GETTING TECHNICAL

In this, the third in a series of technical articles, Mr Wilbert Streefland of Technology Coaching BvbA looks at measuring and evaluating ink film thickness data.

MEASURING AND EVALUATING INK FILM THICKNESS DATA

Is one method for measuring ink film thickness on the surface of a screen roll (anilox roll) any more accurate than another? This topic was raised during a discussion with a customer. At about the same time, Tony Sullivan from Symbotics and I were developing software for analysing data collected related to the ink film thickness on screen rolls. We had a long discussion about the most appropriate statistical representation of this data. In this article, we take a closer look at the methods for measuring ink film thickness. I will not judge the systems because that would require having them all available for testing, which is not the case. Therefore, the following article is not about the accuracy of the different systems, but more about the danger of applying statistics to the data collected.

The basics

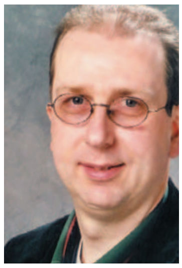
On the surface of a screen roll there is a thin ink film which is the average of the accumulated ink volume of the individual cells on the surface of the screen roll over a given area. Thus the unit for ink film thickness on a screen roll is volume per area (m^3/m^2). The resulting unit is that of length (m). We are measuring a thin ink film and so putting µ (micron) in front makes the numbers expressible in 2 digits. The ink film available on a screen roll in the flexo print process mostly ranges between 2 µm and 20 µm.

Only a part of the ink film available on the surface of the screen roll is transferred during the print process. This is a function of the cell shape, ink release characteristics of the screen roll surface and the shearing of the ink.

Methods for measuring

The measuring method most commonly used to measure ink film thickness on a screen roll is to use a pipette to apply a known volume of ink to the surface of the roll and to then doctor the ink over the surface of the roll. We then blot the ink on a sheet of paper and measure the area of the blot. Dividing the volume of ink applied by the area measured for the blot gives an indication of the ink film thickness available on the surface of the roll. It is claimed that this system is inaccurate because of the human effect on the amount of ink applied, the doctoring of the ink and the measuring of the blotted area.

Usually, the volume of ink applied is 10 mm^3 (10 µl = 0.01 cm^3). If this ink volume covers an area on the roll of 10 cm^2 (0.001 m^2) then the ink film thickness on the surface of the roll is 10 cm^3/m^2 or 10 µm. Evaluating an area of 10 cm^2 on a roll engraved with a screen



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of 100 lines/cm results in 100,000 cells being filled with ink.

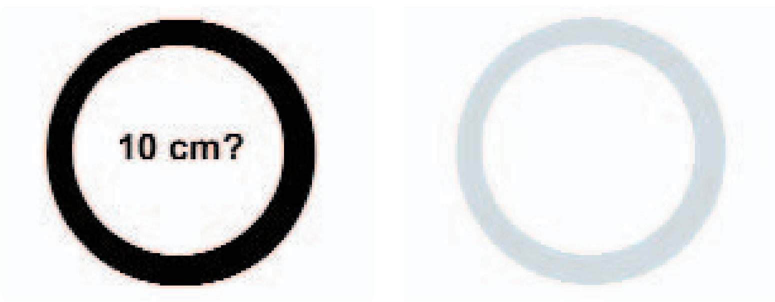
Another method used for measuring the ink film thickness is to use a laser scan microscope or a light interferometer microscope. Due to the dimensions of the optics, only an area involving between 25 to 250 cells is used for determining the ink film thickness. The scanning of the individual cells by these systems is extremely accurate. The dimensions of these cells are analysed statistically to estimate the potential ink film thickness on the surface of the roll. Further, cell depth and screen count can be determined.

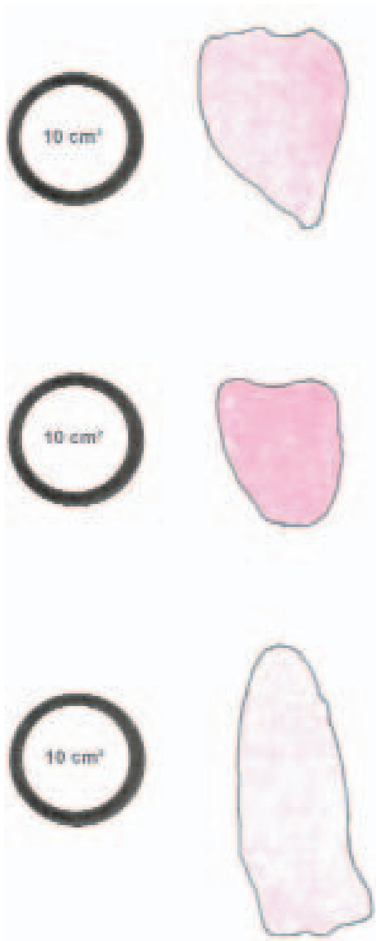
Accuracy of the first method?

The errors affecting the first method of applying a fixed amount of ink are:

1. Preparing the pipette with a precise volume of ink. The pipette I use has an accuracy of about 98 per cent.
2. Doctoring of the ink on the surface of the roll. How much ink is left on the doctor blade after the process? A visual check of the doctor blade shows whether the step was done correctly or not. Is the ink doctored over the surface of the roll filling the cells or is air locked in the cell of the screen roll? This mostly depends on the cell shape. Think of narrow, deep cells or wide, shallow cells;
3. Measuring of the blotted area. I recommend highlighting the edge of the blot area.

To illustrate the effect of this third point, I conducted the following test using IFT Analyzer, a software package developed by Symbotics. First, I printed the picture below (the black and grey circle) 12 times.





I then highlighted the outside of the right (grey) circle using a fine-line thickness of 0.5mm. After this image has been scanned or digitally photographed, IFT Analyser is able to detect the edge of the two circles and determine their area. To minimise any error, I used a high resolution scanner. Following are the results of the right circle relative against the left circle highlighted with a fine-line on the outside: 9.95, 10.02, 9.96, 9.92, 9.97, 9.95, 9.98, 10.01, 10.00, 9.99, 9.97, 10.00. The average of all values is 9.98 the target was 10.00. All values are within 1 per cent of the target value.

The problem

The illustrations, left, are scans from 3 blots made left, centre and right on the surface of a screen roll. The roll was not in a very good condition. The table below provides the results of the individual measurements — again using IFT Analyzer.

The arithmetic average of the 3 ink film thickness measurements is 6.93 µm. But if we calculate the ink film thickness from the total amount of ink applied and the total area covered then we get a different answer — in this case 6.51 µm.

But way is this different? It took some time before I understood. The average calculated from the individual ink film thickness values assumes that all 3 values are equally important. If you first average the 3 area values measured and then calculate the ink film thickness then you are including a weighting factor. Thus the larger area (the low ink film thickness), is affecting the average more than the smaller area(the high ink film thickness). The result is that the average ink film thickness based on first averaging the measured area values is lower.

	Ink Volume applied in µl	Area Covered in cm²	Ink Film Thickness in µm
Measurement 1	10	15.60	6.41
Measurement 2	10	10.72	9.33
Measurement 3	10	19.76	5.06
Total	30	46.08	20.80
Average IFT = 20.8÷3			6.93
IFT from Totals = 10x30÷46.08		6.51	

This "weighting factor" is in principle wrong, because we do not know how representative each of the areas is for the total roll. It would be better to not apply any statistics to these readings and just leave them as they are. The large difference between the readings is already sending the message that the roll needs replacing or cleaning. The average value would not provide this information.

All this still leaves unanswered questions about the results achieved using interferometer scanning. The number of cells involved in one scan of the interferometer method is probably 4,000 times less than using the blot method. Although the scan is very accurate, one needs to make a relatively high number of measurements to avoid the risk of just having scanned a non-representative position on the roll. This is a little bit like the problem discussed earlier. It means that achieving a reliable value is probably more labour intensive using the interferometer method.

THE USEFULNESS OF AN INK FILM THICKNESS ESTIMATE IS NOT ONLY DETERMINED BY ITS ACCURACY, IT IS ALSO DETERMINED BY THE SIZE OF THE AREA TO WHICH IT APPLIES.

Conclusion

One should be careful with applying statistics on ink film thickness data. Calculating the average does not always provide meaningful information. In this situation, it is actually hiding a major error. The usefulness of an ink film thickness estimate is not only determined by its accuracy, it is also determined by the size of the area to which it applies.

Ink film thickness variation has a large influence on printed colour variation as discussed in an ealier article in this magazine titled "Colour difference during production". It is therefore important to regularly measure the ink film thickness of your screen rolls and keep a history of the data. The Symbotics IFT Analyzer software is a useful tool for this — particularly as the print customer wants colour consistency. To understand the accuracy of measuring systems requires controlled testing and evaluation of all systems under equal conditions.

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