Safety and Environmental Issues of UV Coatings: An End User's Perspective

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Recently, management at Anderson Lithograph recognized that there appears to be a significant amount of confusion and incorrect information being circulated throughout various sectors of the graphic arts industry concerning the safety and environmental impact of liquid lithographic coatings used on in-line heatset web offset press applications. Specifically, we have been told that comments have been made within the marketplace to the effect that either the specific UV coating materials and application processes used by Anderson Lithograph, or these materials in general, pose significant safety hazards, and/or are "environmentally unsafe."

As a leader in the application of liquid lithographic coatings technology for high-quality commercial products, Anderson Lithograph believes that it has a responsibility to its customers to clarify some of these misconceptions. In order to properly address these incorrect statements, and provide the reader with as complete an understanding of coating materials and their application as possible, this article has been structured to address these statements in their broadest sense. Specifically, that they encompass all aspects of the product life cycle: (1) the virgin product itself, (2) its use in the printing process, (3) waste byproducts generated from its use in the printing process and (4) the disposal of the finished product at the end of its useful life.

This article is intended as a general information guide, or synopsis; to fully understand the safety and environmental aspects necessitates references to and discussions of the technical aspects of the coating products themselves, and processes and equipment used in the application of these coating materials.

Product Background — Three Types of Coating Systems

There is a significant amount of confusion in the marketplace regarding coatings of the type that we utilize in our heatset web offset printing process. The product we use, trade name Litho UV, is manufactured by Reliance Universal Inc., a division of Akzo Coatings Inc. It is a true ultraviolet (UV) coating product. It should not be confused with the other two classes of liquid lithographic coating materials, namely waterborne emulsion and waterborne catalyzed.

These two coating systems present greatly increased environmental hazards and cost of application, and offer less gloss and abrasion resistance than UV coating systems. When liquid lithographic coating systems for heatset web offset presses are discussed by those not totally familiar with their use and application, the characteristics of each are not distinguished, and confusion between them often results.

Waterborne Emulsion Coatings

These systems may be applied over existing inks (wet trap) using an existing printing unit or a separate print tower before the normal gas-fired dryer. They can also be applied over existing inks after they are dried (dry trap) using a separate tower and gas dryer, or by passing the web back through an open, or second, conventional dryer pass. They offer the least gloss and abrasion resistance of the three types of coating systems.

These systems contain as low as 40 percent solids, with the balance being comprised of water and some inorganic carrier solvents. The latter portion representing increased health hazards over UV coating systems. The solids portion of product is comprised of polymers of high molecular weight, which make their biodegradability (digested by microorganisms) highly unlikely. They are typically photodegradable (via exposure to ultraviolet light). However, papers coated with this type of coating are generally repulpable for reuse in printing papers and other paper-based products.

Waterborne Catalyzed Coatings

Waterborne catalyzed systems generally utilize the same application methods and processes outlined above for waterborne emulsion coatings. However, wet-trap applications range between difficult and impossible, because of the high temperature required for their proper curing. Where applied over wet standard heatset web offset inks, the coating, when exposed to the curing source (heat, web surface temperature of 220–250°F) seals over the inks. This prevents proper drying of the ink system by trapping the slower-evaporating ink solvents and preventing them from escaping into the dryer exhaust stream.

These conditions usually result in surface blistering, and therefore unacceptable quality in the final printed product. The gloss and abrasion resistance levels exceed waterborne emulsion coatings but fall short of UV coating systems.Waterborne catalyzed coatings are more expensive to apply because of their percent of solids content and the high energy costs associated with curing.

These coatings contain 50–85 percent solids, with the balance comprised of an organic cosolvent. These coating systems require high temperatures to cure, such as what would be generated with a separate gas-fired dryer. Some of the coating products of this type contain melamine or urea resin systems, and free formaldehyde. Given the high heat cure requirements, they will produce formaldehyde as an application process byproduct.

Formaldehyde is listed by the EPA as an "extremely hazardous material," known to cause reproductivity toxicity and listed by OSHA as an anticipated human carcinogen via the National Toxicology Program (NTP) and the International Agency for Research on Cancer (IARC). Furthermore, the acid catalyst (found in the melamine or urea resin systems) required to cross link (cure) the coating under heat application, is corrosive to machine parts and presents a significantly increased exposure hazard to humans handling the product during application process.

Ultraviolet Coatings

Coatings in this category are generally applied via a free-standing coater and curing system, which follows the heat-set web offset ink curing system, press dryer and chill rolls. Hence the coating is applied (dry trap) over the cured offset inks. The UV coating system is a self-contained unit consisting of a coater, UV curing unit and a closed-loop product pump and recirculating system. This coating system offers the highest levels of gloss and abrasion resistance of the three coating systems, and the least cost of application, based on the product being 100 percent solids and using low-cost, clean, electric energy to effect proper cure.

The UV coating utilized by Anderson Lithograph is of this type. It contains 100 percent solids, no carrier solvents or cross-linking catalysts. The solids comply with all U.S. Environmental Protection Agency, California Air Resources Board (CARB) and South Coast Air Quality Management District (SCAQMD) regulations and standards for volatile organic compound (VOC) exposure and emission limits.

The solids/chemicals contained in the formula of this product are listed as having only mild eye and skin irritant exposure hazards during handling and application, and present no chronic health hazards from overexposure. There are no ingredients in this product formula that are listed by NTP, IARC or OSHA as being carcinogenic or causing any form of reproductive toxicity. This is unlike some other UV coating products currently being manufactured, which may contain chemicals that are listed as carcinogenic.

UV coatings can be manufactured without these carcinogenic chemicals in their formulas (as is the case with the product we use) without affecting the gloss, abrasion resistance, operating characteristics and costs associated with UV coating products. As such, this product can be handled within our work environment with reasonable housekeeping and worker hygiene practices that we utilize on a daily routine basis for the handling and application of the bulk products used in the pressroom operating environment; e.g., inks and solvents, etc. Specifically, we use gloves and safety goggles when handling this product as part of our normal operating handling procedures to minimize human exposure and the possible mild skin and eye irritation that could result. The product requires no specialized or hazardous solvents for clean up. Machinery parts, rags and clothing can be cleaned using soap and water or mild laundry detergents.

There have been rumors that the EPA has banned UV coatings in several states. There is no documented evidence of this and it is unrealistic considering that the UV coating market represents over $300 MM in sales annually for printing, floor coverings and furniture product applications — to name a few. On the contrary, EPA has looked upon these coatings as a favorable means to reducing volatile organic compounds and hazardous air pollutants, and EPA Administrator Carol Browner recently touted the benefits of UV coatings in testimony presented to Congress.

UV Coating Process Application Byproducts

The in-line application process of UV coating on high speed heatset web offset presses, with its separate coater and curing unit produces no "resident" or residual ozone emissions. Further, it does not produce other VOC emissions that do not meet current EPA, CARB and SCAQMD regulations and standards.

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VOC emissions generated during the curing process are evacuated via a negative air pressure hood into the normal press dryer exhaust stream and fed into an approved air pollution control device, which cleans the stream by incineration at 1400°F to effect a clean-up efficiency of 99.9 percent. The major byproducts of this clean-up process that are expelled into the environment are water vapor and carbon dioxide.

Not unlike most printing processes, the application of a UV coating does produce some waste. The virgin UV coating material left in the coater application unit after completion of a job run is removed, placed in a container and returned to the manufacturer for recycling as make-up product in the production of more virgin UV coating material.

Waste paper, containing dried ink solids and UV coating materials, are collected and sent to waste-paper recycling operations. The polymeric solid compounds in this UV coating product are not ideal for repulping into fine printing papers. However, like waste signatures produced on machine-coated paper substrates that contain normal web offset ink products, waste signatures of this type with the added feature of UV coating can be recycled, via de-inking.

Some examples of these recycled product uses are groundwood for newsprint, chipboard, roofing materials, boxboard, inexpensive simulated wood furniture and certain grades of tissue paper. Waste-paper collectors like Continental Paper Grading and waste-paper processors like James River Paper have indicated that their demand for paper waste containing UV coating are dramatically increasing, especially with respect to their use in the production of tissue paper products for the European market.

Environmental Impact of End Product Disposal

As previously noted, UV coating materials by themselves are not readily biodegradable because of the high molecular weight of polymeric compounds comprising their formula. UV coatings are photodegradable, meaning they break down when exposed to an ultraviolet light source, such as the sun.

The real environmental question is not biodegradability as most of the verbiage in the press would lead one to believe. The majority of U.S. landfill operations where solid waste is deposited are "sanitary landfills" — the type favored by the EPA. In these landfills the solid-waste materials are purposely kept dry to avoid leachate, control conversion of materials and avoid the health risks associated with the more rapid biodegradation process attributable to wet compost type solid waste disposal environments.

Studies conducted by the University of Cincinnati, in cooperation with the EPA Office of Solid Waste, indicate that there is only a 7 percent change in volume over 10 years in solid waste landfills. This is in light of the fact that over 60 percent of the total solid waste materials contained in sanitary landfills are biodegradable (paper and cardboard products representing about 36 percent).

As can be seen from the results of these studies, degradation, whether bio or photo, is a very slow process. Further, the studies have shown that there are a minimum of 32 variables that affect the rate of decomposition of materials in such landfills: pH of the soil, moisture content and temperature are but a few. Given these factors, biodegradation or photodegradation are but only two of the some 32 variables that determine the rate of volume change over a given period in a landfill. Further, they are not independent of, but dependent upon the other variables. Biodegradation in the composites that make-up a product is beginning to become a moot point because of these factors surrounding solid waste landfills.

Hence, the real focus of the EPA's Office of Solid Waste has been redirected toward presegregation of waste to enhance the recycling of waste solids into useful products and/or fuel sources, through environmentally safe processes. Printed products, including those with UV coating materials applied to them, are certainly prospects for recycling, which provides a much better solution for solid-waste disposal than relying solely on bio or photo degradation in solid-waste landfills.

As a solid-waste class, printed materials, with or without UV coating, are considered by the EPA to be in the nonhazardous materials class for landfill purposes. They pose no unsafe conditions to the environment as a solid waste.

I hope that this information provides some factual and definitive criteria upon which to evaluate the question of the environmental safety aspects of using UV coatings.

About the Author

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