MINIMUM PRINTED DOT SIZE AS A PRINT CAPABILITY MEASUREMENT

The flexo print process is the most commonly used for printing on paper and board in the packaging industry. From its introduction, it has been competing against offset. Historically the Flexo printer wants to meet "Offset quality" and this is expressed in the screen count used in the printed image. A common belief is that the higher the screen count, the better the print quality. But is screen count really a measure of print quality?

It is correct that printing a higher line screen count is more difficult. At the same time, a low screen count *can* be printed at a higher print quality than a high screen count. To understand this, we have to take a closer look at what we really are looking at in terms of quality.

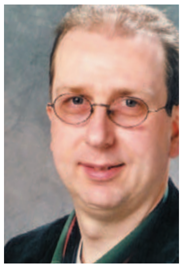
The general comment of Offset being a higher quality print process compared with Flexo is because it can print a higher screen count. How can we decide, in an easy way, which print process best suits a particular application? To answer this question, we have to take a closer look at halftone printing that uses dots. Today there are many different screen types. Let us have a look at the two main types:

— Line screen. The dots are printed on fixed positions in a grid. The interval is expressed in the number of lines per cm at which the dots are positioned. The dot size varies to change the density of the printed colour.

— Frequency modulated screening (stochastic screening). The dots have a fixed size and a random position. The density is changed by the number of dots randomly printed per unit area.

There is also a screen type combining these two types, commonly known as 'samba' screen, combining the advantages of both screen types. Using the 'samba' screen will give you a compromise to use normal line screen until the process used gets to its limit in printing consistently a small positive or negative dot area. Then you change to random placed dots of equal area. This is a good solution to stretch the process capabilities, but it does not change the minimum dot size the process can print consistently. The link between all screens is the size of the printed element, often a dot shaped element. The important variable is the area the element is printing.

The limiting factor is the minimum (positive or negative) size of the 'dot' (printed element) from which the image is built. The size of this element is independent of the screen type used and/or the screen count used. The minimum size of the 'dot' printed and the consistency of this size when printing is dependant on the capabilities of the process and materials used. The variation of the dot size can be linked to the edge sharpness of the printed element.



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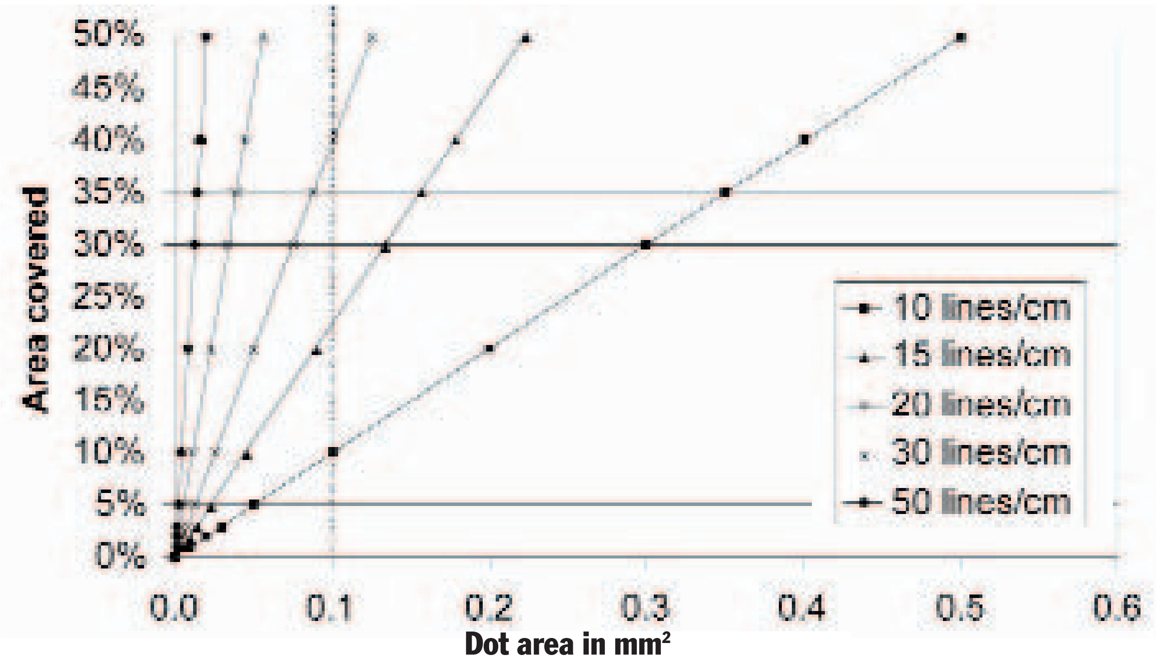


If we express the capability of a print process and materials used as the minimum dot size that can be printed (positive/negative) and quantify the variation of the printed element during printing then that would set values for the quality of the printing. But what is the consequence of using different screen counts in printing an image?

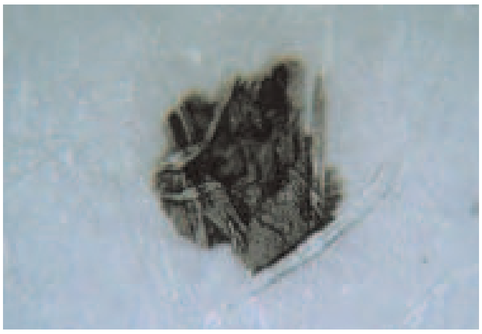
Closer look at halftone

Presenting two pictures of the same image printed at different screen counts would give you a perceptual impression of the problem — but this is what we would like to avoid. Instead, I prepared a graph (top) showing you the printed dot area for different screen counts as a function of the coverage.

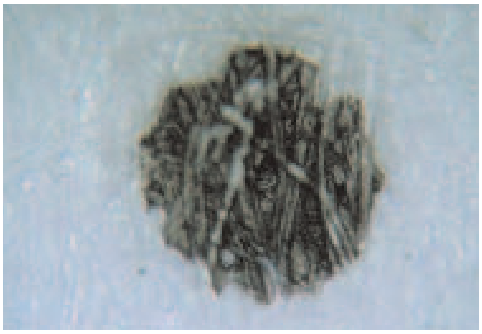
In the graph is a vertical line at a dot area of 0.1mm^2. It crosses the 10 Lines/cm screen at 10 per cent coverage and the 20 Lines/cm screen at 40 per cent. This indicates that the 'dot' area is identical for a 10 per cent coverage at 10 Lines/cm and 40 per cent coverage at 20 Lines/cm. The shape of the dot might be different.

This also indicates that variation in dot area has a much higher impact on coverage at a high screen count than at a low screen count. Thus the range of the dot area (Positive and negative) for a 50 line screen is 0.04mm^2 and for a 10 Lines/cm is 1.00 mm^2.

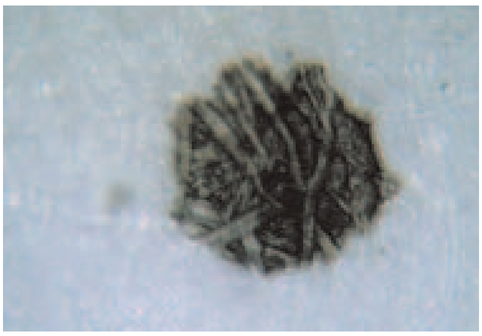
Take a look at a more practical example. We used a microscope to take images of three flexo printed dots on 140gsm white top kraft B flute board.



Flexo printed Dot: 200x Magnification, 2 per cent coverage, 12 L/Cm, dot area 0.014mm^2



Flexo printed Dot: 200x Magnification, 5 per cent coverage, 20 L/Cm, dot area 0.013mm^2



Flexo printed Dot: 200x Magnification, 10 per cent coverage, 30 L/Cm, dot area 0.011mm^2

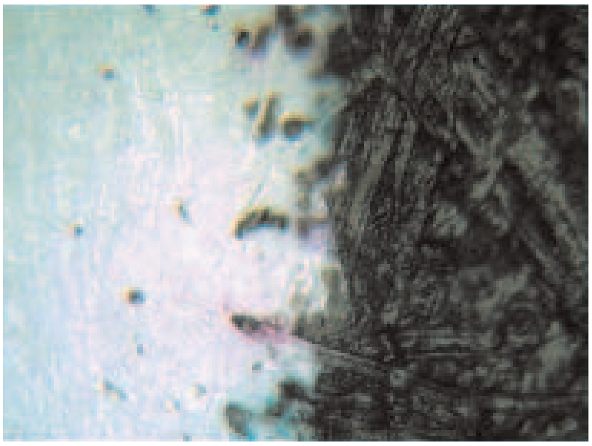
The dots are nearly the same size. There is a difference in the calculated value using the screen count and coverage and the visual representation. The actual size might be different due to the influence of the print process and how the dots were reproduced on the printing plate. The fact is, that all the three screens at some point, used similar sized dots.

If you want to print fine detail, you need to use small dots that result in no dot area variation but has an impact on contrast. If you choose a lower screen count then you will be able to print contrast but not fine details.

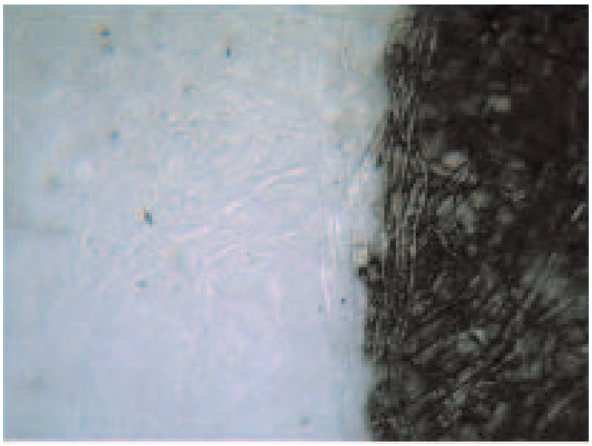
The variation of the dot area is dependant on the capabilities of the print process, plates and materials used.

What about human interpretation? In close proximity, the human eye can see very small elements — but at the same time does not need a high contrast in the image, therefore a high screen count can be used. If the printed image needs to be seen from a long distance, it needs contrast — yet the eye is not capable of seeing the fine detail — so a low screen count can be used. Think of packaging positioned on the shelf, or advertisements on billboards.

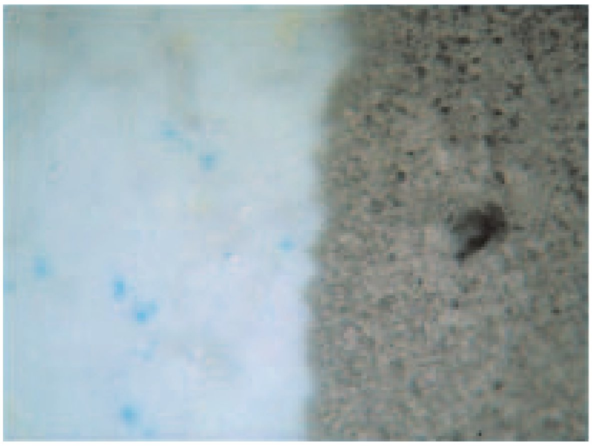
The selection of the screen count is dependant on the viewing distance of the observer. It is not right to closely compare images printed using different technology and intended for different viewing conditions. It also clarifies the concern of using screen count as a quality element for printing.



200 x magnification of the edge of a printed black bar on 90gsm copy paper using a 300 dpi inkjet printer



200 x magnification of the edge of a printed bar-code on 140gsm white top kraft B flute corrugated board using a flexo printer for corrugated board.



200 x magnification of the edge of a printed bar on coated white kraft paper using an offset printer.

Edge Sharpness

Unfortunately, we have never established information on the variation of dot area printed. However, there has been plenty of good work done on evaluating edge sharpness; the sharpness of the edge going from full tone printed to unprinted. Some standardised edge sharpness measurements may provide a good means of quantifying dot area variation. The topic is certainly worthy of more detailed investigation.

Let us take a look at three examples of a printed bar.

SOME STANDARDISED EDGE SHARPNESS MEASUREMENTS MAY PROVIDE A GOOD MEANS OF QUANTIFYING DOT AREA VARIATION. THE TOPIC IS CERTAINLY WORTHY OF MORE DETAILED INVESTIGATION.

The edge sharpness of the flexo printed and offset printed bar is much better than the bar printed using a digital printer. However, printing a photo on the digital printer and gravure printer looks much better then on the flexo printer. The best explanation is probably found in the paper surface properties of the different papers used and the printing plates used. Edge sharpness provides the limit for the closeness of lines for a readable barcode.

What process to use

First you need to determine at what distance the printing has its first impact on the customer. If it is close, then you want to be able to print fine detail. If the viewing distance is long then you want to print contrast.

Printing fine detail requires smooth surface substrates and printing plates that can transfer ink for printing small positive and negative elements. Mostly you want to transfer a thin ink film. In this case, it points towards using Offset or Gravure printing equipment.

Printing contrast means being able to print a thicker ink film if pigment concentration in the ink is becoming the limiting factor. In this case it points towards flexo.

PRINTING CONTRAST MEANS BEING ABLE TO PRINT A THICKER INK FILM IF PIGMENT CONCENTRATION IN THE INK IS BECOMING THE LIMITING FACTOR. IN THIS CASE IT POINTS TOWARDS FLEXO.

All printing needs to reproduce readable bar-codes. The edge sharpness print capabilities of Flexo, Offset and Gravure is probably similar if sufficient attention is paid to the preparation of the printing plates and the setting of the machine given a similar substrate used.

The capabilities of a print process, plates and raw materials used are best evaluated by looking at the variation in dot area of the smallest printed dot and/or the edge sharpness of the element printed. It is better not to use screen count as a measure of print quality. If you want to print fine detail then use a high screen count but remember it will restrict your ability to print contrast accurately. If the object is placed at a distance then use lower screen counts which will give you better control over the printed contrast.

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