

• UV CURING:

HEALTH & SAFETY

By Anthony J. Bean and Joann Cortese

• The use of UV curing materials, inks, coatings and adhesives has become more commonplace in the last 10 years, yet many of the misconceptions about UV that have existed since the early days of the technology live on like ghost stories around a camp fire. The simple truth is that UV curing inks, coatings and adhesives, like all chemistries, do have some health and safety concerns. Those concerns are no greater than for conventional chemistries and in many cases are actually less of a concern.

• It is important to know what concerns exist so that they can be dealt with properly. The purpose of this article is to identify the health concerns currently associated with UV curing and to compare some of the associated health risks when using conventional chemistry. Since UV curing products are supplied by many companies, some being more responsible than others, it is always best to check with the supplier to ascertain any special concerns with the specific products.

• When evaluating the safety concerns associated with the handling of a product in a production environment, there are three basic routes of exposure for every chemical – ingestion, inhalation and contact. Although the oral toxicity of materials typically used in UV curing inks, coatings and adhesives is very low, it is certainly not recommended that any of these materials be consumed. Most would regard any inference to ingesting ink, coating or adhesive as a joke, but poor hygienic conditions can lead to accidental ingestion. Failure to wash or improperly washing hands prior to taking meal breaks can lead to very small quantities being ingested through the handling of the food or beverage. This should and can easily be avoided by following good hygiene practices. Whether the product is UV or conventional, care must be taken to avoid ingestion of all chemicals.

• A major concern with conventional chemistry is the fact that these formulations contain chemicals that are volatile. Volatile

chemicals may release vapors that can then be inhaled by workers. Typical UV formulations do not contain solvents and do not contain VOCs. This eliminates the considerable health risks associated with vapor inhalation. Table 1 compares the toxicity of several typical UV curing materials and several solvents. TMPTA is trimethylol propane tri-acrylate, a common monomer used in many UV and electron-beam curing materials. The oligomers used in UV and EB products are much higher in molecular weight so the properties for the categories listed in the table are the same for most oligomers.

A Comparison of the Toxicity & Other Properties of UV-Curable Ink Components & Some Commonly Used Ink Solvents

Chemical	Flash Pt.	VOC	Hazardous Waste	Community Right to Know List	Systemic Skin Irritant	Toxicity	Reproductive Effects
TMPTA	>212° F	No	No	No	Yes	No	No
Oligomer	>>212° F	No	No	No	Maybe	No	No
VM&P Naphtha	<0° F	Yes	Yes	No	Yes	Yes	No
Toluene	40° F	Yes	Yes	Yes	Yes	Yes	Yes
Xylene	100° F	Yes	Yes	Yes	Yes	Yes	Yes
1-Butanol	100° F	Yes	Yes	Yes	Yes	Yes	Yes
2-Butoxyethyl Acetate	190° F	Yes	Yes	Yes	Yes	Yes	No

- Toxicity through inhalation and ingestion is not typically a concern with UV curing materials. Skin contact is. After looking at Table 1, one might conclude that the UV materials are not much different than solvents with respect to skin irritation. In the purest form, this statement is true for laboratory testing but in the real world, a slightly different situation exists. Since solvents are volatile, the duration of the skin exposure to the solvents in a typical pressroom situation is minimized. Because the UV materials do not evaporate, skin exposure continues until the materials are washed away. Due to this longer skin exposure, the real world effects are greater for the UV materials.

- Acrylate materials in UV curing materials can also sensitize a person over a period of exposure. This means that although a person is not currently sensitive, prolonged exposure (caused by poor industrial hygiene) can lead to a sensitivity and allergic reaction. Since people have various metabolisms, the impact on each individual will vary. Rather than be the “macho” person and tempt fate, it is best to avoid contact whenever possible.

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- One other concern in UV curing is the safety of the UV lamp system which is necessary for the technology. Other than the typical electrical and heat concerns a printer deals with, UV curing systems introduce intense UV light into a printing line. Fortunately, UV light does not reflect significantly from most surfaces. This means that if a worker does not have a direct line of sight to the lamp or the reflecting surface of the reflector, there is not typically a significant amount of UV energy to worry about. The fact that visible light can be seen does not mean that significant UV energy is present. Normally, even escaping visible light is minimal with a well-engineered UV lamp system. If a large amount of light is escaping, it can usually be blocked with a minimum amount of shielding. The system supplier should be notified of any concerns and a check for UV light with a meter can easily determine if a problem exists.

• The other health concern about the UV lamp is the generation of ozone. The interaction of short-wavelength UV light with oxygen causes the generation of ozone. Although it is possible to use an “ozone free” lamp, the negative impact on curing is significant enough that very few people have continued to use these lamps once they see the results. Due to the need to cool the lamps, most suppliers handle the ozone concern by ducting the ozone away from the work environment and also helping to cool the lamp. Due to the high reactivity of the ozone, the material will typically decompose back to oxygen while traveling through the exhaust system.

• In other areas of safety relative to the environment, UV chemistry is superior compared to conventional solvent- and water-based technologies. In addition to the volatility (VOC) issue, UV materials typically do not contain any compounds which must be reported under section 313 of the Superfund Amendments and Reauthorization Act (SARA), and do not contain any materials that are classified as hazardous air pollutants (HAPs). As long as the UV materials are not contaminated, they are not usually regarded as hazardous waste and unlike water-based materials, have an excellent BTU value for disposal as fuel. Table 2 summarizes some of these issues.


Permitting Requirements & Pollution Potential of UV, Solvent-Based & Water-Based Inks.


	UV	Solvent	Water
VOC •	Nil	Yes	Yes
HMIS •			
- Health •	2-3	2-3	2-3
- Flammability •	1	1-4	2-1
- Reactivity •	1-2	1-4	2-1
SARA 313 Reportable •	Not Usually	Maybe	Maybe
Calif. Prop 65 •	Maybe	Maybe	Maybe
HAPs Permitting •	No	Permit Needed	Permit Needed
RCRA •	Not Usually	Usually	Usually

• As a further indication of the positive aspects of UV technology, the South Coast Air Quality Management District in California has removed the need for permitting UV and EB presses going into its area. This action follows the comments by the EPA in congressional hearings where the EPA stated that it would like to see more UV and EB curing implemented due to the positive environmental impact of the technology.

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• The use of UV curing usually leads to a safer working environment. First, the use of solvents is minimized. Since the materials do not “dry up” during down times, they actually require less cleanup which also reduces the use of solvent in the pressroom. Press crews that have had the chance to work with conventional chemistries generally prefer the UV technology because their press work is easier. Certainly the move of UV curing into narrow web has been spectacular. The growth in the wide web arena is just a matter of time (and economics).

• So given the inevitability of the continued acceptance of the UV process, what are the proper safety procedures for working with UV materials? The answer to this rhetorical question is nothing more than having an appropriate program for handling any chemistry in a pressroom. Of prime importance is to read, understand and follow the comments of the suppliers MSDS. Not all materials are created equal. Some products are safer than others. Read the MSDS and once an understanding of the MSDS is established, any special concerns can be addressed. Since the primary concern with UV materials is skin contact (no inhalation or ingestion), the response is to establish a program to minimize or eliminate contact. Use protective clothing, gloves, eye glasses and even full-face shields whenever possible. In addition, barrier creams and lotions are effective but should only be used in conjunction with gloves. If contact does occur with a UV material, wash the affected area with soap and water. Do not use solvents. These procedures are nothing more than good industrial hygiene and should be implemented regardless of the chemistry being used. 

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