

Can UV flexo replace opaque white UV screen?

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Almost like the search for the Holy Grail, printers have been seeking the ability to achieve the opacity and whiteness achieved in rotary screen printing, but using less-costly UV flexo technology. This article aims to explain some fundamentals about the two technologies, to report on current research and developments, and on some of the new possibilities opened up by a recently-launched UV flexo ink.

Opaque white UV inks in general

Opaque white inks are all made with the same pigment: titanium dioxide (TiO₂). It is a difficult pigment to handle in an ink as it is heavy and 'hard'. While it may seem obvious that the opacity of an ink is in direct proportion to the percentage of pigment used, practical tests show, however, that this is not completely true. The correlation is not 100 per cent linear, because the phenomenon of saturation occurs at a certain level.

To formulate an opaque white UV ink is more complex than simply adding more or less opaque pigment. As it will be UV-cured, the ink will require a certain amount of UV light to initiate the polymerisation (i.e. curing); and here the amount and type of TiO₂ has a big impact. Firstly, as the ink is opaque, it naturally prevents the light from reaching the photo initiators, thus hindering the ink cure. By careful selection of the right TiO₂ and photo initiator, it is possible to formulate fast-curing opaque inks that do not discolour – an important feature for opaque white UV inks that is often forgotten. Incorrectly formulated, they have a yellowish tone compared to the crisp white 'colour' achieved with the correct formulation.

Controlling the ink film weight

Another important factor is obviously the ink film weight applied. A similar correlation between ink and opacity applies: more ink may give more opacity, but will also reach a certain saturation point where improvement is no longer linear. The ink film weights required on a substrate with the different print processes are roughly as shown in Figure 1.

Research by print solutions providers has found that the ink's ability to flow and form a homogeneous film on the substrate without air bubbles or pinholes is just as important for the final opacity of the print as the ink film weight and the percentage of pigment used.

This leads us to discuss the fundamental difference between, for example, UV flexo and UV rotary screen: it is, of course, the way that the ink is applied to the substrate. UV flexo uses an engraved anilox roll to carry the ink up to the plate (with a raised image), and then the plate transfers the ink to the substrate. UV screen uses a mesh. Capillary action transfers the ink direct to the web (Figure 2).

Flexo

The engraving on the anilox dictates roughly how much ink will be applied to the substrate. It is not entirely true, but generally speaking there is a correlation between the theoretical ink volume held in the anilox and the thickness of engraving, and is a combination of the lines per centimetre, the angle of engraving and the cell structure. It is, in fact, the volume that the total number of cells in the anilox can carry (Figure 3).

What is still an unknown is how much of the theoretical volume of ink that the anilox can carry will be transferred to the plate after doctoring, and then later to the substrate. This 'transfer factor' is dependent both on ink formulation and on the anilox/cell configuration. Accommodating an improved – thicker – ink layer required new engravings, which gave a high cell volume – > 20cm³/m² – and a special cell structure. This, together with specially- developed viscosity and flow properties in the ink, enabled the transferable volume of ink to achieve the increased density/opacity.

Industry research shows that recent formulations in ink and anilox engravings have greatly improved the ink transfer factor – thus enabling higher ink film weights and the ability to provide solid areas and text at good commercial printability level.

Rotary screen

The ink deposit, and thus ink film weight in the rotary screen process, depends on the screen mesh configuration. There are many different manufacturers of screen mesh types, and for our research we used in this case the system provided by Stork Screens as our reference. It measures the number of lines per centimetre in the mesh/screen, the thickness of the ink layer, and the percentage open area (Figure 4).

Again, the final deposit of ink on the substrate and the structure of the laydown (i.e. no pinholes) is dependent on both screen mesh configuration as well as on ink formulation. Recent challenges for ink-makers are the more compact units being used (the so-called drop-in cassettes) with their smaller diameters, which create greater force on the ink, which can in turn cause more air bubbles and even potentially foam in the ink. Imperative for a good screen white layer in, for example, 'no-label look' designs, is the ink's ability to cope with new challenges like this, while still enabling printers to maintain high printing speeds using easily-overprintable substrates.

Printability

CAN UV flexo replace UV screen? After reviewing the fundamentals of both processes in relation to laying down an opaque white ink, it is evident that there is considerable difficulty for a transfer process that partly involves pressure to force the right ink amount over to the substrate.

Industry studies show that in solid areas it will be possible for UV flexo to match the opacity of rotary screen, but limitations will be evident in finer negative text, where rotary screen still has an 'edge'. Screen printing can create sharper images at lower point sizes. Our internal tests demonstrated that for point sizes as low as 8 point, UV flexo is commercially acceptable for reversed-out text – which also is confirmed by customers using our technology commercially today.

A whiter shade of pale... how to measure it!

To measure the opacity of an ink we use a method called contrast ratio. This is a relative number, whereby a black density is measured through the layer of white ink. Total transparency will give the number 1, and total opacity will give the number 100. In order to determine the opacity for initial feasibility tests, several types of anilox engravings from different manufacturers were compared, all printing with the same UV flexo ink (at standard opacity). The results are shown in Table 1.

During this research, it was discovered that it was not only the ink formulation that had an impact on the opacity, as previously mentioned. It is a much more complex cocktail of factors. Table 2 shows just some of the typical 'influencers' that our testing showed up.

In an ideal world, that ultimate Holy Grail combination that really gives perfect results certainly would exist.

But our experience is that the factors mentioned above – and others – will vary from press to press. For example, the tape that might give good results with one plate and press may not be perfect with another plate and press.

It is, however, clear that there are two dominant factors for success in replacing UV screen with UV flexo:

- The ink formulation;
- The choice of anilox roller.

By comparing a variety of all the above parameters, it was possible to balance them and achieve the optimal configurations. Table 3 shows the contrast ratios achieved.

Combining the right ink, anilox, tape and plate with an appropriate press, it is therefore possible to obtain similar opacity and flow-out in solid areas with UV flexo as with UV screen