Cork Tech Talk News

Manufacturers of Waterbase, UV+EB Curable Coatings, Varnishes and Adhesives

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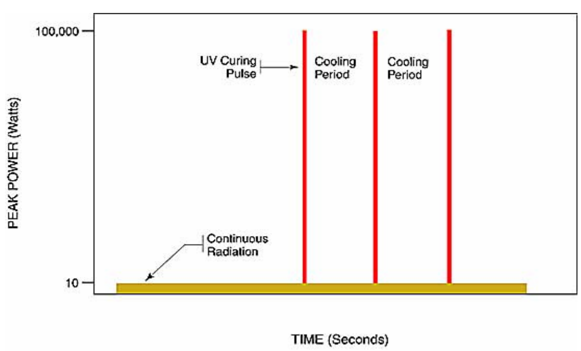
PULSED UV TECHNOLOGY IS ANOTHER CURING ALTERNATIVE

Pulsed UV light or "flash" curing is an energy curing source alternative to other methods of UV curing, including commonly used mercury arc vapor, microwave generated lamp sources, and new LED solid state devices.

Pulsed UV light technology is over-coming UV curing challenges being presented by some of today's cutting edge new product developments, such as UV top coating the new high capacity Blu-ray™ optical disc.

Pulsed UV light technology has the capability of generating very high peak power, as the name implies, in pulses as opposed to the continuous UV light generated by conventional UV lamp sources.

A single pulse of a pulsed UV light can deliver as much curing energy as a continuous conventional UV lamp system in a short fraction of the time.



As an example, comparisons have been made showing pulsed UV light delivering 500 Joules (watt-seconds) of energy in a one millisecond, while a conventional continuous lamp system would take one second. Therefore, a pulsed UV light system could deliver 10 times the energy in the same time by delivering 10 pulses per second. This would be the equivalent of 500,000 watts peak per millisecond. Pulsed UV light delivers UV light at high peak power for deep penetration of the chemistry to be cured.

A pulsed xenon flash lamp generates UV energy curing light from a high pressure, high temperature plasma, where electrons are stripped from xenon atoms to produce a very intense controlled output of photons. A pulsing UV lamp effectively machine guns a curing zone with UV photons at very high densities, thousands of times more than a continuous UV lamp source does.

Pulsed xenon lamps are capable of generating radiation in a very high efficiency wide band-width (50nm to 5 microns). This is especially true in the UV spectral region (180nm to 400nm). Systems have been developed with pulse energy output higher that 1000 joules per pulse, from 250 to 2000 watts, with peak pulse power over one megawatt.

Of special note is the fact that a pulsed xenon flash lamp can be tuned to tune out unwanted IR spectrum, while the UV spectrum is tuned for maximum efficiency, and that spectrum can be tuned to match the curing spectrum requirements of the chemistry to be cured.

A flash lamp consists of a sealed envelope, usually of quartz filled with a mixture of gases, mainly xenon, and electrodes, which convey electrical current to the gas. They may be formed in virtually any shape including flat, linear, spiral, serpentine, helical, etc., to match cure zone shapes. Proper reflector and lens optics are important to system optimization.

A pulsed UV light source system consists of the following components:

Cork Industries, Inc. 500 Kaiser Drive, Folcroft, PA 19032 610.522.9500 F 610.522.9659
Elmer W. Griese, Jr. 440.748.0980 ewgriesecork@oh.rr.com
Website http://www.corkindustries.com

- Flash lamp module
- PFN (pulse forming network)
- High voltage power supply
- Flash lamp trigger
- Control module
- Cooling system
- Reflector

Pulsed UV light offers the following benefits:

- High curing energy deliverable in a short time span
- Faster free radical generation
- The ability to penetrate thick or opaque non metallic substances
- The ability to penetrate thick or opaque adhesive and coating layers
- Substrate heat build-up is virtually eliminated
- No continuous IR output
- Instant on-off energy curing system
- Accommodates curing on a wide variety of product shapes and sizes
- Offers wide UV spectral bandwidth
- Lamps can be made blown in a large variety of cure zone accommodating shapes
- Photo initiators can be reduced
- No mercury used in the system
- No overexposure of substrate and chemistry to IR or visible light
- Simple to operate, automate and adapt to contemporary, high speed lines
- Process flexibility and efficiency re: broad UV spectrum, high UV output and changeable pulse parameters
- Potential to develop visible light curing materials utilizing the systems ability to generate high visible light output

The ability to control heat build-up in pulsed UV light systems offers advantage in the UV curing of coatings, varnishes, inks and adhesives on heat sensitive substrates.

Lower heat is the result of:

1. Pulse separation
2. No need to heat to vaporize mercury (as in a conventional lamp)
3. Minimized IR production

Pulsed UV light use includes major markets involving sterilization and adhesives curing. Laminating adhesives involving one transparent substrate laminated to either transparent or opaque substrates have potential to become a large market.

Pulsed UV light curing of coatings has demonstrated a reduction in cure time and the ability to cure on heat sensitive substrates.

Significant recent applications include:

- DVD bonding
- Blu-ray Disc™ top-coat curing
- CD lacquer curing
- Lubricious coatings on hard drive
- Curing heat sensitive materials
- Semiconductors
  1. Wafer manufacturing
  2. Tape removal
- Medical device manufacturing
  3. Hydro gels
  4. Lubricious coatings on guide wires

Historically, xenon flash lamps have been used commonly as photographic strobe lights and also in high-speed "stop motion" photography. They are also used as light sources for pumping atoms in lasers to excited states to result in the emission of monochromatic light.

Pulsed lamps must be respected from the viewpoint that they contain very high pressure that can rupture explosively. Furthermore, the quartz envelope is dangerously hot (150° C) during operation. System-wise, very high voltage (+20KV) is necessary for triggering.

Pulsed lamps should be handled only with protective gloves and safety glasses, and only with welders type goggles when fired up. Very intense UV and visible light as well as IR can cause eye damage.

Pulsed UV light technology offers another UV source to be explored as new challenging UV applications are considered.

Chart and Photo courtesy Xenon Corp.