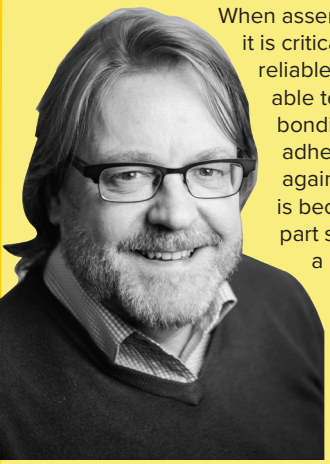
All of the lights

PETER SWANSON, MANAGING DIRECTOR AT ADHESIVES SPECIALIST INTERTRONICS, GIVES HIS TOP TIPS FOR GETTING THE BEST FROM YOUR ULTRAVIOLET (UV) CURING PROCESS.

Since its introduction in the 1960s, UV curing technology has streamlined adhesive applications for medical devices. Over the last few years new UV curing technologies have been emerging, resulting in greater equipment choices and process considerations than ever before.

Typical applications for UV curing medical device adhesives include needles and cannulas, reservoirs, tube sets and catheter bonding. When an adhesive is required in a medical device assembly, manufacturers have a range of adhesives chemistries and cure options to choose from.



When assembling a medical device, it is critical that processes are reliable, consistent and are able to be validated. For bonding parts, UV light curing adhesives perform well against these criteria. This is because they are single part systems and come in a range of viscosities, facilitating precise, repeatable dispensing, both in quantity and location. Curing is fully completed in seconds and within a controlled process window which means that immediate on-line quality assurance checks are possible. Understanding and managing process variables is key for a robust procedure, as mandated by the industry.

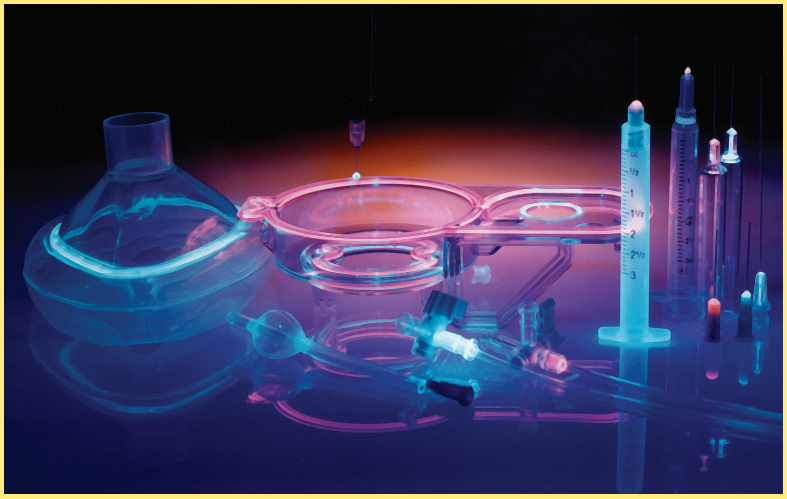
The choice of adhesive is substrate dependent. For example, an adhesive which adheres well to PolyVinyl Chloride (PVC) may not adhere well to stainless steel. However, ensuring good adhesion to all of the substrates is particularly challenging in medical device manufacturing, possibly due to the use of less common plastics, such as PolyEther Ether Ketone (PEEK). A capable supplier will be familiar with industry-specific substrates and have appropriate adhesives for evaluation. In some cases, plasma surface treatment can be used to improve adhesion to low surface energy polymers.

Medical device manufacturers will want to consider selecting adhesives that pass ISO 10993 or USP class VI testing, which indicates that they are non-toxic. In addition, the adhesive will need to withstand the required sterilisation process (e.g. EtO - ethylene oxide). Intertronics supplies a wide range of ISO 10993-tested UV-curable adhesives that are able to withstand sterilisation. Opting for a biocompatible adhesive will help the device to pass toxicity testing later on.

LAMP CHOICE

UV curing lamps are usually based on two types of quite different technology. Mercury arc lamps produce a broad spectrum of light and have been used successfully for decades, making them the predominant type of lamp for UV curing. However, despite their popularity, this type of lamp does have some drawbacks. They typically have a less than 2,000-hour bulb operational life; the intensity of the lamp degrades over time and is therefore a process variable which needs measurement and understanding. To guarantee a complete cure it is important to compensate for this. The bulb will need replacing before the output becomes inefficient.

Light Emitting Diode (LED) lamps are a more recent technology and, unlike mercury arc lamps, produce a narrow spectrum of light. When using a LED UV curing lamp, the output does not appreciably degrade over time, there are no bulbs to replace and there is no warm-up time required. One of the major



advantages over broad-spectrum lamps for medical applications is that LED UV lamps have a constant output, rather than one that decreases over time, removing a process variable and as a result increasing consistency.

LED lamps also emit a cooler light radiation than mercury arc lamps, are more electrically efficient and meet the increasingly stringent regulations regarding the use of mercury. However, LED lamps will not work optimally with all UV curing adhesives - this is because many of which are designed to cure with broad spectrum UV light.

When choosing a lamp, it's important to remember that not all materials cure optimally with both types of lamp and a mismatch can result in non-optimal or poor bonds. Before taking advantage of LED UV curing technology, it's important to remember that it is not a simple like-for-like replacement for a broad spectrum lamp. The spectral output of a curing lamp should be correctly matched with the material that is being cured.

CORRECT DOSE

The key to success with UV curing is ensuring that the adhesive or other light curing material receives the correct dose of UV light. The dose depends on both the light intensity and time of exposure, as well as the appropriate wavelength for the material.

The correct dose can be achieved by carrying out testing before the final cure in order to understand the minimum dose needed for an application. From this, the user can then see how much energy is needed to achieve an optimal cure and can establish a curing process at the minimum dose, plus a recommended 25% safety factor.

Generally, Intertronics recommends a minimum curing intensity of around 50 mW/cm2. It is not recommended to use very low power UV lights for extended times as this is likely to result in non-optimal or incomplete curing for most industrial grade products, which may have a minimum activation energy level. Higher intensities should give a better cure and therefore a better performance in a shorter process time.

A radiometer can be used to measure light intensity and will give an output in either mW/cm2 or W/cm2. Radiometers with different spectral sensitivities are recommended for use with the different broad spectrum and LED curing lamps. Some radiometers can also measure dose. If you're unsure which radiometer is suitable for your application, the technical staff at your UV equipment or materials supplier should be able to advise you.

THE PROCESS

With most UV curing adhesives, curing starts with exposure to light and stops when the light is removed. The production process should ensure a full cure during the time of exposure. If possible, all of the adhesive should be exposed in one dose of UV light, as multiple exposures could affect the integrity of the bond.

UV light is hazardous. However, protecting operators is straightforward. For manual, hand-held curing operations, a common sense approach would be to consider how you would look after yourself on a sunny day at the beach e.g. cover up exposed skin and protect eyes. A good supplier will deliver safety eyewear with each lamp and will help with any further Personal Protective Equipment (PPE) needed, as well as the risk assessment.

Training is recommended for everyone involved in the process. Additionally, a radiometer can also be used to check levels of UV light near the equipment, and to give colleagues better understanding of any hazard.

With new UV curing technologies entering the market regularly, there is even more potential for it to streamline manufacturing once the process is right. If you're struggling to optimise your UV curing process, a specialist may be able to help.

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