

COATINGS & ANILOX TRANSFER EFFICIENCY TO THE SUBSTRATE

Flexo style chambered doctor blade metering coaters, as they were discussed in the 02/99 TechTalkNEWS, have become the dominant coater type used on sheet fed offset presses. They have proved capable of producing high levels of precise, repeatable application of clear coatings, and other fluid products.

Integral to this success has been the development of the laser engraved ceramic anilox roll, which is durable and does not wear over time. This means that the cells engraved into the ceramic to carry a pre-determined volume of liquid are consistently the same.

Well that all sounds pretty good, - precise, consistent, repeatable, but how do we go about choosing the cell volume, pattern and the screen count, to deliver the coating volume that we want to a substrate? Remember an anilox is engraved to order creating a large number of microscopic holes (cells) that are laid out into a pattern (the engraving angle measured from the axis of the roll) and a screen count defined as the number of cells per linear inch along the engraving angle.

So how do we choose coating anilox engraving specifications?

In a chambered doctor blade flexo system, fluid is pumped into an enclosed chamber where it is picked up by the laser engraved roll (anilox). An enclosed doctor blade system with one blade set to the anilox in the direction of rotation (positive angle), and the other set in the counter rotation direction (negative angle), scrapes the surface of the anilox clean leaving only the fluid volume filling the engraved cells. When the anilox is in contact with a raised surface plate or blanket cylinder, the fluid volume contained is released to the surface for transfer to the substrate.

Now, the shocking news! Depending on rheology of a coating, in the flexo process the amount of coating transferred to a substrate is said to be only 19% - 24% of the anilox engraved cell volume. Whoa you say, can that be right? - only one fifth of the fluid volume in the cells ends up on the substrate!

Well, it is correct and you must account for these transfer efficiencies in the design of an anilox.

If you happen to know from experience that a known weight of coating has been transferred by an anilox of known volume, then the volume of coating applied and the percent of deposit can be calculated. If this information is not available then the assumption is that the transfer rate will be approximately 21%. In other words, only 21% of the fluid volume contained in filled anilox cells will reach the substrate being coated. By the way, this number doubles (42%) for direct gravure process application where you transfer directly to a substrate and no plate or blanket is involved to split a wet coating film.

Anilox manufacturers differentiate between thick film coatings, those requiring more than 12.5 billion cubic microns per sq.in. (BCM) anilox volume, and thin film coatings, those requiring less than 12.5 BCM anilox volume.

The preferred cell patterns for thick film coatings are trihelicals and quads with 45 degree cell angles. Engraving screen counts can range from 30 to 200 cells per lineal inch and cell volume from 12.5 to 50 BCM.

The preferred cell patterns for thin film coatings are 60 degree hex's, the same essentially as for flexo inks, which are thin film applications. Engraving screen counts can range from 165 to 1,300 cells per lineal inch and cell volume from 0.7 to 12.5 BCM. The 60 degree hex pattern allows 15% more cells to be engraved into an anilox than a 45 degree pattern allows, meaning that preferable thinner walled, shallower, bowl shaped cells can apply comparable coat weights. Channeled cells are advised for high viscosity coatings over a 800-2,000 cps range.

Coating applications may be specified as (dry or wet weight per unit of area). Unit of area in graphic arts is commonly expressed as:

- 3,000 square foot ream
- 1,000 square feet (MSF)
- 1,000 sheets of a given size

Since coatings are specified by weight, but are applied by volume, you need to know:

- *weight per gallon of the applied coating*
- *percent solids of the applied coating*

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Example:

Converting applied weight to applied volume:

Target dry coat weight: *0.4 pound/unit of area*
Unit of area: *1000 sq. ft (144,000 sq. in)*
Coating % solids: *40% (0.40) (use decimal)*
Weight per gallon: *8.6 pounds*

Calculations:

Dry wt. per unit of area = wet wt. per unit of area
% solids

$$\frac{0.4}{8.6} = 1.0$$

Wet wt. per unit of area = Gallons per unit of area
Wt./ gal.

$$\frac{1.0}{8.6} = .1163$$

Gallons X Cubic in.'s per gal. = Cubic inches per unit of area

$$.1163 \quad X \quad 231 \quad = \quad 26.86$$

Cubic in.'s per unit of area = Cu in.'s per sq. in.
unit of area

$$\frac{26.86}{144,000} = 0.0001865$$

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Cubic in.'s per sq. in. X 25,400 = Cubic Microns per sq. in.'s
of substrate surface

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$$0.0001865 \times 25,400 = 3.0566 \text{ BCM per sq. in. applied to substrate}$$

Determining the anilox roll volume needed:

If no actual information is available regarding actual application amounts, then a transfer efficiency rate of 21% is assumed for flexo.

Applied cubic microns = Anilox Volume required
Transfer rate

$$\frac{3.0566 \text{ BCM}}{.21} = 15.28 \text{ BCM}$$

Remember, engraved roll (anilox) to plate or blanket to substrate flexo coating processes, most often deliver not less than 19% nor more than 24% of the fluid contents of the cell to the substrate. Some plate or blanket types (photopolymer) may be found to improve transfer somewhat.

While this discussion is targeted to give the reader an idea of what actually occurs in the flexo application of coatings with a chambered doctor blade setup, always consult with your anilox supplier to determine exact specifications for specific anilox coating cylinders.

Always remember that anilox roll cleaning is very important as cell volume can change radically with dry fluid build-up. Follow your anilox suppliers roll cleaning instructions so that you are guaranteed optimum anilox transfer efficiency.

Definitions:

Micron = a metric unit of measurement

- *.0001 inch = 25.4 microns*
- *BCMs = billion cubic microns per square inch of anilox surface area.*

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