Printer demands give rise to UV inks

(Converting Magazine® June 1997)

As concerns over environmental issues, process efficiency and image quality continue to grow, use of UV inks gains ground.

By David Lanska
Narrow Web Sales Manager
Stork Cellramic, Inc

As industry demands visual impact, printers seek to add color density while preserving or even enhancing the image quality. It is the ability of untraviolet-cured inks to positively impact color density and image quality, while facilitating improvements in print efficiency, that explains its rising popularity. The most significant reason for the growth of UV inks is concern over environmental issues.

In an era of environmental awareness and intolerance for environmental hazards, waste disposal issues are becoming a driving force in the choices printers and ink manufacturers make. Consequently, printers have migrated to water based inks wherever applicable. However, water based inks can be very unforgiving. Left open to air just once, water-based inks can dry in the anilox roll's cell structure, reducing cell volume and necessitating removal of the roll from the press for cleaning.

It is easy to understand why plugging has become such a universal problem when you consider the increasing demands placed on press component manufacturers and ink makers.

What printers want

- More colors
- Heavier ink coverage
- Inks that dry faster
- Inks that don't run, (i.e. stay put)
- Durable and rub-resistant images

In the face of these demands, most manufacturers have done what they can to accommodate their customers. Some ink manufacturers have come out with "new and improved" formulations.

It stands to reason, however, that if an ink dries quicker on a substrate, it will dry quicker in the cells of the anilox rolls. If the ink is more durable on the substrate, it will be more difficult to remove from the cells.

Anilox roll manufacturers are faced with similar printer demands. For example, chrome engravings with shallow cells have been replaced with steep-walled laser engraved cells. Cell depths have increased. Cell openings have decreased as linecounts have increased. The demand for maintaining or increasing ink density while simultaneously providing finer distribution has increased. There are two problems with these scenarios: Deeper cells do not typically release ink as well and finer engraving provides a greater cell wall surface area for the ink to adhere to.

By pushing to achieve greater printing impact, printers and component manufacturers have created a big problem-removal of dried ink resins can be expensive, aggravating and nearly hopeless. The proliferation of equipment, supplies, techniques and services for cleaning anilox rolls gives testament to the scope of the problem of plugged cells.

Existing rolls can be used with UV

The good news is because UV inks do not dry in air, they do not tend to plug the cells. There is no component that evaporates, so there is no need for cleanups between press runs. The press could even be left over the weekend without cleaning and be ready to go on Monday.

It is important to recognize that print quality is the cumulative result of the entire ink distribution system.

UV inks act like liquid plastic. As the ink is exposed to UV radiation, a chemical reaction takes place during which time the photoinitiators cause the ink components to cross-link into a solid. Assuming all of the ink transfers from the cells to the substrate, to achieve the same color density previously attained with water-based ink, the anilox roll would have to be specified to deliver about 35 percent less ink to the substrate. Of course, viscosity plays a key role in determining the percentage of ink to transfer.

UV inks are typically very thick. Although lower viscosities are available, UV inks generally range from 1000 to 5000 centipoise, as compared to 100 centipoise for water-based inks. It would be reasonable to expect water or solvent inks to more readily transfer from the engraved cells to the substrate.

It is important to note that printers are experiencing good results with rolls manufactured to specifications established for water and solvent inks. Existing anilox rolls can be used for printing UV inks and to provide a benchmark for specifying new anilox engravings. Transfer factor aside, the significantly thicker consistency of UV ink can benefit the print quality by reducing color bleed and dot gain.

Because 100 percent of the material applied to the substrate remains after curing, there is the potential to achieve greater densities with UV inks than with conventional inks. Due to the higher viscosities, UV inks tend to stay where they are placed. Dot gain is negligible, resulting in exceptional image sharpness. For that reason, UV inks work well for printing fine line, process and vignettes.

Cured UV ink provides many desirable end-use qualities, including excellent rub-resistance, chemical resistance, exceptional color consistency and superior gloss. Although functions of the pigment, UV inks also provide lightfastness and opacity.

One of the greatest advantages of UV inks is that they do not change consistency due to evaporation or pH. Without manipulation, the ink maintains consistency throughout the duration of a press run. And because the ink does not dry in the cells, significant savings can be realized in terms of labor, consumables, anilox roll cleaning expenses and roll refurbishment.

With typical water and solvent-based inks, evaporation results in a system where the constant is variability. Over time, the ink changes its viscosity and affects the laydown. Ink resins dry in the cells of the anilox roll resulting in further changes to the laydown. Press operators attempting to correct for changes in ink density add extenders and other additives to the ink. Degradation of print quality results as the anilox continues to plug. The ink is further altered until its consistency has little resemblance to the ink the job was started with.

Paying attention to housekeeping

Because of the tendency of traditional inks to plug the anilox rolls, it is necessary to pay careful attention to press-side housekeeping practices. Even rolls idling for minutes can begin to plug. When this happens, the rolls must be removed from the press and cleaned with aggressive chemicals or harsh agitation, either of which can damage the fragile, engraved cell structure. Some water-based inks have a catalyst component, which undergoes a chemical reaction that links the chemical structure to create an ink layer almost impervious to all but the harshest cleaning approaches. When these inks harden, they do not re-wet and predicate the need for the anilox roll to be resurfaced at considerable expense.

To reduce the likelihood or at least slow the process of cell plugging, printers must clean the rolls on press before each occasion when the press will be idling, as well as between print jobs. To purge the cells and plates of any residual ink and cleaning chemicals, the press is run until the web is clean. Over time, repetitive cleaning can result in substantial costs associated with waste materials and disposal.

When the press is down for cleaning, it is not producing. Press operators and maintenance people have to spend their time manually cleaning the rolls. Manual cleaning is messy and time consuming, and with the growing trend toward higher cell counts, has limited effectiveness. Unfortunately, sooner or later even the best efforts at cleaning will succumb to cell plugging. This does not happen with UV ink because it stays wet and maintains consistency until it is exposed to concentrated UV energy. Over the course of a year, improvements in press utilization can be substantial.

Drawbacks include lamps that add heat

Printing with UV inks does have some drawbacks. While waste and maintenance costs are less, startup and operating costs are higher. Because the inks are not manipulated, print color is adjusted by the choice of anilox roll. This may predicate the need for having a wider assortment of anilox rolls in-house and more precisely specifying cell characteristics for a given print job. To shorten the learning curve, it may be advantageous to test print results with a banded anilox roll. In any event, switching to a new system invariably results in expenses, errors and waste until the system is understood and the parameters fine-tuned.

Because UV inks do not dry, any small spill can end up being a large mess. Ink can be tracked from department to department on people's shoes. UV inks can damage clothes and irritate the skin. Some press operators can even experience allergic reactions to UV ink chemistry. Care must always be taken to prevent direct contact with the skin.

UV inks do not adhere well to some poly substrates. In order to raise the surface tension sufficiently to achieve good adhesion, the web must first receive corona treatment. Because UV inks are thick and do not flow easily (the same characteristics that make them ideal for fine line and process work), the have problems with printing smooth, consistent solids. In particular, the microscopic turbulence and surface tension of anilox rolls engraved to 60 degree results in extensive pinholing. There is almost universal agreement that pinholing is reduced with a 30 degree cell placement pattern.

Printers already achieving desired print quality levels might want to carefully consider if potential quality improvements are worth the price.

UV inks require special lamps that focus energy onto the web surface. The purchase of the lamps represents a significant upfront capital cost. In addition, it might be necessary to purchase equipment to dissipate some of the heat from the press. Even daily operating expenses are higher due to higher energy consumption for the UV lamps. Printers already achieving desired print quality levels might want to carefully consider if potential quality improvements are worth the price.

While the curing mechanism is the UV spectral component of the light, the lamps emit a significant amount of infrared energy. The IR energy offers no benefit and actually has the negative effect of inducing heat onto the web surface.

During an idle cycle, the web can scorch and even break. This potential can be reduced and energy savings realized by adjusting the output power of the UV lamps relative to press speeds and ink thicknesses delivered at a given print station. It is important to specify lamps with reflectors suited to the ink film thicknesses most often encountered.

UV is not for all printers or all situations

Potential gains in color density and image quality have to be carefully weighted against conversion and operating costs. The quality demands of the typical print jobs run should be the determining factor. It is important to recognize that print quality is the cumulative result of the entire ink distribution system. Each of the components can add or detract from the finished result, UV inks can be the vehicle for achieving outstanding print results. In all likelihood, however, most printers can achieve better results than they are currently getting just by fine-tuning their current process.

There is no question that the use of UV inks will continue to rise, given the advantages they have over water and solvent-based inks. As concerns over environmental issues, process efficiency and image quality continue to grow, UV will continue to gain ground.