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**Research area: Product aims**

Paper, paperboard and board // graphic papers

**Key words:**

Web offset paper, web offset printing, tone value, dot gain, Process Standard Offset

**TITLE:****Quantification of practically relevant influences on dot gain in heatset web offset printing and their quantitative and economic consequences****Background/Problem area**

The objective in the printing process is to reproduce an original as faithfully as possible. One major problem is that the ink transfer from the printing plate to the paper by means of the rubber blanket generally goes hand in hand with an enlargement of the dots known as dot gain. This dot gain consists of two components, i.e. the optical and the geometrical dot enlargement. If this dot gain is not selectively counteracted in pre-press, deviations between the original and the print product may occur during the print run and result in makeready waste.

Dot gain is influenced by a number of factors, just like the entire print result. These factors include the press, printing ink and fountain solution, rubber blanked, print-related parameters, and the paper itself. An accurate quantification of the influence of the individual factors has not yet been accomplished. The characteristic dot curve of the press is normally known. The other print-related contributing factors can be varied within certain limits by the printers, although the quantitative effects of such variations on dot gain are not sufficiently understood.

An important role in dot gain is attributed to the paper. At present, there are only empirical findings relating to the effect of the paper. This knowledge has been incorporated into the Process Standard Offset (PSO) (ISO 12647-2).

In particular, there is no knowledge available for estimating dot gain on the basis of fundamental paper properties. In addition, the subject, i.e. the print contents, can also influence the print results via partial dot gain. These effects cannot be readily quantified either.

**Objectives/Research results**

The objective of the research project was to minimise the economic losses as a result of deviating dot gain in heatset web offset printing whilst at the same time maintaining the required print quality.

It could be demonstrated that the online measurements of print density and dot gain (Quad Tech) correlate well with the spectrophotometer measurements, i.e. the online systems provide meaningful data. A comprehensive data exchange was established between print houses and the research institute, and a software tool (VB) was developed for the detailed, automated analysis of online data.

The analysis of more than 100 data records has shown that the dot gain fluctuates over time – in some cases significantly – and that this is not caused by the paper. On average, the fluctuations amounted to  $\pm 2.5$  % absolute. Extreme deviations of as much as 10 % occurred in very long print runs and can be attributed to abrasive plate wear. The press width was found to have a considerable effect on both print density (concave) and dot gain (convex). Dot gain deviations of up to 5 % absolute were found. The study of paper influences on dot gain revealed that this effect cannot be neglected either. When looking at papers of the same grade, however, the influences of press and printing parameters are predominant. The results of extensive paper evaluations prove that due to the numerous interactions involved, there are no singular relationships with dot gain. It is therefore impossible to estimate the dot gain on the basis of fundamental paper characteristics. A revised version of the Process Standard Offset (PSO) was issued in 2013 (ISO 12647-2:2013-12). The dot gain curves published in the PSO were confirmed by the project results. Thanks to their adaptation to the paper grades commonly used today, the curves provide a sound basis for print standardization. The new PSO is therefore a valuable tool helping printers to minimize costs caused by tone value deviations. Prerequisite is that they establish representative plate calibration curves for each individual paper grade and press. Moreover, knowledge needs to be gained jointly with plate manufacturers about the tonal shift caused by abrasive plate wear. Paper-induced variations in dot gain are negligible within the same paper grade, i.e. the influences of press and print-technological parameters prevail.

**Application/Economic benefits**

Interviews and conversations with heatset printers have revealed that the printing phenomena ghosting and deviations in dot gain in heatset web offset can lead to substantial economic losses. Press- and paper grade-specific calibration curves will enable printers to minimize print problems caused by dot gain deviations, allowing them to save up to €100,000 per press and year in the segment of high-quality heatset web offset printing. This is particularly relevant to printers in the new German Länder, where around 20% of the corresponding print capacity is located. The results are also of interest to printing press manufacturers having to minimize width-induced dot gain deviations by design measures against the background of increasing machine widths.

**Project period: 01.02.2012 – 31.01.2014**

**Remarks**

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