Advancements in UV-Hybrid Inks

By Don Duncan

UV hybrid *raison d'etre* or "Wot's up wid'dat?" The concept of UV-hybrid inks evolved in the 1996-1998 era as a means to simplify the life of printers. "Best-laid plans of mortal men," etc. The idea was that many litho printers, both carton and commercial printers, wanted to put a very high-gloss coating over their oil-based lithographic inks. Water-based coatings, which are easily applied in-line, gave 60° gloss numbers in the 50s-70s, depending on the substrate. UV coatings were well known to be able to reach 90-100 in gloss, so there was great interest in using them. However, when a UV coating is applied and cured over a still-wet oil-based ink, there is a substantial drop-off in gloss over a day or two as the ink dries. A 95 gloss right off the press might be a 65 in two days.

However, after some clever formulating,* voilà—*an ink that will UV coat in-line without gloss back, that will run on conventional rubber rollers and blankets and that will cure with less than full UV-interstation curing.

One solution was to apply the UV coatings off-line, after the inks have dried, but that requires a two-step manufacturing process. Some printers had to send their printed work out for off-line UV coating. Another solution was to use a double coater, and apply a water-based primer in-line over the wet litho ink immediately followed by in-line UV coating. This works, but it requires a double coater and it requires the printer to purchase two products to do one job.

The UV-coating formulators expressed sympathy for the situation, but essentially just sang, *"Qué será, será,"* and declared it to be an ink problem. Ink formulators began looking for creative ways to address the problem. Ink folks already knew that the gloss-back problem did not exist with UV coating over UV ink, but UV ink required some changes in rollers and blankets, as well as the installation of UV lamps. However, after some clever formulating, *voilà*—an ink that will UV coat in-line without gloss back, that will run on conventional rubber rollers and blankets and that will cure with less than full UV-interstation curing. These are the three core tenets of UV-hybrid technology. The inks are thus "hybrid" between conventional oil-based inks and what are now known as "full UV" inks.

What Were They—What Are They Now?

When the earliest versions of UV-hybrid inks were put on press in 1997-98, the idea was to put a little UV-curable material into an oil-based ink to make a stronger ink/coating bond through a cross-interface curing mechanism. It sounded good, it looked good on paper, it worked OK in the lab, but saying it was "somewhat unsatisfactory" on press doesn't begin to cover it.

Like many broad-based technology innovations, there were many people in several different companies pursuing the answer to this problem

simultaneously, not just some *Wunderkind.* This led to a critical mass of work being done, so that there was sufficient discussion among ink companies, varnish companies, raw material suppliers and printers that ideas were built upon and progress was made. There was not a consortium or really any organization to this process at all. Rather, the discussions in this chain were usually facilitated through an ink company working independently from other ink companies, but there was still some informal transmission of broad concepts from printers, or from raw material suppliers, that were working with multiple ink companies.

Photo courtesy of IST.

Gear-side view of interstation UV-curing unit from below.

There's no need to rehash every technology generation that the industry saw, but there were several. For instance, the initial need was for paper and paperboard as the substrate. UV coating over ink for folding carton and commercial printing was the initial need. Then, requests began coming in for UV hybrids on plastic substrates, or on web forms presses. For a while, a composition-based definition of UV hybrids was common: that they contained a mixture of UV-curable and non-UV-curable (a.k.a. "conventional") raw materials. This turned out to be a fairly meaningless definition (they all contain non-curable pigments, after all) while at the same time being some what limiting to the formulator. After some period of angst, the industry seems to be migrating to the performance-based definition.

Therefore, a UV-hybrid ink will:

- UV coat in-line without gloss back,
- Run on conventional rubber rollers and blankets without swelling, and
- Cure with less than full UV interstation curing.

This allows the formulator to take any chemical approach that works for an individual printer and that meets these performance targets. Different ink companies have widely varying formulation strategies, and somewhat varying degrees of success at meeting these goals, but these are the generally accepted targets. Regardless of the supplier, there is science behind the concept, it makes practical sense, and the printer needn't worry about the *feng shui* of his plant in order to ensure success.

What Does the Current Generation *Do*?

This type of performance-based definition is also a reflection of the fact that it is much more important what UV hybrids *do* (and don't do) as opposed to what they *are*. Even these three performance components to the definition limit the formulator somewhat vs. so-called "full" UV ink. Therefore, UV-hybrid inks can be different things to different people. For a folding carton printer wanting fast turn-around, high gloss, and the ability to continue to run occasional oil-based jobs on his press, all three parts of the performance definition are critical. Those inks are UV hybrids.

For a forms printer running a web press who does not coat and who already has fully UV-compatible rubber rollers and blankets (because he's currently running "full" UV inks), the ability to turn off a few UV lamps and save some money is the important property. He doesn't care about in-line coating or about compatibility with conventional rubber. The formulator can remove those constraints from his formulation, provide an ink that will cure with fewer than full interstation curing, and make the printer happy. Those inks are UV hybrids.

For a commercial printer running on rigid plastic who wants to go back-and-forth between oil-based and UV Hybrid inks, but does not UV coat, the formulator can provide an ink that meets only those needs. The formula can be adjusted for the number of curing lamps the printer has, and be optimized for adhesion to his substrate. Those inks are UV hybrids.

How Are They Used?

UV hybrids run essentially like any other lithographic ink. They are added to the ink fountain of a litho press immediately after an oil-based job without a 100% cleanup to bare metal. The more cleaning of the press and ink fountain between ink technologies, the better, but some printers have gotten "good enough" results with minimal cleanup between oil-based and UV-hybrid jobs.

The fountain solution should not be changed either. The concept of UV hybrids is to be "plug-and-play" with litho presses running oil-based inks. Dip out the oil-based inks, wipe down the ink pan, add the UV hybrids, turn on the lamps, and go.

What's the Down Side?

The biggest down side of running UV hybrids is for printers running plastic substrates. The range of

substrates where UV hybrids have good adhesion is large, but not as large as "full" UV inks. The only time this comes up is when a plastic printer needs to run both oil-based and UV Hybrids on the same press. That means that he will have conventional rubber rollers, and that means he needs the non-swelling UV-hybrid inks. Unfortunately, the best formulations for giving broad adhesion properties on difficult plastics also swell conventional rubber rollers. If a printer wants to run on plastic, wants to run some UV and wants to run some oil-based, there are some limits on the range of plastics where he will find success. Always test adhesion on the plastic in question before going to press.

Another limitation is that the limitations on formulation that are required to meet the performance definition can create inks that are not as operationally friendly on press as "full" UV inks. If a given set of press circumstances causes any of the standard litho printing problems, like misting, scumming, emulsification, high dot gain, etc., the UV-hybrid formulator simply has fewer options available while keeping within the hybrid performance criteria. This is much less a problem than it was five years ago, as ink formulators have gotten very creative in squeezing the most out of a reduced set of formulation components. Nevertheless, there are still some more options available if the hybrid criteria are not in place.

A third limitation is in the rubber rollers and blankets. There are several nitrile rubber-based compounds that are very successful in oil-base litho printing. The EPDM rubber is very successful in "full" UV inks. While it is possible to run UV inks on nitrile-type rubbers, there is a period of transition while the rubber acclimates to the new ink chemistry. It is NOT possible to run oil-based inks on EPDM rubber. This has led to several roller and blanket companies introducing rubber compounds that are designed to go back-and-forth between UV inks and oil-based inks. These rubbers still are somewhat of a compromise vs. running a press with either dedicated technology. The UV-hybrid inks, though, are designed to run on the same nitrile rubber that works well for oil-based inks. However, if there is enough UV business to dedicate a press to that chemistry, there are fewer sacrifices and compromises if the printer puts fully UV-compatible rubber on the press and removes the formulation limitations from the ink company.

Is This a Phase, or an End Unto Itself?

Are UV hybrids the death knell, the end of the line, the *Götterdämmerung* of traditional UV inks, or of conventional oil-based inks? Not quite. Oil-based inks are less expensive and run great on paper, paperboard and many plastics. They water-coat just fine in-line, and water coating is less expensive than UV coating. Oil-based inks and water coating are great, economical choices for many printers.

"Full" UV inks, especially on plastic substrates, are a great choice. They lithograph well, and there are many "tweakable" options for the formulator. Adhesion is very good across a broad range of substrates. Full interstation curing ensures that the resistance properties (rub, scuff, moisture, chemical) of the ink film are at their best. On a press dedicated to UV, these inks are a great option.

But, if a printer needs to UV coat in-line *and* needs to go back-and-forth with conventional oil-based inks, UV hybrids provide the means. Switching oil and UV technologies on the press is a simple cleaning process, installing two or three UV-curing units on, say, a six- or eight-color press is not very expensive, and being able to deliver a 90+ gloss product in-line and in-house can be of great value.

This is a "hammer and nail" issue. As the old adage goes, I've got a hammer so every problem looks like a nail. These three ink technologies represent a toolbox. There's more than just a hammer. A printer can pick the tool he needs to solve the problem that he has. It's all about making good choices, and one role that suppliers to printers have is to present and explain options so that good choices can be made.

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