

# RECENT INDUSTRY TRENDS AND THEIR IMPACT ON THE USE OF UV- CURING AND EQUIPMENT DESIGN

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Recent worldwide trends are creating a confluence within the coatings and adhesives industries that could have a profound impact on the way these products are formulated and applied. Specifically, high energy prices and environmental concerns about carbon dioxide emissions are converging to put the spotlight on the use of thermal energy as the mechanism to cure these materials. Thermal curing, largely fueled by natural gas, has historically been the primary means for driving off solvents and water and accelerating the crosslinking of the resin, especially in OEM product assembly. The ovens required for the thermal curing are often inefficient (as measured by energy generated versus energy required to crosslink) and are modest sources of carbon dioxide. As a result, alternative curing technologies are gaining traction in North America, especially the use of ultraviolet light (UV).

UV-curing is widely accepted as the curing mechanism for wood coatings, plastic coatings and packaging overprint varnishes. In these applications the benefits versus thermal curing go beyond energy and environmental including:

- less capital investment
- less floor space
- potential for greatly enhanced coating/adhesive properties
- highly suitable for curing 100% solids formulations
- more suitable for curing coatings and adhesives used on heat-sensitive substrates such as plastics and wood.

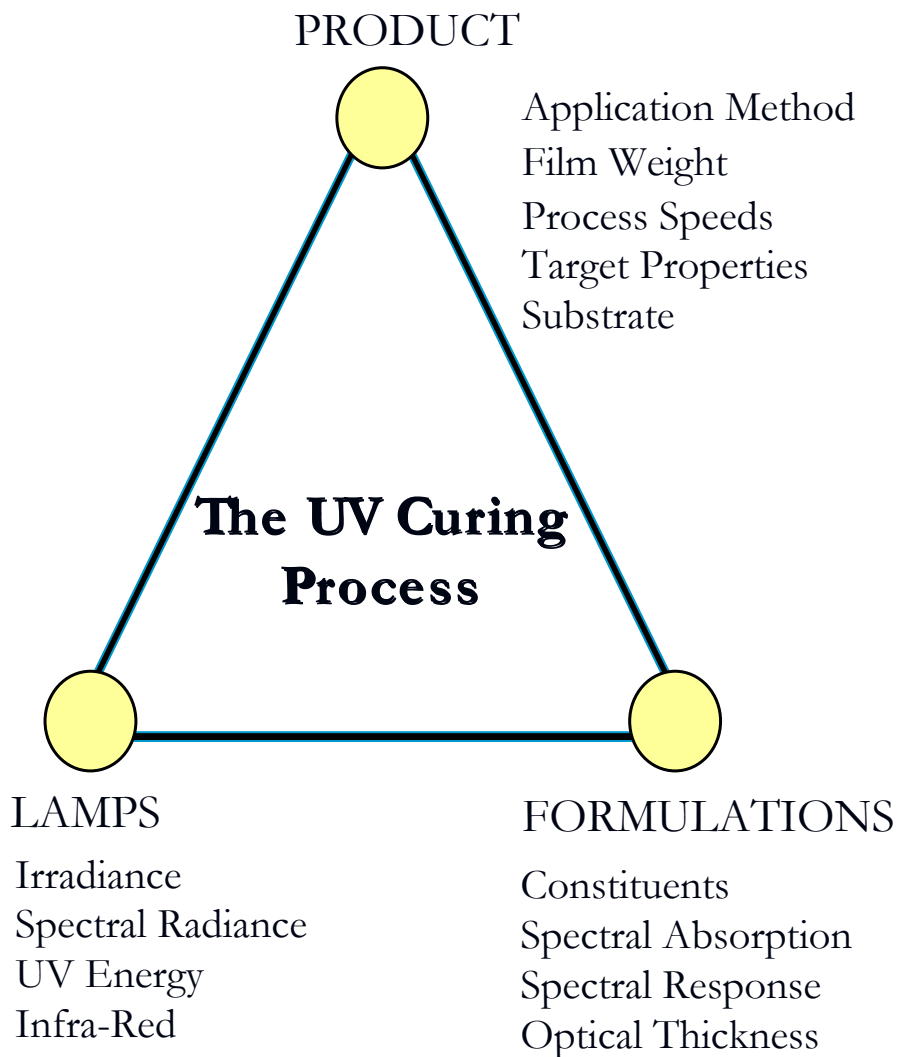
The use of UV-curing is emerging in adhesives as well with the total North American market for radiation-curing adhesives in 2004 estimated at \$225MM growing at 10%/yr. Of this total, UV-curing is estimated at \$75MM/yr growing at 12%/yr. Typical applications can be found in the table below.



<b>Product Assembly/Aftermarket Adhesives</b>
Headlamps
Sealing direct current motors
Electronics
Syringes and medical devices
Glass bonding
Fiber optics
DVDs
<b>Pressure Sensitive Adhesives</b>
Tapes
Labels
Release liner coatings
<b>Coated Abrasives Adhesives</b>
<b>Laminating Adhesives</b>
Paper to paper
Paper to wood

The equipment required to UV-cure can have an important impact on the finished properties as well as the cost to operate the application process. Substantial progress has been made in this area, specifically, the understanding of the relationship between performance properties and UV curing conditions. As a result, the communication between the various stakeholders in the process; end-user, process integrator, adhesive formulator and UV lamps supplier has significantly improved - delivering superior value to the customer. The graphic below demonstrates the process parameters that are integral to defining the UV curing process.





R. Stowe; Fusion UV Systems, Inc.



It is important to note the direction of the requirements of the process come from the end-user. Next, the formulator develops an adhesive that meets the customer's performance and productivity requirements. Then, the UV lamps supplier determines the best lamp solution based on the UV spectral requirements of the formulation and heat limitations of the substrate and how the UV lamp can be integrated into the system.

The specific UV lamp features that deliver key benefits are dependent on the end-use application and type of curing conditions. The primary UV curing conditions used with adhesives are defined as:

- Linear curing is used in web-based applications such as pressure sensitive adhesives, laminating adhesives and coated abrasive adhesives where a row(s) of UV lamps are suspended over the web
- Flood curing is used primarily in bonding adhesives, though linear curing can be used in high productivity applications such as DVD bonding, where high productivity is required and a larger surface area to cure.
- Spot curing is used in bonding techniques that require only a very small area to be cured.

Linear curing benefits from life of the system coupled with superior UV spectral output stability. The specific features of the UV curing equipment that relate to this benefit, has the most impact. Variable power supplies allow the curing conditions to be varied based on the product being coated and the speed of the line. Also, the recent development of solid state power supplies has shown benefits in lower power consumption, improved curing efficiency, and longer system life. Recently, some manufacturers have increased the warranties on the UV curing system and various consumables, thus lowering the cost of ownership.

Flood curing is used in many of the applications where spot curing is utilized, but there is a need for higher productivity. The primary configuration is a lamp mounted over an indexing or continuous conveyor. The key features of the UV lamps are usually the optics, IR output, and spectral stability.



Spot curing is the easiest process to test and apply to production. Key features are portability and flexibility. The units are portable and can be used by workers or integrated into automated dispensing and curing processes. Once again, the limitation is they can only be used to cure a small area.

Various coater manufacturers have made the investment in UV curing equipment on their pilot lines so process characterization and verification can be demonstrated to end-users. These pilot lines are also tools available to the other stakeholders; raw material suppliers, UV lamp manufacturers, and formulators to test and quantify the benefits of new product development.

UV-curing is well-established in the coatings and printing industries and will become increasingly accepted in the adhesives industry as users and formulators develop products and adhesives for the process. These innovations will result in higher performing products that use less energy, capital and have little or no solvent emissions.

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