design FAQs

ULTRAVIOLET CURING

FREQUENTLY ASKED QUESTIONS

WHAT IS ULTRAVIOLET CURING?

Ultraviolet (UV) curing uses high-intensity UV light in a photochemical process developed in the early 1960s to quickly cure or "dry" inks, coatings and adhesives. It eliminates the ovens and air-drying equipment needed to evaporate solvents and dry inks, a time consuming process. Evaporating the solvents also makes inks and other coatings shrink by more than 50% and creates airborne pollutants.

HOW DOES UV CURING WORK?

UV curing is based on photochemical reactions. A small amount of photoinitiator is added to a mix of liquid monomers and oligomers that make up an ink, paint, coating, adhesive, potting compound, or sealant. Exposure to UV radiation energizes the photointiators, making the materials dry and harden thoroughly and quickly. UV light can also be used to clean or prepare surfaces for follow-on coatings such as adhesives and paints.

WHAT ARE THE BENEFITS OF UV CURING?

UV curing speeds production by eliminating the time spent in drying ovens. It reduces reject rates by ensuring complete and thorough curing and hardening. This becomes more important with thicker layers of material such as potting compounds and encapsulants. UV curing also creates coating that are more scratch and solvent resistance, and when used to prepare surfaces or cure adhesives, it promotes superior bonding.

WHAT INDUSTRIES RELY ON UV CURING?

UV curing has been widely adopted in many industries including automotive, electronics and telecommunications, and graphic arts, including glass and plastic decorations. It has been used on medical devices, optical storage components, and for wood processing.

WHAT IS PULSED UV/ VISIBLE CURING?

In traditional UV curing systems, mercury-based lamps are always on so as to avoid the lengthy warm-up periods needed for these lamps to come to full power. Mechanical shutters in front of the lamps open long enough to provide the needed amount of UV energy. Pulsed curing gets the job done with extremely short pulses of ultra-high power, anywhere from 1 kW to 1 MW, depending on the application. (See the graph: Three paths to 1,200 Watt-seconds)

WHAT ARE THE ADVANTAGES OF PULSED UV CURING?

Pulsed curing lets engineers adjust several parameters to get optimum results for an application. They can tune the UV wavelength and intensity, pulse width, number of pulses, and time between pulses to get the best balance between high energy, low heat, and short cure times while still maintaining low average-power outputs. Adjusting the time between pulses lets manufacturers control heat buildup, eliminating the risk of changes or damage to substrates due to excess heat. Because pulses are more intense than the light used in continuous UV/Visible curing, they penetrate deeper into materials and trigger photochemical reactions quicker, shortening cure times.

Shorter cure times leads to other benefits including faster throughputs for high-volume manufacturing. Shorter curing times lets QA find and fix problems faster, thus reducing scrap. And quicker curing means less time for dust and particles to contaminate parts during painting or coating, a common cause for scrapped parts. Xenon lamps can also be turned on and off instantly with no warm-up periods needed as with mercury lights.

IS UV CURING ENVIRONMENTALLY SAFE?

Compared to using drying ovens to cure inks and coatings, pulsed UV exposure consumes much less energy and takes up less factory space. But continuous UV exposure from mercury-based lamps presents another set of problems.

If a lamp gets broken, enough mercury gets spilled that emergency measures should be carried out to clean up the hazardous waste. Care must also be taken when disposing of burnt out mercury lamps.

A more environmentally friendly method of pulsed UV curing is to use pulsed light from xenon-based UV lamps. Xenon is a non-hazardous inert gas and the lamps contain no mercury.

Pulsed light also brings environmental and safety benefits. For example, pulsed UV lamps do not generate potentially dangerous microwaves. Pulsed systems also employ energy bursts, so the lamps are off during most of a typical duty cycle, This means up to 80% less energy is needed than in mercury UV systems. In one manufacturing line, for example, the average power required was reduced from 6,000 W using mercury vapor lamps to less than 1,000 W after converting to a pulsed xenon UV system.