HIDDEN ISSUES WITH UV ADHESIVE AND COATING APPLICATIONS

Richard B. Jones
Vice President

The ChemQuest Group, Inc.
Cincinnati, Ohio

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It is very well established that radiation cure plays a significant role in a wide array of adhesive and coating applications across a number of key industry segments (*see Figure 1*). According to a recent survey conducted by RadTech International, North American consumption of UV and EB products now stands at approximately 209 million pounds per year with an AGR of slightly better than 7%. The key drivers behind the growth of radiation cure over the past several decades are also well established: higher productivity, improved performance and environmental compliance. To that end, much has been written over the years regarding the features, advantages and benefits of radiation curing, along with numerous articles about UV/EB products and equipment. What are not often covered are the "hidden" issues associated with these applications – issues that are not often seen or experienced until after the process is up and running. Because UV curing constitutes the bulk of the radiation-cure market space, this article will only speak to that curing method.

As with any adhesive or coating application – regardless of curing mechanism – there is always the balancing act between **Product**, **Process** and **Part** (*see Figure 2*). This is hardly a new concept, yet many of the hidden issues are rooted within and/or between these key elements.

Let's start by looking at **Product**. As we know, it is the various constituents of a formulation – polymer system, additive package, curing mechanism, rheology control, etc. – that determine the basic performance characteristics of the final **Product**. Yet, not all UV adhesives or coatings are alike. For example:

- Have such factors as bond-line or coating thickness on the **Part** been factored into the amount of photoinitiator in the **Product** formulation?
- Has the amount of photoinitiator in the **Product** been balanced against the **Process**, i.e. the amount of energy (line speed vs. lamp intensity) that the **Part** will typically see?

As noted earlier, some of the key features of UV-cured **Products** are higher physical properties and better part performance versus standard curing systems. Unfortunately, there is often a misguided sense, though, that UV-cured systems are so much better that they are seemingly "bullet-proof". Like any adhesive or coating system, **Product** physical properties need to be matched to the ultimate **Part** performance specifications, thus avoiding the myth that UV will figuratively "cure all ills".

Finally, no **Product** discussion would be complete without touching on health and safety issues associate with UV-cured **Products**. In general, UV-adhesives do not require any special handling over and above what is customarily done for non-UV adhesives. Such is not the case for monomer-based UV coatings which are the workhorse of this category (as opposed to such alternatives as monomer-free or water-based UV coatings). In that about 1 person in 12 has an inherent dermal sensitivity to these monomers, efforts always need to be made to insure that workers do not come into skin contact with such products via wearing proscribed protective gear. An additional consideration for monomer-based UV coatings is that they must never be sprayed unless used in an automated, controlled chamber, or unless the sprayer is in a full protective suit. Such considerations, though, are not required if application is via brush, rollcoat, flowcoat or curtaincoat.

As for the **Process**, this incorporates not just the application and curing equipment, but also line set-up and maintenance. While it was noted earlier that **Product** formulation dictates the basic performance characteristics, it is the **Process** that determines the degree to which those properties are achieved. There are many examples where a good **Product** was "ruined" by a poor **Process** due to inadequate equipment, poor lay-out and/or ineffective maintenance. Conversely, a good **Process** can often compensate for an average **Product**. While application and curing equipment for UV adhesives is not much different in price or maintenance than for standard adhesives, the same cannot be said for UV coatings which involve bigger lines and apply larger volumes of material than UV adhesive operations. As a result, capital costs are significantly higher than standard coating lines. A bigger issue, though, is that many UV coating operations do not provide for a commensurately higher level of monitoring and maintenance to be sure that the **Product** is seeing the required energy, e.g. correct line speed, clean lamps, focused reflectors, etc. In short, routine line surveys are a must to insure that the high-productivity **Process** is operating as designed to avoid putting out a high volume of unsatisfactory **Parts** either because of too much or too little energy.

Finally, the **Part** substrate and its geometry are only a few of the factors here that need to be considered. Substrate chemistry, cleanliness and surface energy are no less an issue for UV applications than they are for standard applications. Yet, because of UV's high productivity, substrate consistency is paramount because it does not take long for such high-throughput **Processes** to generate a lot of scrap due to poor **Product** adhesion. As for **Part** geometry, a UV limitation is the need for line-of-sight between the photo-reactive sites in the **Product** and the proper energy output of the **Process**. This can be

particularly problematic for UV adhesives where at least one of the substrates must be transparent to the applicable wavelengths to initiate the reaction. While dual-cure and cationic-cure are two ways around this problem, there are compromises with these alternatives that would need to be factored into the considerations. As for UV coatings, curing one-dimensional **Parts** is a very mature art. It is curing in two and three dimensions that can be problematic and must be factored into the **Process**.

The success of any adhesive or coating application has been, and always will be, a function of maintaining the balance between the **Product**, **Process** and **Part**. This certainly is the case for UV adhesives and coatings, which have many "hidden" issues that need to be addressed. Higher productivity and performance are the norm with UV-cure. Yet, high volume of sub-standard **Parts** can quickly result if the **Product** and the **Process** are all not in synch.

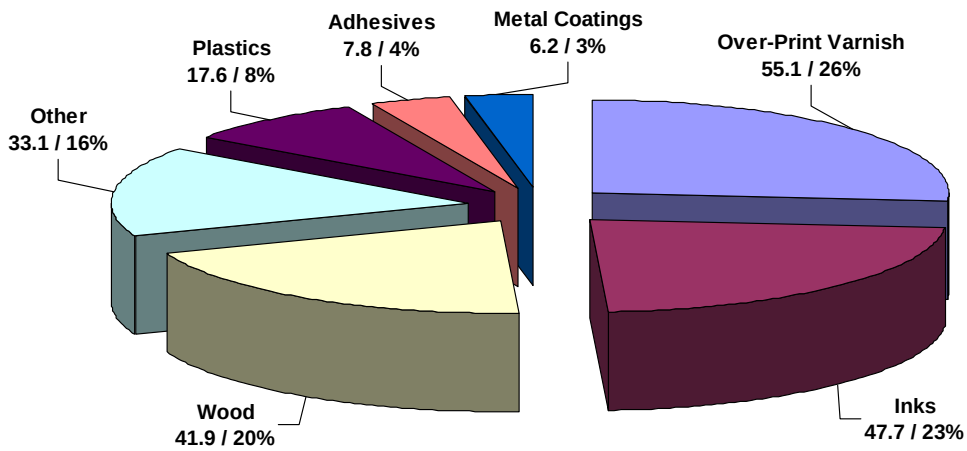

Figure 1

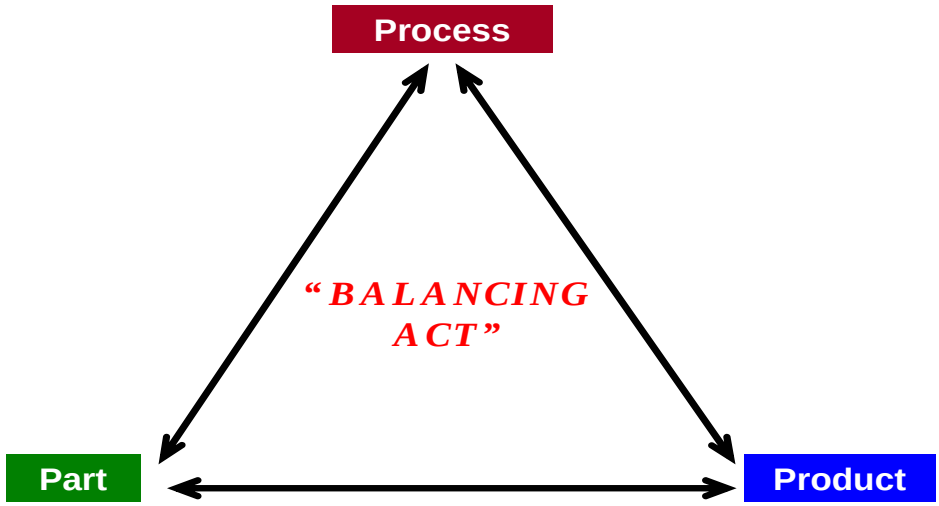

Figure 2

About the Author

Richard B. Jones
Vice President
The ChemQuest Group, Inc.
www.chemquest.com
an international strategic management consulting firm specializing in the adhesives, sealants and coatings industries, headquartered in Cincinnati, Ohio. Call them at (513) 469-7555.

Richard B. (Rick) Jones joined The ChemQuest Group, Inc. in September 2006 from Valspar Corporation where he was Business Director / Floor, Door and Window Coatings. Previously, he spent twenty-eight years within the adhesives and coatings businesses - from PPG Industries to Lord Corporation and Sovereign Specialty Chemicals. His entire career has focused on business management, marketing and technical aspects with expertise in automotive refinish, auto/truck assembly, industrial products, global automotive and aerospace OEMs - in addition to wood coatings product development and sales. Rick holds a B.S. degree from Allegheny College, Meadville, PA..

Questions or request for additional copies of this paper may be directed to the author at:

The ChemQuest Group, Inc.
8150 Corporate Park Drive
Suite 250
Cincinnati, OH 45242

(513) 469-7555
(513) 469-7779 – FAX **www.chemquest.com**