

Specifying an Anilox Roller

What corrugated converters need to know in terms of basic information, specifications and applications.

The anilox roll is considered the most important part of the flexographic precision ink delivery system. This system must transfer ink to the plate (solid or dot) in the required amount so the ink color and density matches what is required by the buyer, and it needs to be in a consistent and repeatable manner. Just like in cooking, where measuring cups are used to give a repeatable outcome from a recipe, you can think of the anilox roller as a precise liquid volume instrument. If a recipe specifies an amount and you just pour in the ingredient you cannot expect the outcome to be the same as the last time. Using specified amounts of any ingredient will give predictable results. This is just as important in printing as in cooking. Since in printing the quantity of the produced product is much greater than in cooking, I believe using the proper amount of ink is even more important.

Simply put, the anilox roller is a measuring cup made up of volume carrying pockets that have a particular unit of volume measurement called a "BCM/square inch." The pockets (cells) are put into the ceramic surface by a laser-engraving machine. For the pockets (cells) to have a volume carrying capability, the cells must have an opening and a depth (Fig. 1). However, unlike measuring



By Tony Donato
Harper Corp. of America

cups, there is no standard off the shelf anilox specification. Unfortunately, there is an infinite availability of anilox volumes and then add the combination of line count (cells per linear inch) and the possibilities can be overwhelming. Don't panic, we will narrow the possibilities down to make the job easier.

Specifications

Let's first tackle the specifications. Color density is controlled by the volume of ink applied to the sheet. Volume of ink available from an anilox is measured in BCM's (billion cubic microns). Because of the size of a micron (25,400 microns per inch) and the number of cells the laser can engrave into the ceramic, a second unit had to be added to get the volume unit up to an understandable number. BCM/square inch is the volume unit for North America (Fig. 2).

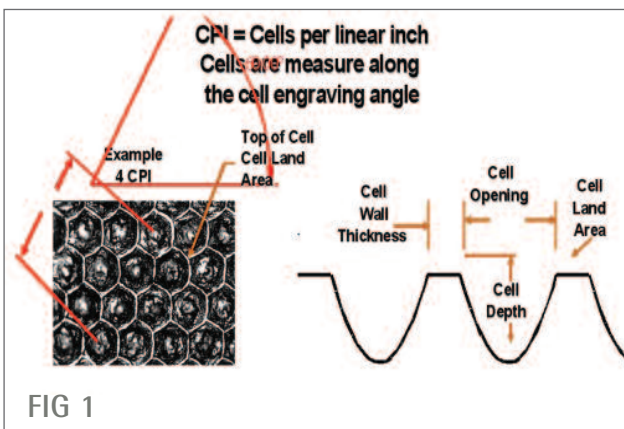


FIG 1

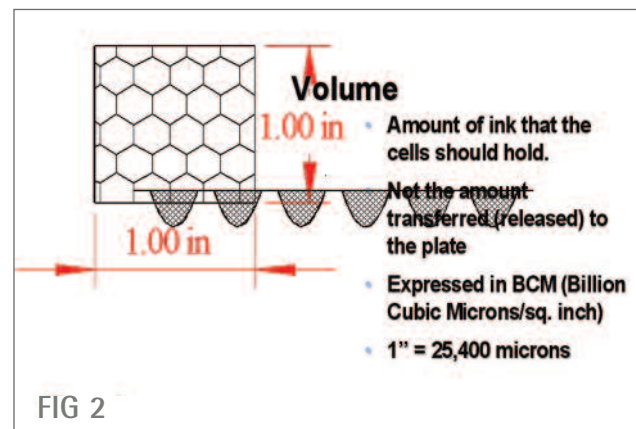


FIG 2

For the purpose of helping to confuse or un-confuse those who have received an anilox in European volume units, I will try to give some simple conversions. The European anilox volume is measured in "Cm³/M² (cubic centimeters per square meter). I will not go through the difference between a micron and a centimeter. I will just move to the down and dirty conversion factors. A BCM is converted to European unit by multiplying the BCM by 1.55. The European unit is converted to a BCM by multiplying by .6455. For example, 12 BCM/IN² x 1.55 = 18.6 Cm³/M² and then 18.6 Cm³/M² x .6455 = 12 BCM/IN².

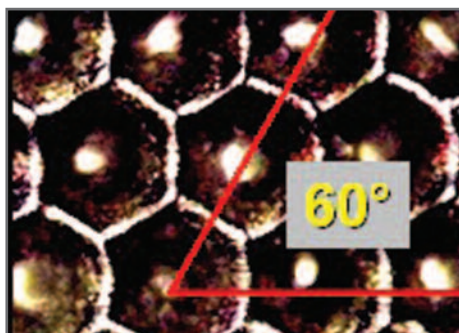
The CPI (cells per linear inch) is counted in the angle of the engraving (Fig. 1). The angle of the engraving is what determines the pattern of the cells. There are four basic patterns (nests) used in laser engraving. The 60°, 30°, 45° and trihelical (continuous thread) (Fig. 3). The 60° and 30° are basically honeycombs. The hexagonal (honeycomb) leaves the smallest post areas and allows the cells (pockets) to be nested the closest together. This grouping for the cells helps to reduce screening and increases densities when the cell's ink is transferred. The difference in the 30 and 60 is the orientation of a flat or a corner being located at the top of the cell in the circumvential (around the roller) direction.

The 60° pattern has a corner located at the top and bottom as the anilox rotates past the doctor blade. It is thought that this allows the doctor blade to fill the cell with less trapped air. The 60° engraving pattern is the workhorse of all the engravings. It works well with the plate angles minimizing moiré and keeps the ink (dots) close together when deposited on the plates.

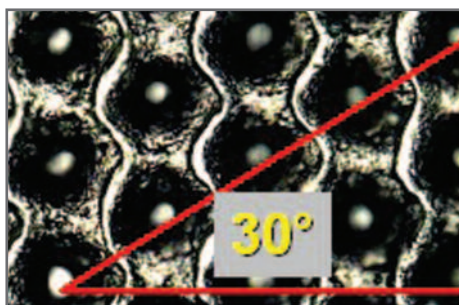
The 30° has the flat of the hexagon located at the top and bottom (positioned like a stop sign). The biggest advantage of this orientation is it gives circumvential alignment to the cell centers, which makes it easy to add an additional dimension of partially removing the top and bottom cell wall (Fig. 3). The 30° channel is favored with inks that have high viscosities. The partial walls allow the excess thick ink when doctored, to be pushed along and not trap air.

The 45° pattern is a holdout from the old mechanical (knurling) engravings days. The

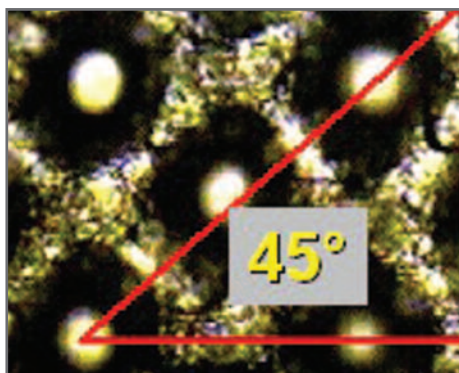
FIG 3: angle of the engraving



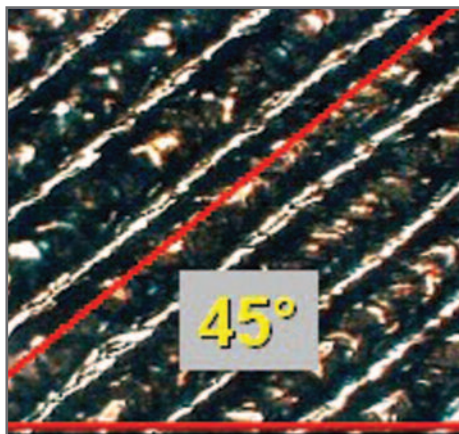
60° Hex Workhorse of Engravings



30° Hex Channel White & Thick Inks



45° Quad still used for Viscous coatings



45° Trihelical when you need a flood

Simply put, the anilox roller is a measuring cup made up of volume carrying pockets that have a particular unit of volume measurement called a 'BCM/ square inch.'

pattern was partially dictated from the ease of making a mechanical engraving tool. The 45° made it easy for the relief angle of the engraving tool not to pick the metal as it rolled out the pattern. However, in process printing there was an issue of moiré because of a conflict of plate angles with the CMYK plates. This pattern is mostly used for coatings and solid flood applications such as with a tint sleeve or flood blanket.

The trihelical engraving is a continuous thread. This is a variation of the 45° pattern. Different from the 30° channel, the cell walls in the 45° are completely removed to the bottom of the engraving. Where the substrate is very absorbent (a sponge) and the coating needs to be very thick and full covering, this pattern is used. This engraving will transfer very large amounts of ink or adhesive in a short time. Since it is missing half of its cell walls and the remaining are spiraled like a barber's pole, the trihelical pattern can be hard on doctor blades.

Applications

This is the point where we start discussing application of the anilox basics. What you see on the printed surface is the result of the plate surface depositing the ink it received from the anilox. To keep dot gain and ink film thickness under control, the ink transfer is not one to one. For flexo printing to work at its best, you want a minimum of four anilox cells to contact a plate dot. In addition, the P-O-P group and those working on tight fluted sheets and high plate screen counts, the ratio will go to six to one (Fig. 4).

The two controlling factors that determine the anilox specifications are the plate count (line screen) and the substrate

What impacts CPI selection?

- **Plate Screen Count**
- **Line & Solid jobs 4 anilox dots per plate dot.**
- **Process jobs 6 anilox dots per plate dot.**
- **Examples:**
 - 25 LPI x 4 = 100 CPI minimum
 - 45 LPI x 4 = 180 CPI minimum
 - 65 LPI x 4 = 260 CPI minimum
 - 85 LPI x 6 = 500 CPI minimum
 - 105 LPI x 6 = 660 CPI minimum

FIG 4

to be printed. In Fig. 4, the popular corrugated line screens are matched with a minimally appropriate anilox CPI. A substrate can act like a sponge or a piece of glass. It can absorb the ink or the ink can just lay on top. How the substrate reacts will determine the volume of ink needed from the anilox to accomplish your customer's objective. Reviewing Fig. 5, you will see there are starting point recommendations for four popular corrugated surfaces. The substrate principle is the more absorbent the material, the higher required anilox volume (BCM) that is needed. Moreover, just as obvious, when printing on clay or other coated surfaces, a lower volume is required. The type of printing also affects the volume required. Process printing requires less ink than a solid or line job.

Most corrugated flexographic printers have a disadvantage over other flexo printing segments. The inability to easily and quickly change the anilox roller in a corrugated press limits how jobs are planned. The

The inability to easily and quickly change the anilox roller in a corrugated press limits how jobs are planned. The corrugated printer has to get very creative on what job can be printed on which press.

FIG 5

BCM recommended range / Ink Film Thickness			
Type of Corrugated	Process Printing	Combination Printing	Line and Solid Printing
Clay Coated	1.5 to 2.8 BCM / 2.3 to 4.4 Microns	2.6 to 6.5 BCM / 4.0 to 10.0 Microns	3.0 to 7.1 BCM / 4.7 to 11.0 Microns
Bleached	1.7 to 3.5 BCM / 2.6 to 5.5 Microns	2.6 to 6.5 BCM / 4.0 to 10.0 Microns	2.7 to 7.8 BCM / 5.5 to 12.0 Microns
Mottled	2.3 to 3.9 BCM / 3.6 to 6.0 Microns	2.6 to 6.5 BCM / 4.0 to 10.0 Microns	4.2 to 8.2 BCM / 6.4 to 12.6 Microns
Brown Kraft	4.5 to 6.3 BCM / 7.0 to 9.7 Microns	5.2 to 8.7 BCM / 8.0 to 13.4 Microns	5.8 to 9.7 BCM / 9.0 to 15.0 Microns

Anilox Volume Selection?

- 120 CPI BCM Range 11 to 16 to 18
- 140 CPI BCM Range 9 to 14 to 18
- 160 CPI BCM Range 7 to 13 to 18
- 180 CPI BCM Range 6 to 11 to 16
- 200 CPI BCM Range 5.5 to 10.5 to 15.5
- 220 CPI BCM Range 5.0 to 10 to 13.5
- 240 CPI BCM Range 4.5 to 9.5 to 12.4
- 260 CPI BCM Range 4.5 to 8.5 to 11.8
- 280 CPI BCM Range 4.4 to 8.0 to 11.0

FIG 6

corrugated printer has to get very creative on what job can be printed on which press. The creativity also extends to how long an anilox can be used before it absolutely has to be changed. With these ideas in mind, for a rack-out press, you may want to specify the volume as much as 10% more than you need and add extender or adjust the viscosity to tone down the color.

The corrugated printer needs flexibility. This is where you have to look at the range of plate screens that you typically run. It is possible to get the volume you need for the substrate but do it with a higher CPI anilox that has an extended volume. Fig. 6 shows the standard BCM range that your anilox supplier can provide in volume for a given CPI. It also shows a second upper limit. These are achievable volumes. Since the volume is necessary to achieve S.I.D. (solid ink density) and the proper CPI is what is needed to ink the plate without causing transferring problems, pushing the CPI up and maintaining your needed volume gives you that flexibility. Using a higher CPI than is minimally needed does not cause any issues with the plate, and in many cases helps to keep the plate clean.

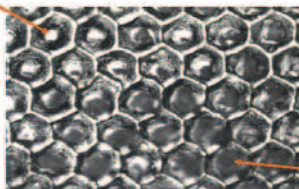
However, if you use this method of pushing up the CPI of the anilox, the cleanliness of the cells are more important than ever.

Combining the basics of anilox specifications with a fingerprint of each press will help in understanding what densities your present anilox inventory is capable of producing.

What you are looking at?

100x or 200x scope can be used to make sure cells are clean.

Can see bottom in Clean cells.



Dirty cells look filled

FIG 7

Plate / Ink / Anilox

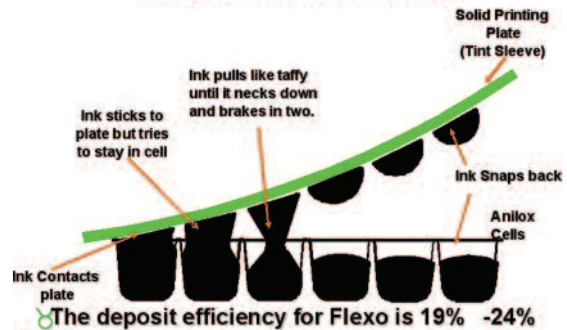


FIG 8

Those extended volume cells can become plugged if a cleaning routine is not part of the daily and weekly press maintenance. Fig. 7 shows a picture of a plugged patch of cells and a clean cell. As part of your press maintenance, someone should be assigned to monitor the surface of the anilox roll. A 100X or 200X microscope can be used to

trace the life and predict the performance of your anilox. Having the same person periodically look at the cells through a microscope will show them if the cells are being cleaned and they can also watch the cell wall width. As an anilox roll wears, the cell walls will start increasing in wall width. This increase is a direct reflection of a reduction in BCM.

Looking at Fig. 8 you will see an illustration that tries to depict the ink split that happens between the anilox rollers' ink carrying pocket and the plate. Simply stated, when the plate surface (dot or flat) comes in contact with the metered anilox roller, the ink wants to transfer but the sides and bottom of the cell want to retain the ink. The ink is basically pulled until it more or less looks like an hourglass then it splits. Part of the ink snaps to the plate and part snaps back. This splitting action happens again with the plate and the substrate. The flexographic process typically deposits on the substrate between 19 and 24%

Dirty Anilox Cells



FIG 9

of the volume (BCM's) of the anilox on the substrate.

This splitting principle is another reason why anilox cell cleanliness must be maintained. Look at Fig. 9 and you will see if ink from a previous job was allowed to dry in the cells. The volume being transferred drops quickly. Again, assign a person in your crews to monitor the aniloxs for cleanliness, wear and damages. Make sure the person keeps a logbook with dates of inspections and a record of the observations. Work with your anilox supplier to develop cleaning procedures and anilox care and maintenance training for your operators.

Final Points

The anilox specifications are affected by the screen count of the plates and absorption of the substrate. Never go below 4 CPI's per plate screen count. The volume of the anilox is what determines solid ink density, and changes in the volume can affect the obtainable tonal range. Cleanliness and wear will change the available volume of the anilox. Monitoring the volume and density that is produced for a given substrate will help the planning of the jobs that can be run on the particular deck. Even if the density changes, matching the worn volume to a density will help you to schedule what jobs can be run on that deck.

Flexibility in planning jobs comes from understanding and monitoring how the anilox roller inventory is producing. Since you cannot just change rollers in and out on a rack type corrugated press, you must know the potential from each anilox. If you keep your anilox's CPI toward the upper range, you may be able to use a worn anilox to print a tint or when less density is required without causing a plate transfer issue. Creativity in using your anilox inventory is very important in the corrugated flexographic segment.

Combining the basics of anilox specifications with a fingerprint of each press will help in understanding what densities your present anilox inventory is capable of producing. It cannot be over emphasized for you to work closely with your ink, plate and anilox suppliers when you fingerprint your press. Establish a print performance team using your suppliers.

Tony Donato is process and product development engineer for Harper Corp. of America. For 18 years he has been working in the areas of flexography concerning anilox rolls and doctor blades. He has 25 years of equipment manufacturing experience. He can be reached at 800-438-3111 or tdonato@harperimage.com



Apply & Inspect Glue with a Single Valco® Control.

FlexosealPRO®

There's value in your existing Valco Flexoseal® lap-gluing system. Upgrade now to the new FlexosealPRO® system from the industry leader.

NEW

DATA COLLECTION AND VISUALIZATION SOFTWARE

Monitor flexo-folder-glue with Valco's VisiPRO technology. Graphical presentations of machine performance provide measurable process data critical for customers, ROI analysis, and capacity analysis.

Non-Contact & Contact Gluing.

100% in-line quality assurance • "Auto-glue" gluing • glue pattern inspection
Jam prevention • Double-feed and skew detection • Bar code reading
Data collection • More...

For all of your cold glue & hot melt adhesive application needs.
www.valcocoldglue.com • www.valcomelton.com • www.meltonhotmelt.com

VALCO MELTON

COLD GLUING AND HOT MELT SYSTEMS BY VALCO CINCINNATI, INC.

For more information visit www.ValcoMelton.com, or contact your local representative.
Corporate office (USA): Valco Cincinnati, Inc. OH, Tel: 513.874.6550
Info@ValcoMelton.com • www.ValcoMelton.com • Serving Over 52 Countries Worldwide.

The Industry Leader. A proven brand for over 55 years.