to select either the longitudinal process or the torsional process. The decision on which of these two options to use is depending upon the product itself, the joint / sealing configuration, and the material.

The table below provides a guide to the characteristics and benefits of each process:

	Longitudinal	Torsional
		
Mechanical Stress	High	Minimal
Energy Transfer	Concentrated	Area
Weld Time	Short	Very Short
Weld Configuration	Spot	Area
Process Window	Medium	Wide
Increasing Part Size	Amplitude Reducing	Amplitude Increasing

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Turning To Torsional

Examples of how the different ultrasonic joining methods have been applied, and the benefits of the longitudinal or torsional processes are shown below:

Application	Challenge	Recommended System	Reason
	Weld sensor holder to a thin wall bumper (weight reduction)	Torsional Ultrasonic System	No marks on the Class A Surface. High welding strength
	Welding coffee capsules with Bio or Mono material	Torsional Ultrasonic System	Secure welding of the film. Simplifies the design of the capsule, and depending upon the material the longitudinal process also works
	Weld electronic part into a waterproof housing made from recycled polymer	Torsional Ultrasonic System	No damage to the electronics because of the smooth torsional ultrasonic welding technology
	Welding a stand-up pouch with Mono or Bio-material	Longitudinal Ultrasonic System	Faster cycle time when compared to thermal sealing. Reliable weld, even with a contaminated sealing area.

The torsional welding process, which is exclusive to Telsonic, is the ideal solution where one or more demanding materials are to be joined, where there are sensitive parts which must be protected from mechanical stresses, and where there is a requirement for very short cycle times. Other benefits from the torsional process include a wider process window, higher amplitudes, and high weld strengths However, the main limitation of the torsional process is that it is not suitable for all weld seam shapes.

02 Markus Scheuber, Head of Global Business Unit Plastic Welding, TELSONIC AG, Switzerland

Conclusion

When choosing the right joining method for your materials, there is a lot to consider, and the ability to draw upon the extensive application experience resident within Telsonic will ensure that the technology will be configured to deliver the optimum solution to your specific requirements.

By Markus Scheuber, Head of Global Business Unit Plastic Welding, TELSONIC AG and Tom Pettit, Genesis Sales & Marketing Limited