Flexo platemaking, in its most basic concept, is very simple. You start with a sheet of solid (or liquid) material, selectively alter it chemically using UV light, then remove the areas you don’t want, leaving the areas you do want as the image. More than 30 years ago flexo plates were made by hand, carved out by skilled plate makers, but they really did equate in many ways to sophisticated “potato printing” and gained flexo its low print quality reputation. But, today it is very different, increasingly scientific, and significantly better. So, why do people find it so complex? This article will explain the key points, and clarify common confusions.

Flexo plate terminology
To explain the process of platemaking, it is important to understand the plate and its terminology. When manufacturing a plate, the raised image area is a distance above the polymer base, which is called the floor. The height
from the floor to the image area surface is the plate relief. The back of the plate is supported with a film layer to provide dimensional stability.

The thickness of the plate depends on the press and its final application. Plate thicknesses generally vary from 0.045” (1.14 mm) to 0.250” (6.35 mm), with the average thin plate in North America being 0.067” (1.70 mm), used for labels, folding cartons, flexible packaging, etc. Thick plates range from 0.125” to 0.250” and are used more for corrugated post-print and multiwall bags, etc.

**Basic plate and platemaking details**

There are two fundamental starting photopolymer formats—liquid or sheet—that are used to make most flexo plates. Photopolymer plates are made of monomers and UV initiators that, when exposed to UV light, experience a chemical reaction to make the monomers join together to become a solid mass of polymers. Whatever the plate format—liquid, analog, or digital—the same basic chemical reaction in the platemaking process exists.

Normally the first step is to expose the back of the plate to UV light, curing it evenly to build and raise the plate floor to its required level. This also activates the monomers and photoinitiators throughout the rest of the photopolymer mass.

The top of the plate is then selectively exposed to UV light, through some form of mask, to build the image areas, while the non-image areas remain un-polymerized monomer. The finer the details, the longer this takes.

The nonimage areas of unpolymerized photopolymer are then removed—using a variety of methods—to the plate floor leaving the image area behind. The most common methods for removing the nonimage area on sheet plates involve either washing it away with plate washout chemistries (traditional solvents, new low-odor plate processing solutions, or water and detergent combinations) or a thermal process (involving heat to melt the polymer, and remove it with a wicking material under pressure). Liquid photopolymer methods squeeze off most of the waste liquid photopolymer (for reuse) then wash the rest of the liquid plate.

In the case of solvent processing, once the nonimage areas are removed, any absorbed solvents which swell the plate must be dried out of the plate to bring it back to its original height before the next stage. This is done using hot air driers and air flow.

The surface of the imaged area of the plate is typically in the middle of the photopolymer mass, and remains potentially partially unpolymerized and tacky. To address this issue, the plate is further exposed to UVA and UVC light to complete the polymerization process and to de-tack the surface of the plate.

The plate is then ready for inspection, measurement, and finishing. The plate should be allowed to stand for a period before use because the chemical reactions of photopolymerization do not stop immediately, but often continue several hours after exposure to the UV light, until the plate is fully stabilized. Running the plate on-press too soon risks shortening the plate life and affecting stability, especially in fine details.

This is the basic explanation of platemaking, and is relatively simple. What makes platemaking more complex is the huge variety of possible combinations for photopolymer plate materials, plate thicknesses, plate hardness, mask and imaging technologies, plate processing systems, plate processing solutions, and finishing options. These also depend on the final application for the plates, whether narrow-web labels, carton board, envelopes, wide-web films, multiwall bags, or corrugated, to name just a few.

**Plate imaging methods**

The most common imaging systems in use for flexo today are analog and digital Laser Ablative Mask System (LAMS). For the analog system, the matt film is imaged separately and then applied to the surface of an analog plate, covered with a vacuum sheet, and, with vacuum applied, exposed to the UV light. The final dots and lines on the plate are enlarged to some extent compared to dots and lines on the film, due to the deflection and refraction of light passing through the cover sheet, the imaged film, and the plate slip cover that stops the film sticking to the photopolymer. An analog plate has a flat top dot structure with good support structure, for excellent on-press performance.

Digital LAMS plates do not use film, but instead a black layer is applied to the surface of the plate. The black layer is then ablated using a high power laser imaging device, removing the black layer where image areas are required, and leaving the rest to be the mask for the non-image areas. The plate is then exposed in a normal exposure unit, but without the vacuum—meaning it is exposed in the presence of air. The oxygen in the air reacts with the photo initiators, slowing the polymerization process, resulting in shrinkage of the dots and instead of flat tops, they are bullet shaped dots.

A third growing technology, available since 2008, is a laminate platemaking process, where a thermal imaging layer (TIL), a very high capability thermal ablative film, is imaged in a low-power thermal imaging device, typically used for offset rather than flexo. The TIL is then cold-laminated to a special digital flexo plate, so that the emulsion of the TIL is in intimate contact with the surface of the photopolymer plate, and the film backer of the TIL acts as an oxygen barrier. The plate and TIL laminate are then exposed in air, but absence of oxygen inhibition and perfect contact between plate and emulsion results in a 1:1 digital file-to-plate image transfer. The TIL is then delaminated before plate washout and processed as normal. The dot structure is flat-top with good support, like analog plates, but to much higher resolutions, up to 300 lpi and with full tonal range.

A fourth platemaking method is direct laser engraving (DLE) where the unwanted areas are ablated by very high-powered lasers, leaving the image areas behind. This is the only truly digital imaging processing of flexo plates, not relying on further chemical reactions with UV exposure, and plate processing. It is typically used for continuous image and sleeve imaging applications. Speed and costs of the laser systems are the greatest current limitations to growth of this process.

**Laser imaging technologies**

There are several commonly used laser imaging systems applied to digital flexo plates. Two of these are applied to digital LAMS plates, and are high-power ablation lasers for the black mask layer.

The most common are single Gaussian laser beams. These ablate with high power but have a distinct soft dot profile due to the laser power profile, with high intensity across the middle of the beam, that drops off at the edges in a bell-shaped power profile curve. The second is a multibeam version with multiple lower power beams combining for similar overall power. But, this version produces a central zone of intense power, and a steeper drop in power near the beam edges, resulting in less of a soft dot fringe.
A third option applies to the laminate plate system, where Kodak’s lower power SQUAREspot technology (commonly used in offset platemaking) is used in imaging a TIL before lamination to a special digital plate. Each 10.6 micron square is a matrix of 4 x 4 laser hits resulting in a hard dot structure with sharp dot edges, and a 1:1 transfer of the digital image to the plate surface.

With the digital image file consisting of images made up of combinations of square pixels, the use of laser profiles with a round format will always result in conversion errors from the digital file to the plate. This occurs where the laser overlaps and changes the area coverage. In digital LAMS plates this is combined with the oxygen inhibition, making the dots shrink during UV exposure. This actually smooths the edges of the dots where the laser beams overlap, making the dots visually more acceptable, but the variables in imaging and exposure mean that the final results can be quite variable, and difficult to control.

**Plate exposure**

A critical step in all flexo platemaking is the exposure of the plate to UV light to cause the chemical reaction for polymerization of the image areas. This is a critical step in the control of the final plate produced. The basic technology for this has changed very little in the last 20 years, with small incremental steps, rather than major steps, forward. Key to the process is consistency and repeatability.

It is known that variables such as heat and humidity can affect the process and the final result. Simple items like a chilled bed of the exposure table, and sufficient airflow to remove the air heated above the plate can greatly enhance the consistency. Also to address the natural tendency of the UV tubes to lose intensity and power over time, the inclusion of a light integrator that measures the light output and adjusts the exposure time automatically to ensure consistent light energy is an important feature on a modern plate processing system.

**Plate processing**

For all flexo platemaking (except DLE), the processing of the plate is a chemical process. The unwanted monomers and photoinitiators are dissolved or melted and then removed. The most common plate processing methods use a plate washout chemistry—either water and detergents as a water wash solution or solvents as a solvent washout system. In both cases the washout chemistries absorb the unwanted photopolymer, but can be recycled and removed, by separating and removing the unwanted photopolymers, which are sent for safe disposal, often through incineration.

The solvents used today are available with no reportable hazardous components, low odor, reduced VOC levels, and an operator-friendly nature. They are recovered using traditional distillation, or cold recycling systems, with 1 gallon of solvent recovered at about a 90 percent rate each time, and capable of producing approximately 40 square feet of 0.067” photopolymer plates per gallon, before being completely exhausted.

Thermal platemaking is the other popular platemaking method, where instead of dissolving the unwanted photopolymer, it is repeatedly heated to melt it, with the melted photopolymer removed using a developer roll under pressure. Typically the plates go through 8–12 revolutions of this cycle to reach the required plate relief, with the melting of the unwanted plate material releasing gasses that are exhausted from the operator areas. The developer roll is a single-use material and must be bigger than the plate area. Typically to produce 40 sq. ft. of plates (like a gallon of solvent), 440–480 sq. ft. of developer roll is used, and must be returned to the manufacturer for safe disposal by incineration.

The choice of solvent wash, water wash, or thermal plate processing should be a decision based on technical requirements. Consider each process’s distinct benefits and drawbacks, e.g. solvent plate processing being capable of producing plates to the highest specifications, but thermal processing being the most convenient and faster today. Keep in mind that new chemistries and cold recycling systems are changing this balance in terms of speed and convenience.

**Conclusion**

Overall, flexo platemaking is very complex if you let it be. In reality it combines plate material and imaging systems to produce a commercially acceptable plate for production. The more consistent the image transfer and plate production, the more consistent it will be on press, resulting in shorter setup and improved repeatability. It will be better for the printer, the end customer, the bottom line, and the environment.

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