EPOXIES
INNOVATIVE BONDING SOLUTIONS ETC.

# UV Curing Adhesives & Potting Compounds

An Introduction to Ultraviolet Curing.

## Introduction:

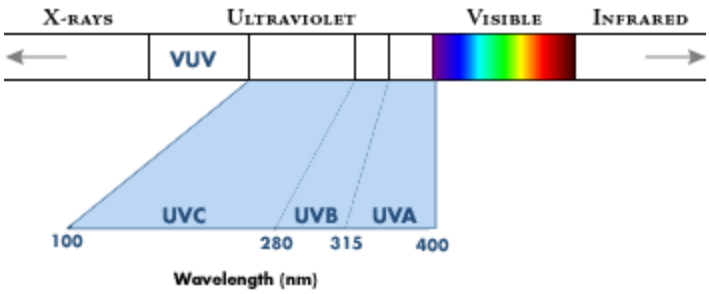
Recent advancements in ultraviolet curing have given engineers a new opportunity when choosing adhesives, potting compounds, coatings, and sealants. Until now, most of these systems were either two-component systems requiring mixing, one-component heat cure systems, or solvent-based systems. Ultraviolet curable formulations are materials that cure (harden or polymerize) when exposed to ultraviolet light. Epoxies Etc… has developed an extensive line of UV curing products designed to fit a wide range of electronic, aerospace, decorative, and medical device applications.

## Benefits of UV Curing:

- **Fast Cure:** Materials cure in a matter of seconds or minutes compared to hours.
- **No Waste:** UV curable materials are one component. The user can apply only what is needed to do the job.
- **Unlimited Work Times:** Unlike two component systems, which have a set pot life, UV formulations can be used with no time constraints.
- **Low VOC:** UV formulations do not contain hazardous solvents.

## What is Ultraviolet Light?

Ultraviolet light exists just below visible light in the electromagnetic spectrum. UV light ranges in wavelength from 100 to 400 nanometers and cannot be detected by the human eye. The UV spectrum can also be broken down further into three groups: UVA (315-400 nm), UVB (280-315 nm) and UVC (100-280 nm). UVB and UVC are higher energy and are generated from high intensity sources such as medium pressure mercury vapor lamps. Most photoinitiators absorb in the UVA and UVB region. For low intensity curing applications, fluorescent “black lights” are a convenient source of UVA.




epoxies.com
21 Starline Way
Cranston, RI 02921 USA
t 401.946.5564
f 401.946.5526

EPOXIES
INNOVATIVE BONDING SOLUTIONS ETC.

## Types of Ultraviolet Curing Resins:

The two major types of ultraviolet formulations are free radical and cationic. As expected, each of these two chemistries has advantages and disadvantages. The advantages of free radical systems are very fast cures, and the wide variety of raw materials available allow formulations to be customized to fit diverse applications. When a radical photoinitiatior is exposed to UV radiation free radicals are formed, initiating the reaction. When the light is removed, polymerization stops. The nature of this reaction requires a uniform exposure over the entire area being cured; this can be a disadvantage if there are shadowed areas. Free radical formulas may also suffer from oxygen inhibition. Oxygen inhibition retards the cure at the surface and can leave it slightly wet or tacky. This problem can be minimized by proper selection of the photo initiator and light source. More sophisticated cure units are available to displace oxygen with nitrogen in order to eliminate the inhibition.

Cationic formulations are composed primarily of cycloaliphatic epoxies. Among the advantages of cationic formulations are the lack of oxygen inhibition and the so-called "dark cure". When a cationic photoinitiatior is exposed to UV light a strong acid is released, this acid catalyzes the reaction. Since this acid is a true catalyst and is not consumed by the reaction, polymerization will continue when the light is removed. This can be beneficial to parts with shadowed areas, as long as these areas receive some minimum light exposure. A thermal post treatment is often recommended to complete the shadow cure. While cationic formulas generally cure more slowly than free radicals they offer improved thermal resistance and lower shrinkage. Choosing one chemistry over the other comes down to the requirements of the specific application.

Popular Epoxies Etc…UV Products

| *Free Radical* |
|---|
| 60-7105 - Adhesive |
| 60-7114 – Potting & Encapsulating |
| 60-7111 – Potting & Encapsulating |

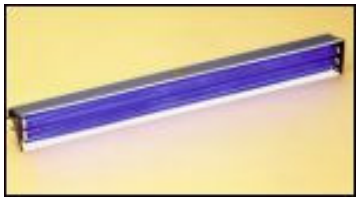
| Cationic |
|---|
| 60-7107 – Potting/Encapsulating |
| 60-7155 - Coating |
| 60-7156 - Coating |

## Choosing a Light Source:

Choosing the correct light source is critical to the end performance of the system. The photoinitiator in the formula must be matched to the spectral output of the lamp for complete cure. Below is a chart that describes the three major light sources that Epoxies Etc… offers. Each of these units is unique and offers advantages in production. Almost all of the UV curing products offered by Epoxies Etc. will cure under any of these light sources.

epoxies.com
21 Starline Way
Cranston, RI 02921 USA
t 401.946.5564
f 401.946.5526

EPOXIES
INNOVATIVE BONDING SOLUTIONS ETC.

| Light Source | Photo | Description |
|---|---|---|
| Blacklight |  | These lamps emit ultraviolet light in the UVA spectrum with a peak around 350 nm. With a relatively low intensity curing with these lamps generally run around 15 minutes. These lamps are the most cost effective way to enter the world of UV curing materials. |
| Conveyer Unit |  | These units utilize mercury vapor bulbs (as well as others) to produce UV light. With a spectral output of 240 to 500nm they have high intensity and cure material in a matter of seconds. These units work well for coating or potting in large areas like circuit boards. |
| Spot Cure |  | These Units also utilize a mercury vapor lamp, with outputs between 240 and 500 nm. Output of these units can be carefully controlled with the use of bandpass filters. These units offer more control than a conveyor unit and allows for the operator to aim light into areas that would normally be shadowed. |

Some of the important attributes of a light source leading to a proper cure are: power, spectral output, distance to substrate and the age of the lamp. Power output of a lamp is measured in watts. The higher the power of the lamp the more energy delivered to the substrate. This translates into a faster and a more complete cure. High intensity lamps also produce more heat. This must be considered when curing with heat sensitive substrates. The distance between the substrate and the lamp affects the intensity of the light on the UV resin. As the distance increases the intensity decreases leading to slower cure and reduced cure depth. Lastly, as a lamp ages its intensity begins to diminish and its spectrum can actually begin to shift. These three factors all play an import role in curing UV resins. A radiometer can be used to measure the intensity of the light source. This instrument allows the user to determine the optimal intensity for curing as well as monitor the quality of the bulb.

epoxies.com
21 Starline Way
Cranston, RI 02921 USA
t 401.946.5564
f 401.946.5526

EPOXIES
INNOVATIVE BONDING SOLUTIONS ETC.

## Safety:

Certain safety precautions must be taken into account while using UV light sources. Ultraviolet light is the cause of the common suntan and sunburn. While operating high intensity UV light sources special safety glasses should be worn. Always consult the Material Safety Data Sheet (MSDS) before using any chemicals. The MSDS will suggest the appropriate personal protection equipment. Refer to the manual and proper operating instructions for the UV equipment.

For more information, contact: Epoxies, Etc… 21 Starline Way, Cranston, RI 02921, Tel 800-Epoxies (376-9437) Fax 401-946-5526, www.epoxies.com

IMPORTANT:



epoxies.com
21 Starline Way
Cranston, RI 02921 USA
t 401.946.5564
f 401.946.5526