Building Micro Surface Texturization For White Inks And Coatings In Flexo

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Abstract

Optimized flexo plate surface patterning offers tremendous benefits for brand owners, trade shops and printers. The opportunities for printers to reduce ink spends by leveraging advanced technology to mitigate the need for double hits on whites and spot colors, to produce cleaner printing, and increase press speeds. In addition, new technologies improve pack cleanliness and color vibrancy; free decks for value-add or promotional content and; improve readability.

Plate surface patterning has been gaining acceptance over the last few years. In 2010, Kodak's Digicap NX Patterning, a proprietary application of a micro surface texturization pattern to improve ink transfer efficiency, was recognized with an InterTech technology award that set a new standard for ink transfer in the industry, particularly for process printing. Since 2010 more technologies have come to market from a range of suppliers offering various digital patterning solutions and textured digital plates. Some offer a fixed surface built into the raw plate material and others rely on pattern selection, sometimes from hundreds of options.

White Ink Printing Opportunities

Most of the patterning solutions in the market are aimed at improving process densities but a more recent development focus has been on spot colors and white ink. Typically, wide web flexible packaging printers attribute only about 25% of their ink spending to process inks. White ink, in contrast, tends to be somewhere in the region of 50% of their ink spending with spot inks representing the remaining 25%.

The ability to achieve white layer opacity targets with a lower volume of white ink offers monumental opportunities for nearly every flexible packaging printer; but it doesn't come without technical challenges. Pinholes continue to be the #1 challenge for whites. Kodak's technical team has spent significant effort over the

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last two years conducting production scale trials and understanding plate surface patterning technology with KODAK FLEXCEL NX Plates. The technical team also focus on the effect on ink transfer across a broad range of Flexo applications ranging from low anilox volume process printing to heavy white laydowns. Reliant on the core 10,000 dpi imaging capabilities of the KODAK SQUAREspot Imaging Technology and the ability of a KODAK FLEXCEL NX Thermal Imaging Layer to consistently resolve extremely fine elements the outcome of this development effort for white printing is a small number of expertly engineered surface patterns that virtually eliminate pinholes and increase the achievable opacity with a lower volume of ink.

Development of the new Advanced Surface Patterns

During the development of these engineered surface a series of development steps and learnings were applied. These relate strongly to the practical realities of using the raised surface of the flexo plate to carry the image, having the micro engineered structure to drive the ink transfer process without transferring the inherent pattern from the anilox, and the need to carry differ ink volumes, and pigment types and loads, depending on the ink system and applications.

Through the development process Kodak applied a clear series of intermediate steps, with their findings at each step, these were (Figure 1):

Step 1.
Apply Standard DigiCap NX Pattern – the standard DigiCap NX pattern, as introduced in 2010, offered benefits with process printing but as the anilox volumes increased, it became less effective.

Step 2.
Larger Patterns Support Larger Anilox Volumes – through comparative testing with the ability of the Flexcel NX imager, it was clear that applying larger regular patterns better addressed the higher anilox volumes but resulted in increased ink laydown variation in the form of mottle.

Step 3.
Use Standard DigiCap NX To Address Mottle – to gain the benefits of the larger pattern, but minimize the effect of mottle, the Standard DigiCap NX pattern was reapplied onto the surface of the larger pattern. This significantly improved the mottle, while assisting the function with the larger anilox rolls, but still did not eliminate all of the pinholes.

Step 4.

Remove Select Features To Enable Flow – with some of the pinholes attributed by their shape and nature, to a probability of entrapped air, key features of the DigiCap NX were removed to enable flow of ink and air between the larger features. This enabled better displacement of the air, which functioned well, and led to the development of the final set of patterns.

Step 5.

Dedicated Set Of Patterns By Anilox Volume – development of a set of 5 dedicated new patterns that progressively increase in size, and volume of ink carried on the surface of the plate. This results with patterns that are tuned to anilox volumes, and function more like gravure in controlling the ink carried on the surface.

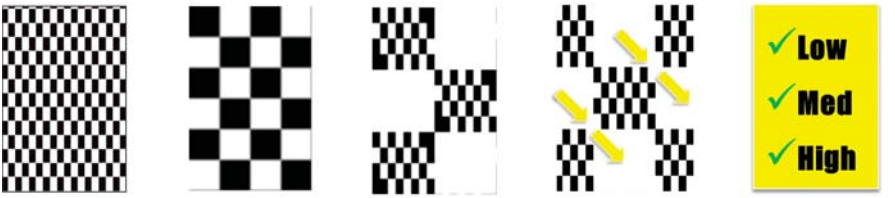

Figure 1 – *Images indicating the 5 stages of the development process*

During the development of these surface engineered patterns, we also learned that measurement of the dry ink film weight for white inks is very erratic, and recommend measuring wet ink volume used over the total job, and averaging (Figure 2). Also the effect of plate bounce has a significant effect on the measured opacity and the harmonics of the press cause variation around the print cylinder. In Figure 2 below shows the effect of bounce on 400 opacity measurements on a single 50mm square patch of white, and the second shows the effect of bounce and harmonics around the cylinder.

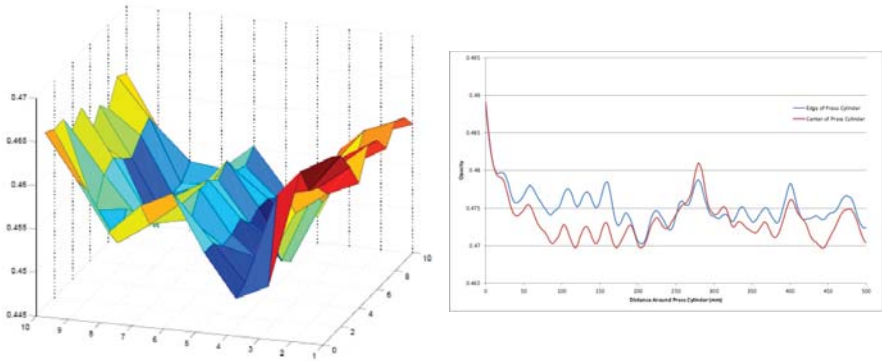

Figure 2 – *Images demonstrating the effects of bounce and press harmonics on the measurements for white opacity*

These factors drove the need to ensure that single measurements are not used for opacity, and that sufficient measurements are taken around the cylinder to be statistically significant when averaged.

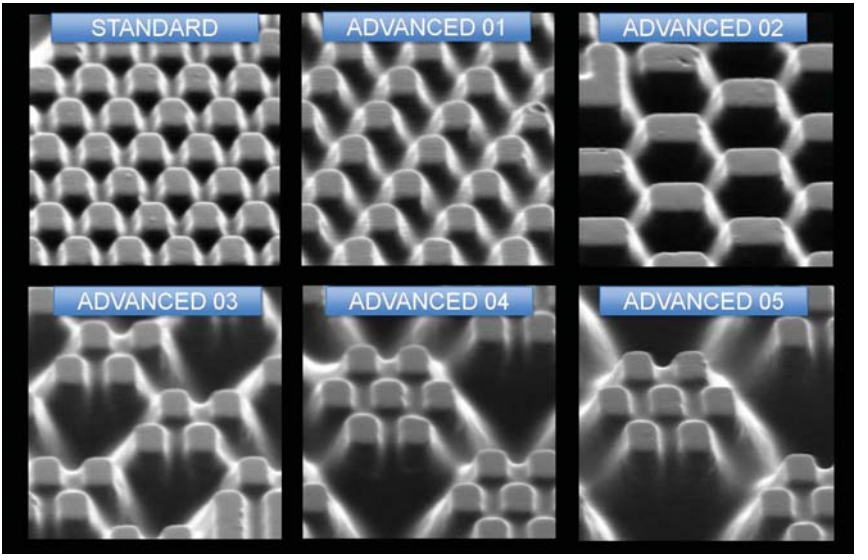

Figure 3 – *Micro images of the new plate surface patterns built for use with progressively larger anilox volumes (each image is approximately the size of a human hair)*

The resultant full pattern set, six patterns in all (Figure 3), actually cover the full range of print conditions used in flexo. Modelled to broadly match patterns with anilox volume the patterns were engineered to hold a specific amount of ink within the surface pattern and release it uniformly. Managing ink flow and air entrapment has proven to be very important to achieve the most uniform laydown and eliminate Trailing Edge Voids (TEV). This means that surface patterns must be reproduced very precisely and repeatable, something that fortunately the KODAK FLEXCEL NX Plates can do day in and day out.

Advanced 01 is a new process printing pattern which delivers an even more uniform ink laydown with exceptional reverses and enables the use of softer mounting tapes and lighter impression that delivers obvious benefits for highlight printing. Advanced 02 is optimized for typical spot ink applications with higher anilox volume selection delivering great solids and better reverses. Advanced 03 through 05 are targeted for light to heavy white ink laydowns. They also are applicable to heavy spot coatings such as the classic Reflex Blue or metallic inks.

The opportunities opened up by the optimized patterns are illustrated by the live printing results in Figure 4. A trial that compared standard flexo printing to results with the advanced surface patterns at a range of anilox volumes clearly shows the reduction in pinholes and the improved opacity with each anilox

combination. Obvious opportunities present themselves for moving to lower volume anilox or eliminating double hits, and trials have shown that the absence of pinholes is often more important than measured opacity in achieving the brightness and cleanliness of overprinted colors that brand owners desire.

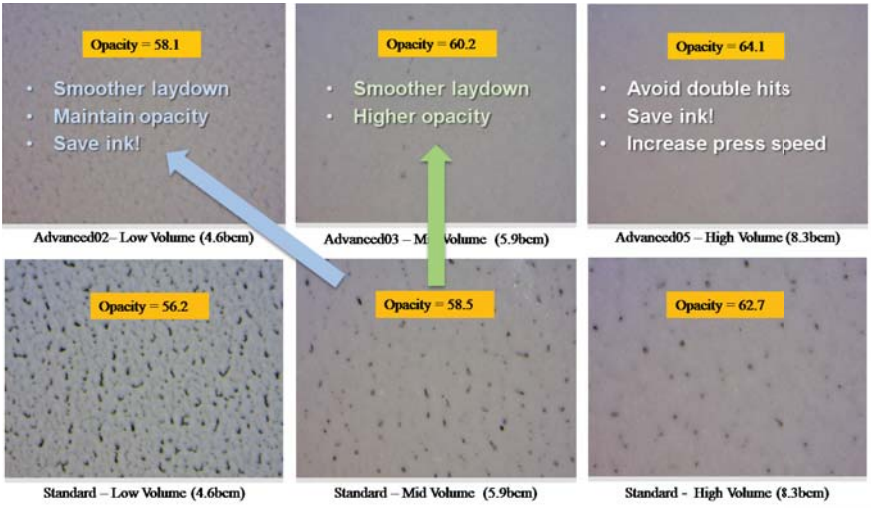

Figure 4 – Micro images of white ink laydown at 200X magnification - *for 3 anilox volumes showing improvement in pinholing and opacity using the advanced DigiCap NX patterns.*

By substantially reducing the white ink volume, the printer can also run the press faster as whites are usually the limiting factor for press speed due to drying. Another, often ignored, aspect of improved white ink laydown is the potential for, reducing lamination adhesive use, shortening the drying/curing time, and potentially increasing the laminator speed. In many operations the plant output is limited by the lamination speed, and pinholes in the white ink result typically in slower lamination. It starts to become apparent how print quality of a white layer can impact the profitability of the entire operation.

Successful implementation and Simple Optimization

The technology, which by the way is backwards compatible with the entire install base of FLEXCEL NX Imagers, has been extensively proven in solvent ink applications on wide web presses. Similar successes have also been observed in Japan with water based inks on film, and the new patterns are also effective for UV inks especially for high ink volumes.

The optimization process is very simple on press. A single target is used to identify the optimum pattern & tape for a given print condition. As an example a printer can easily determine the optimum pattern for white for each of his typical aniloxes in about 30 minutes. We found it to be beneficial to characterize some of the heavier spot aniloxes at the same time so that a broad range of data is available for assessing

ink saving opportunities with the improved laydown. The same process and plate can also be used to identify the optimum pattern for all other ink types as well.

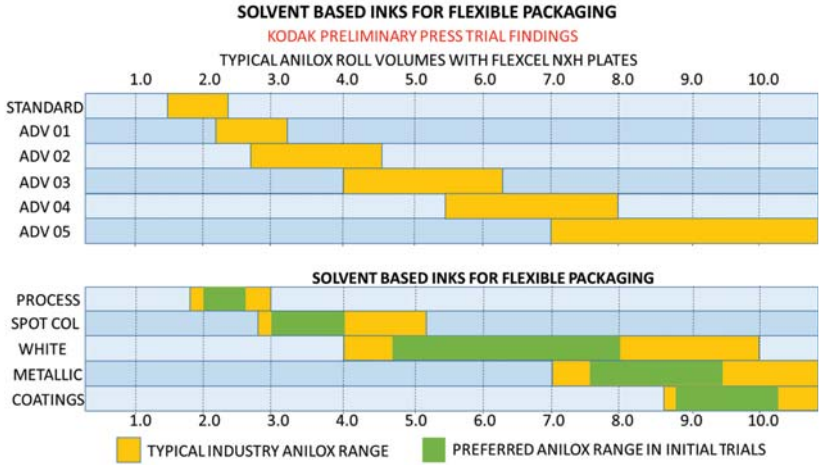

***Figure 5** – Example of anilox volumes to pattern for solvent based ink on film applications*

As a second step, we recommend running an existing production job. For the first half of the run use the new white plate with the best pattern identified during the simple pattern test, and measure the ink volume used. Then for the second half of the run use your normal white plate, and measure the ink usage again. This test will meet two objectives: confirm print performance through a long run, and identify real ink savings. There's no substitute for real numbers when it comes to proving what the technology can do for your operation.

An elegant solution to a tricky challenge

In order to deliver the patterning technology across the full range of applications another problem had to be solved in development. We identified that the deeper patterns required to deliver superior results with white or other high volume spot colors could lead to ink bleed and poor reverses around feature edges such as text. Traditionally an un-patterned keep-away is used around a feature. The drawback to that approach is limited control of the ink and airflow. Instead of a solid keep-away, Kodak developed and patented the use of an automatically integrated fine pattern as an Advanced Edge Definition (AED) feature as shown in Figure 6.

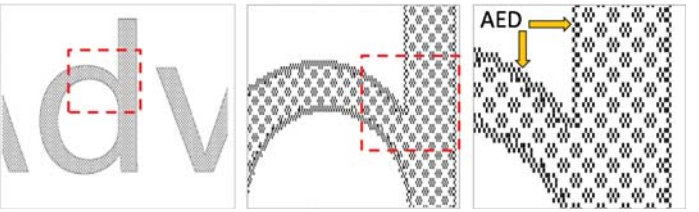

***Figure 6** – Advanced Edge Definition (AED) patented technology to release air while retaining the ink for sharper cleaner printing.*

The Advanced Edge Definition approach proved to be vital in improving reverses. This is very well demonstrated in Figure 7. The right hand side shows the performance of an Advanced 01 pattern incorporating Advanced Edge Definition for very clean reverses. It's an elegant solution to a tricky problem and is allowing brands to make better use of smaller text for mandatory content without losing valuable marketing space on the package.

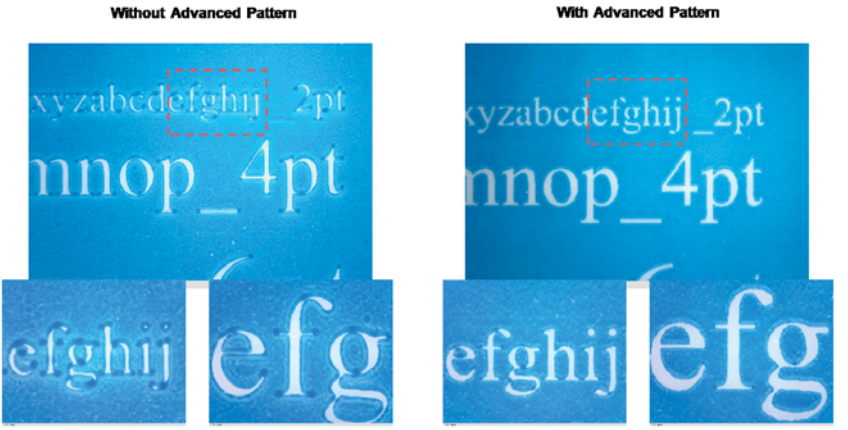

Figure 7 *– Images showing at 200X magnification the impact of Advanced Edge Definition (AED) with fine text reverses for solvent based ink on film*

In summary, Kodak's advanced surface patterning technology offers vast improvements from process printing to whites. The latest surface patterning improvements result in reduced ink spends, improved press productivity, faster lamination and reduced VOCs. In addition, cleaner brighter overprinted colors with a larger color gamut are achievable in conjunction with cleaner smaller reverses, smoother highlights and additional value using your existing equipment.

We strongly encourage you to put it to the test.

Dr. Andreas Albat leads Kodak's Packaging Research and Development team, with a focus on the full solution commercialization for Kodak's flexographic solutions. Dr. Albat also has extensive industry experience in software development, color and screening and holds a Ph.D. from the University of British Columbia, Canada, and a degree in mechanical engineering from the Technical University of Braunschweig, Germany.
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