How to achieve high opacity whites in flexo

Sonia Arcos

High opaque white is a challenging application in today's flexographic printing. In rotary screen opacity levels of above 85% are easily achievable but its higher pre-press costs and ink consumption together with lengthy set up times and lower production speeds make flexo a much more cost effective option. Recent developments in narrow web ink, plate and anilox technology now allow flexo printers to achieve the opacity level of rotary screen whites.

The most common way to measure opacity is with a technique called contrast ratio, where printed samples are placed over a black background, and the density of the black ink is measured through the print. For total coverage a value of 100 should be obtained. Standard UV screen opaque whites have a contrast ratio of 87 using this technique. To successfully achieve opacity values comparable to screen printing in flexo the following printing recommendations are key:

Anilox

In order to achieve opacity levels above 85%, a high volume of ink is necessary. Because UV inks are thick and do not flow easily, transferring a high volume of UV ink can be a challenge as the higher the volume the more difficult it is to achieve a smooth coverage.

Selecting the right anilox engraving for printing high opacity whites can make a real a difference to the results achieved. This is particularly the case with anilox rolls engraved to 60 degrees. This engraving pattern aligns the hexagonal cells horizontally across the axis of the anilox. This causes a microscopic turbulence at the moment of transfer, which combined with the high surface tension of the inks will result in extensive pin holing. By switching to a 30 degree engraved anilox, pin holing will be reduced significantly.

There are other factors to consider apart from the engraving angle. These include the line count or number of cells per linear inch or centimetre and the engraving design. The higher the number of cells per linear inch or centimetre the more uniform and smoother the ink laydown will be. However selecting too fine an anilox may compromise the ink transfer. When engraving specifications have heavy volumes combined with high line counts, the cell inevitably forms more of a conical shape. Cells with conical shapes will plug more easily and function in an inefficient manner compared to bowl shape cells. The key is to use the finest anilox possible capable of delivering the required coating weight efficiently and consistently.

Today's laser technology allows anilox manufacturers to design high transfer engravings that are capable of evacuating the contents of finer cells efficiently. High volumes of ink can now be transferred by a greater number of cells improving smoothness of coverage, eliminating mottling and pin holing.

There are different anilox engravings specific to the application of high opacity whites in the market. At Cheshire Anilox Technology we have developed the easyflo HD engraving (Figure 1) which features a 30 degree, high-release engraving with an open and linked cell design. The results achieved with this anilox have been outstanding compared to conventional engravings (Figure 2). Channel engravings have been accepted for many years as a proven way of improving ink flow within the Anilox cells and alleviating the pressure that can build up inside the chamber which will contribute to excessive foaming and vibrations of the blades. Foaming and inconsistencies in the metering action can cause uneven coverage and extensive pin holing. Channels are proven to eradicate pin holing by as much 70% in UV printed solids.

Recommended cell volumes for achieving the highest opacity possible with a high opacity white ink range from 25 cm^3/m^2–40 cm^3/m^2. Specific cell volumes will need to be assessed on an individual basis. A good starting point would be to check the opacity level achieved with your current anilox and conduct a banded anilox trial (an an-

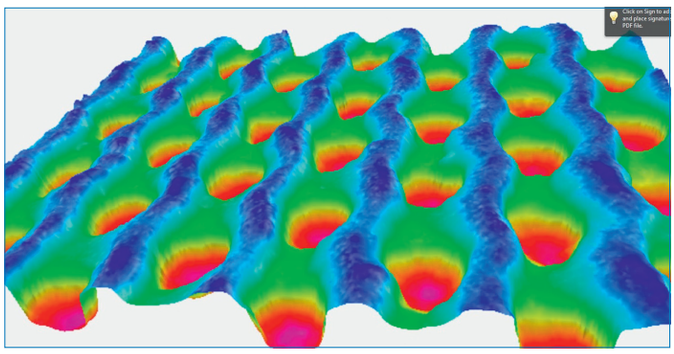


Figure 1:
Easyflo HD engraving by Cheshire Anilox Technology

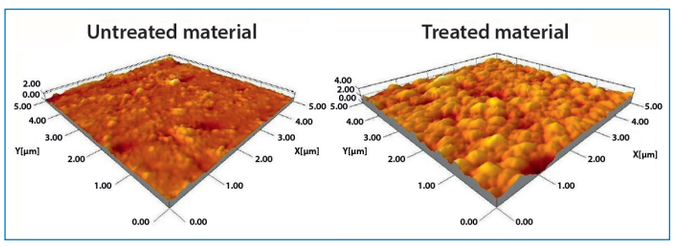


Figure 2:
Corona treatment. Image supplied by Vetaphone

ilox with different engravings on the same roll). This allows you to compare the benefits of different engravings side by side which will have been specially selected and tailored to suit a specific application.

Substrate treatment

In general, the ability of a substrate to anchor inks, coatings, or adhesives is directly related to its surface energy. If the substrate surface energy does not significantly exceed the surface tension of the fluid which is to cover it, wetting will be impeded and a poor bond will result.

If the ink has a dyne level lower than the material's surface energy, then the ink will spread out over its entire surface in a uniform wet layer. However if the ink's dyne level is equal to or higher than a material's dyne level, the ink will become cohesive and tend to remain in droplets.

UV inks have a high surface tension – usually around 50 dynes/cm. Therefore, there are higher demands on the surface energy of the substrate, requiring a target surface energy of near 60 dynes/cm or greater.

To obtain sufficient wetting and adhesion on plastic films, pre-treatment just before the printing unit is necessary. The treatment of any film will dramatically alter the surface tension and will enable the ink to wet out and adhere to the surface. Corona discharge is the most common method for treating plastics to increase dyne levels in narrow web applications. Corona is a high frequency electric discharge towards a film surface. The result from this action is an improvement of the chemical connection (dyne/cm) between the molecules in the plastic and the applied ink. This surface treatment neither reduces nor changes the strength and appearance of the material.

It is important to note that the dyne level of a treated film dimin-

	Contrast ratio
Std UV screen	85–87
Std UV flexo & conv anilox	72–76
High opacity white ink & conventional anilox	80–82
High opacity white ink & easyflo HD	85–87

Easyflo HD anilox and high opacity white ink trials results

Typical surface energy of substrate		Required surface energy for adhesion with:	
PTFE	<20 Dyne/cm	UV ink	48–56 Dyne/cm
Silicone	<20 Dyne/cm	Water based ink	50–56 Dyne/cm
PP	30 Dyne/cm	Coatings	46–52 Dyne/cm
PE	32 Dyne/cm	UV adhesive	44–50 Dyne/cm
PS	34 Dyne/cm	Water based adhesive	48–56 Dyne/cm
PC	34 Dyne/cm		
PVC	40 Dyne/cm		
PVC-U	37 Dyne/cm		
PET	42 Dyne/cm		
BOPP	32 Dyne/cm		

Typical surface energy of a substrate

ishes over time and it can be necessary to corona treat the material again just before use. The rate at which the dyne level diminishes is dependent on many variables. Certain substrates like PVC tend to maintain corona induced surface energy longer than APET or OPET.

The transportation and storage conditions of a treated film can also cause rapid degradation of the initial surface energy. In general, high temperature and low humidity conditions should be avoided to minimise a drop in dyne level.

Thicker and older film stocks are more difficult to treat as slip agents may have migrated to the surface. Materials that have not been treated under extrusion can be difficult to treat afterwards.

For higher adhesion, ideally the film must be treated by the manufacturer and by the printer immediately before printing.

High opacity ink

Using a high density, low viscous opaque white ink specially formulated to print opaque whites on film will make a huge difference in the results. It is equally important to carry out ink trials to determine optimum conditions. We suggest you work closely with your ink supplier to assess the best solution.

Printing plate

Over recent years new advancements in plate technology have considerably improved the ink transfer properties of polymer plates. The surface of a typical photopolymer plate is very smooth. When ink is deposited on this surface, it does not load well or disperse uniformly. The surface tension of the plate may hinder the ink from wetting out well on the plate's surface. Therefore coverage will suffer. This is problematic when trying to transfer a uniform and dense layer of ink onto clear film.

It has always been proven that ink density is improved on plates with rough surfaces. Capped plates have a thin top layer that is texturised, offering a higher affinity for ink. The new technology applies a micro level surface pattern across the entire imaged areas of the plate including solids, lines and halftones. This is claimed to significantly improve the ink transfer efficiency resulting in increases in achievable printed density and opacity.

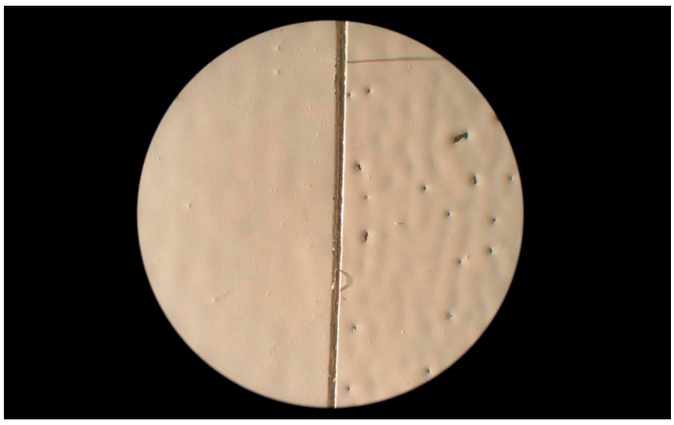


Figure 3: ***High opacity UV ink Vs Standard UV ink. Image supplied by Flint Group***

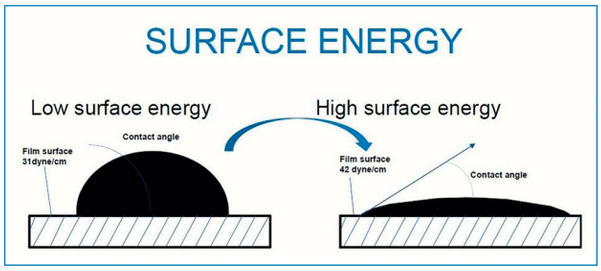
From another angle, other plate advancements has proven to be very effective – this is the pinning dot technology. This technique is based on the principle that if the plate dots have a low surface energy, this will cause the ink to not wet out the dot surface and form globules. This is claimed to have a high contact angle (Figure 3). The contact line where the liquid surface meets the solid surface is called the pinning point. The higher the position of the pinning point on a flexographic relief printing plate, the lower the plate wettability, but the higher the wettability of the substrate. A plate with a high ink pinning point will effectively repel more ink from its surface and therefore more ink will be transferred to the substrate.

In order to assess which plate is best for you, work with your plate supplier to choose the best option for achieving the highest opacity.

UV Lamps

With anilox cell volumes of 35 cm^3/m^2 and above the use of 160 W/cm (400 W/inch) UV lamps is recommended, even a double pass with two separate lamps might be required. Again work with your UV lamp supplier to assess the optimum set up for your required production speed.

In addition, always check the condition of the lamps before starting. Verify that the UV lamp filters and the quartz window is clean and that the lamp bulbs have not exceeded the recommended bulb life hours.



Surface energy, Image supplied by Vetaphone

Mounting tape

The use of high density (hard) tape is recommended to lay down heavy solid coatings with less pin holing.

Doctor blades

Either reverse angle or chambered doctor blade systems can be used. The blade thickness is critical for metering a high amount of ink, the use of a 0.010" (0.250 mm) or 0.012" (0.300 mm) blade is recommended. Many other factors can affect the final printed result and therefore we recommend to finger print any new designs to determine conditions required, before starting commercial runs. ■

Sonia Arcos

Sonia Arcos is the Technical Sales Director of Cheshire Anilox Technology with more than 12 years' experience in the printing industry. Highly qualified, she has a strong technical knowledge and understanding of the flexo printing industry, which has assisted customers to improve workflow efficiencies, print quality, and productivity worldwide.