# Optimizing HD Flexo for Different Plate Technologies and Substrates

**Tatiana Bozhkova, A. Ganchev and Jana Kisova**

**Keywords:** HD Flexo, screen elwements, increase of the tonal value, printing plates

**Flexo printing is a technology widely used in the packaging industry – for labels, packaging for food, pharmacy and for many other applications. Flexo printing is suitable for printing on a large variety of substrates like different foils, paper, carton, corrugated or combined materials. With the development of the market, customers and print buyers are asking for top quality, especially as this is related to the printing of labels. This is the reason why in April 2009 Esko developed an entirely new approach towards the flexo printing, named HD Flexo. The goal is to achieve High Definition Flexo by combining two elements – high resolution (4000 dpi) and a special algorithm for screening that would make the smooth transition to zero in vignettes. As a result of the implementation of the new technology, according to Esko, several improvements are observed, i.e. smooth transitions to 0%, and increased tonal range, similar to offset and gravure printing. Additional advantage of HD that are claimed by Esko include a full range of printing plates (solvent, thermal or water processed); higher run length, due to the perfected shape of the screen elements, resulting in a higher stability of the dots during printing process and increased tonal range, when HD Flexo is used. For test purposes, analyses of parameters of HD Flexo at real production conditions were done. Test samples were printed on two different substrates - paper and polyethylene. Printing conditions were the standard for the printing house and some higher screen rulings were tested to establish the possibility to increase the commonly used screen ruling.**

## 1. Introduction

The growth observed nowadays in the packaging industry and particularly in the flexo printing technology is related to the increased level of print quality in flexo. This is valid not only for the already developed world but also for the so called emerging markets, including Bulgaria. Interest in state of the art technologies is easy to understand – this could be the best way to compete for print buyers, who look to reduce costs, but are not ready to compromise with the quality.

There were several developments that help the flexo industry to become stronger, but the impact of the new technologies in the plate making process is a really big contributor to this trend. The goal of going digital was to eliminate one additional step, such as film making and all critical aspects of copying a negative film to the photopolymer plate. One step less of course gives a big advantage – we can forget about all troubles like dust, poor vacuum, lost of fine elements etc. But dot shrinking (or the so called now round dot vs flat top dot) during digital plate making was a real gift for technology. It gave the flexo a chance to reproduce a very fine and small half tone dots with steep shoulders, reducing the dot gain to the level of offset printing. The result was a big increase in the tonal range, which improved the reproduction of fine details, especially in the highlights. Conversion from analog to digital plate practically gave a chance for flexo to successfully compete with other print methods, such as offset and gravure. The chance to make flexo a leading technology in the packaging industry gave a strong push to the key suppliers to allocate a lot of resources to further develop it. We can say that in practice, the reproduction with flexo printing became very close to what can be achieved by offset printing, but there were still some open questions and one of them was a smooth transition to "zero". Partly, this was solved with the invention of the hybrid screening, an elegant way to make such transition practically invisible. But, it was correct only when such transition was in one color. If the reproduction required it to be applied in more than one color, then it does not look so nice. Overlapping of stochastic screening in more than one color is always a challenge and the results are not always good. The main goal of the HD Flexo is to solve this problem. However, implementing it in practice requires the definition of optimal parameters and settings.

The objective of the present research is to analyze the parameters, required to implement the HD Flexo technology in real production conditions and to specify how much screen ruling can be increased without compromising with the speed and stability of printing.

## 2. Materials and Methods

### Conditions of test trials

Tests were made using a digital plate making technology on the following photopolymer plates: DuPont Cyrel DPR45 – Solvent washable plate and DuPont Cyrel FAST DFQ45 – Thermal Plate.

Printing plates are produced on the following equipment:

- Cyrel® Digital Imager - CDI Spark 4835 and CDI Advance Cantilever 1450;
- Exposure unit Cyrel 2000 ECLF;
- Solvent plate making processor Cyrel 1000P and Cyrel Dryer 1000D;
- Thermal plate making processor Cyrel FAST TD1000;
- Printing press Edale Beta 330, 8 colors, width 330 mm, maximum production speed 150 m/min.

Test plates with a thickness of 1.14mm were produced at Polyflex Ltd. according to the standard for the company plate making process used in their daily production.

Print trials were done in Janet Printing house.

The photopolymer plates used were a thickness of 1.14 mm and were produced using the CTP technology from a "Polyflex" form. Better results are received when an anilox cylinder is chosen with a lower ink transfer. For the printed images the same set of anilox rolls were used, with a cell count of 1200 lpi and the ink transfer for Cyan is 2.3 g/m$^2$.

## Methodology of the research and analysis of results

The photopolymer plates are chosen according to a digital plate making technology with solvent and thermal washing. Six different plate sets of solvent and thermal plates were prepared with screen ruling of 198 lpi, 174 lpi and 161 lpi. The preferred solid ink density was from 1.30 to 1.40.

HD Flexo benchmark test targets are combined with test targets developed by Polyflex. The control elements used were measured and visually controlled.

The samples are printed on two different substrates: paper and polyethylene. The control test target, marked as DuPont Cyrel® DPR, is shown on (Fig. 1).

At first, the circles for transition to zero are checked – they have to transition to zero without a visible halo effect. This can be observed without special measuring devices. Based on this, the preferable screen ruling is selected. The higher screen ruling gives the possibility to reproduce more fine details of the image, but it depends on many factors – the RIP characteristics, the printing press and especially the anilox roller parameters, the print substrates, the dot gain and many others. That is why printing with a screen ruling of more than 200 lpi is very difficult to achieve, due to all these factors, which are influencing final results.

Once the screen ruling has been chosen, a magnifying glass is used to observe the created dots at 0.5% imprint on the four different screen fields (HD Flexo C56, C46, C36 and C30). For example C30 means that the smallest dot is created by 30 pixels at 4000dpi.

Dot size and dot gain gain were measured with Gretag Macbeth densitometer.

Based on this, a print characteristic curve is created. The interesting part in the HD Flexo technology is that bump curves are not applied, or if they are applied, the bump up is minimal. As for the dot gain compensation in mid tones – it remains the same, because HD Flexo is changing the algorithm for screen generation at highlights and shadows only.

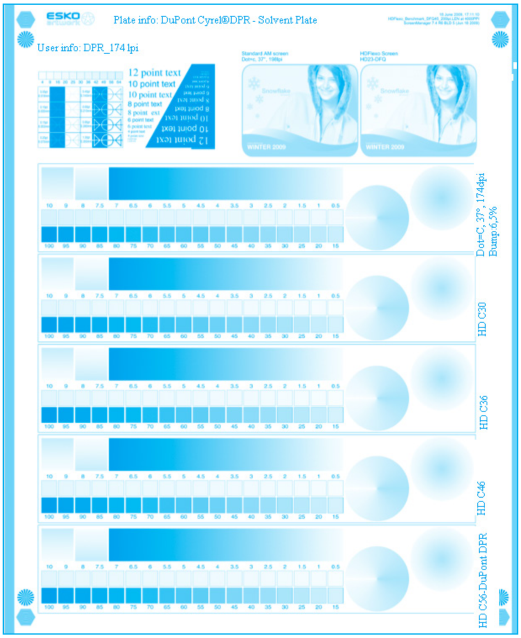


**Figure 1:** HD Flexo benchmark test plate

## 3. Results

A print characteristic curve based on the results obtained from a test print on paper with solvent washed plate type and screen ruling of 161 lpi shown in Figure 2. As it can be seen from the graphic, the best results were achieved at value HD C 46 (Fig. 2 b).

The results of the print trials, printed on paper with solvent washed plate and screen ruling of 174 lpi are shown in Figures 3 a,b.

According to the method for print test trials on paper described above, the results for solvent washed photopolymer plate at screen ruling of 198 lpi, the best results are achieved at HD C56 (Fig. 4 a, b).

A print characteristic curve based on a print test trial, printed on polyethylene with solvent washed plate at screen ruling of 161 lpi is drawn in Figure 5 a). Field HD C36 is selected as at this value the transition to zero is the smoothest (Fig. 5 b ).

A print characteristic curve of a print test trial on polyethylene with solvent washed photopolymer plate at screen ruling 174 lpi is drawn (Fig. 6 a, b) – best results are achieved at HD C 46.

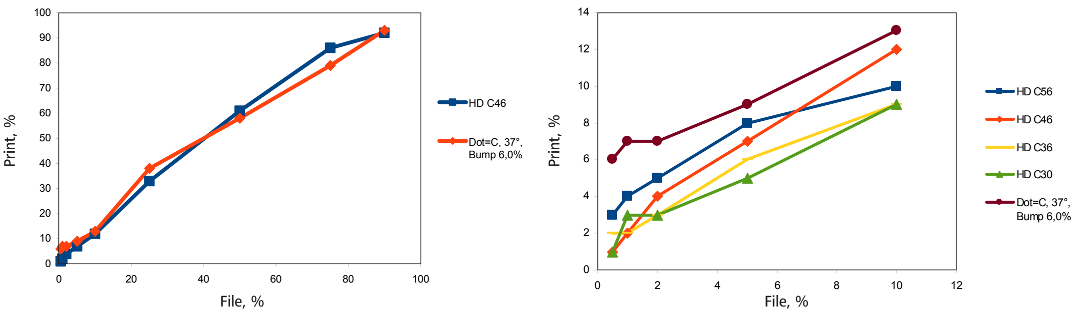


**Figure 2:** a) Gradation of the reproduction, b) Gradation of the reproduction in highlights; screen ruling: 161 lpi; substrate: paper; plate: solvent washed photopolymer plate

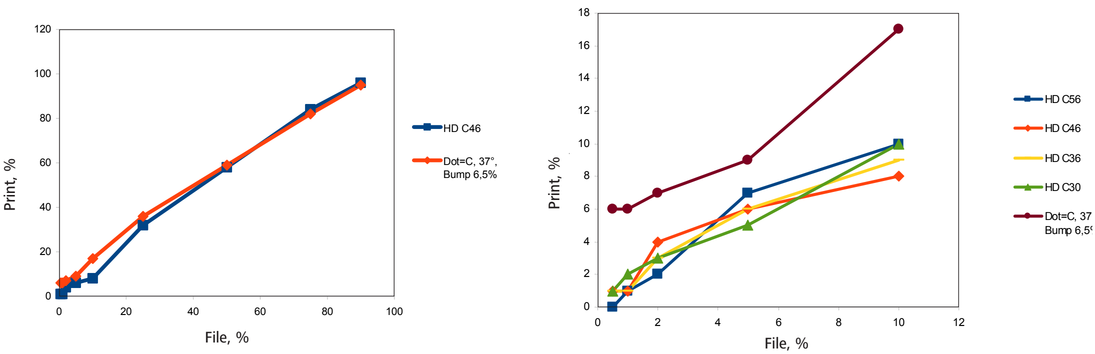


**Figure 3:** a) Gradation of the reproduction, b) Gradation of the reproduction in highlights; screen ruling: 174 lpi; substrate: paper; plate: solvent washed photopolymer plate

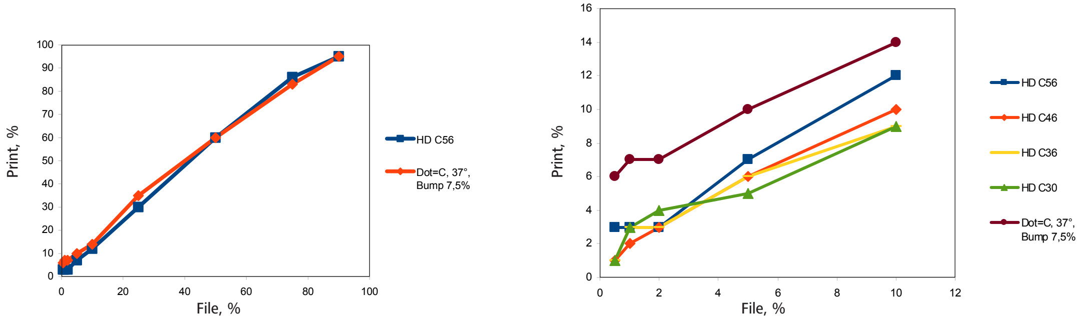


**Figure 4:** a) Gradation of the reproduction, b) Gradation of the reproduction in highlights; screen ruling: 198 lpi; substrate: paper; plate: solvent washed photopolymer plate

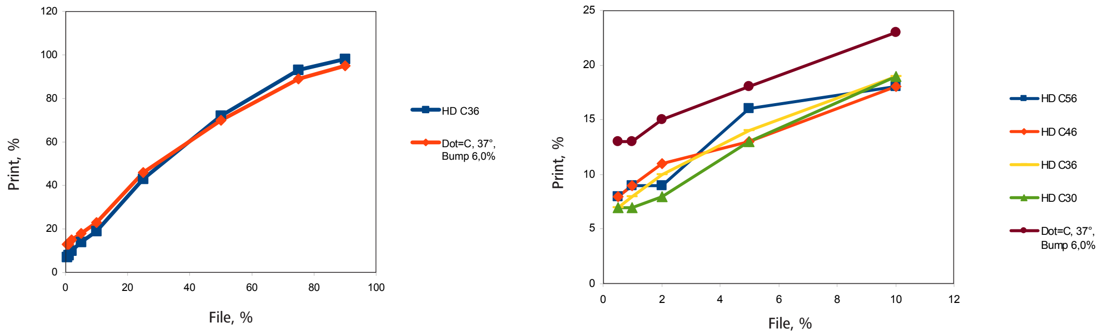


**Figure 5:** a) Gradation of the reproduction, b) Gradation of the reproduction in highlights; screen ruling: 161 lpi; substrate: polyethylene; plate: solvent washed photopolymer plate

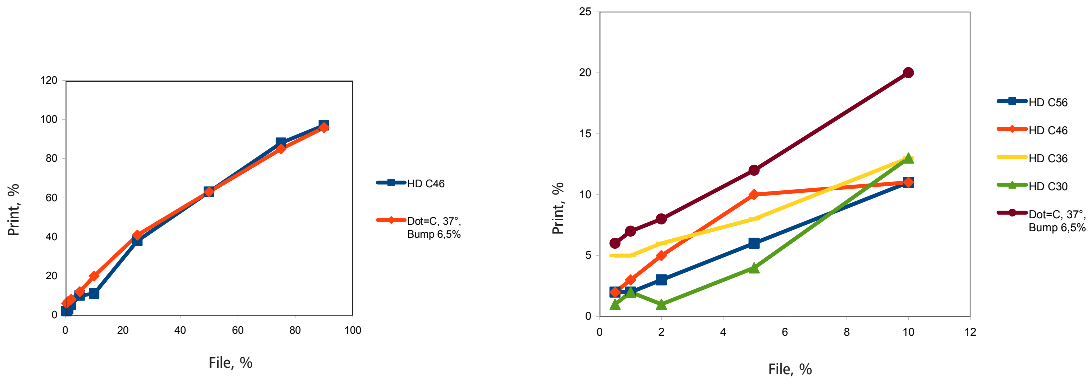


**Figure 6:** a) Gradation of the reproduction, b) Gradation of the reproduction in highlights; screen ruling: 174 lpi; substrate: polyethylene; plate: solvent washed photopolymer plate

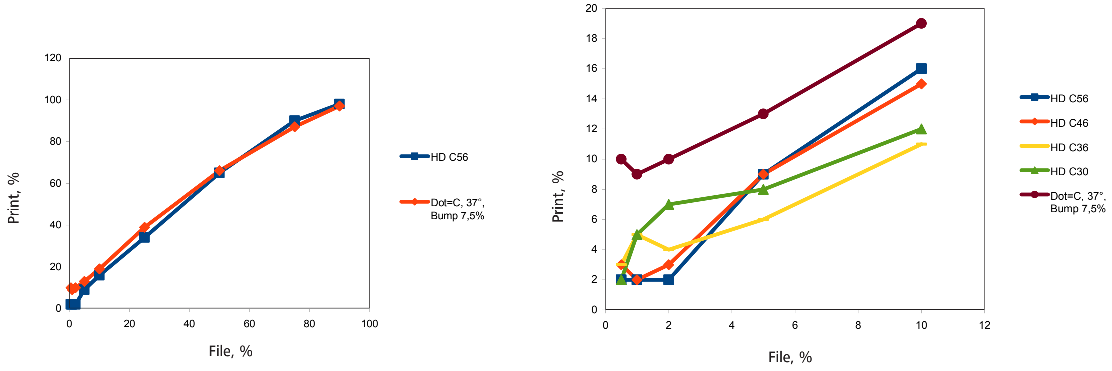


**Figure 7:** a) Gradation of the reproduction, b) Gradation of the reproduction in highlights; screen ruling: 198 lpi; substrate: polyethylene; plate: solvent washed photopolymer plate

Following the above mentioned steps, a benchmark test is made for the thermal technology, and the only difference is that at the FAST® technology the HD dot values are lower (HD C31, C29, C27, C23).

For the print test on paper – thermal photopolymer plate with screen ruling 161 lpi, and from the drawn curves (Fig. 8 b), the smallest dot to be built with 27 pixels at 4000 dpi is selected, i.e. HD C27 (Fig. 8).

The graphics on Figure 9 b shows, that on print samples, printed on paper with thermal plate and screen ruling 174 lpi, the smoothest transition is observed when HD C23 is applied (Fig. 9 a).

The graphics on Figure10 b shows that on print samples, printed on paper with thermal plate and screen ruling 198 lpi, the smoothest transition is observed with 27 pixels, i.e. HD C27 (Fig. 10).

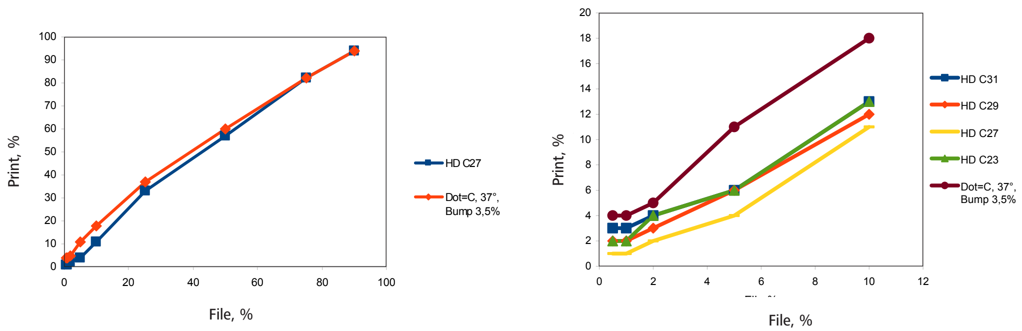


**Figure 8:** a) Gradation of the reproduction, b) Gradation of the reproduction in highlights; screen ruling: 161 lpi; substrate: paper; plate: thermal photopolymer plate

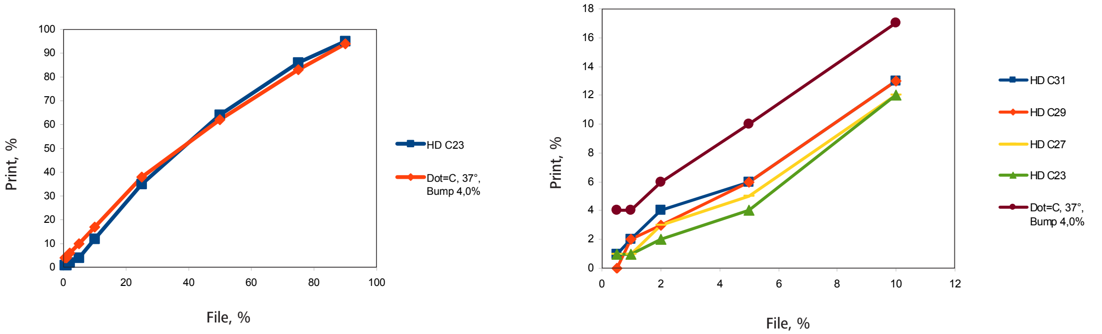


**Figure 9:** a) Gradation of the reproduction, b) Gradation of the reproduction in highlights; screen ruling: 174 lpi; substrate: paper; plate: thermal photopolymer plate

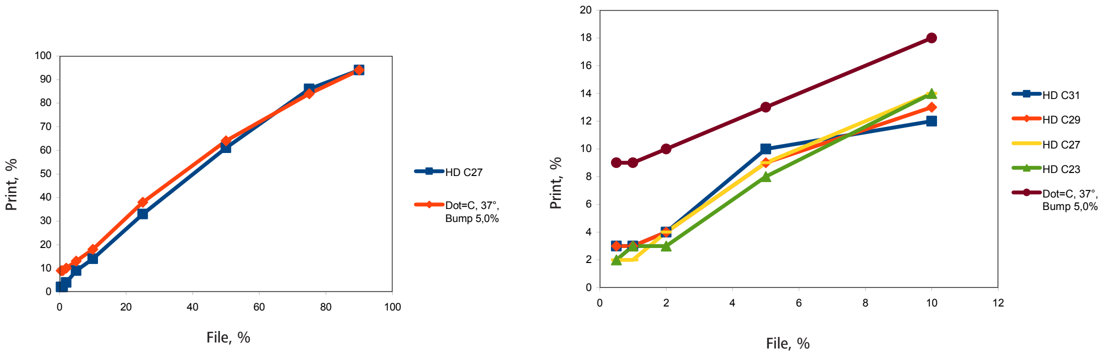


**Figure 10:** a) Gradation of the reproduction, b) Gradation of the reproduction in highlights; screen ruling: 198 lpi; substrate: paper; plate: thermal photopolymer plate

A print characteristic curve of print samples, printed on polyethylene with thermal plates and screen ruling 161 lpi is drawn (Fig.11 a) using HD C36, because on Fig.11 b is seen, that at this value the smoothest transition to zero is observed.

A print characteristic curve of a test print, printed on polyethylene with thermal plates and screen ruling 174 lpi is drawn (Fig.12 a) using HD C29, as on Fig.12b it is seen that at this value the transition to zero is the smoothest.

A print characteristic curve of a test target, printed on polyethylene with a thermal plate and screen ruling 198 lpi is drawn (Fig.13 a) using HD C27, because on Fig.13b it is seen that at this value the transition to zero is the smoothest.

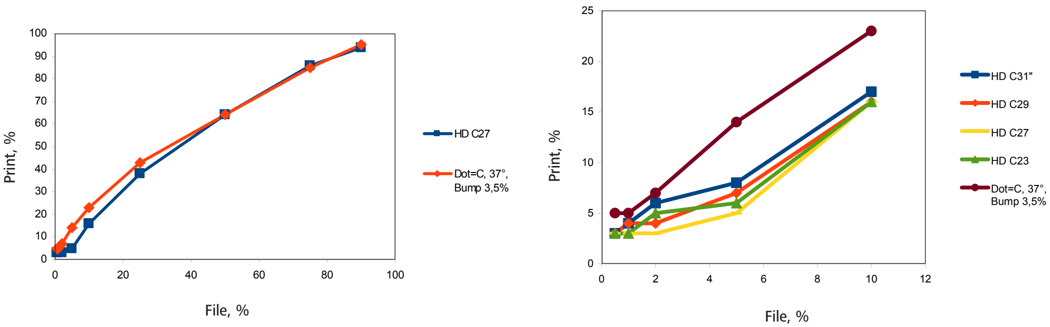


Figure 11: a) Gradation of the reproduction, b) Gradation of the reproduction in highlights; screen ruling: 161 lpi; substrate: paper; plate: thermal photopolymer plate

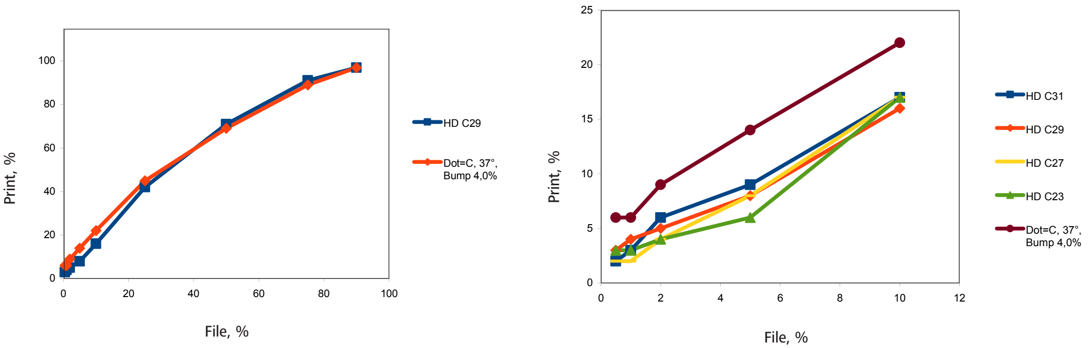


Figure 12: a) Gradation of the reproduction, b) Gradation of the reproduction in highlights; screen ruling: 174 lpi; substrate: paper; plate: thermal photopolymer plate

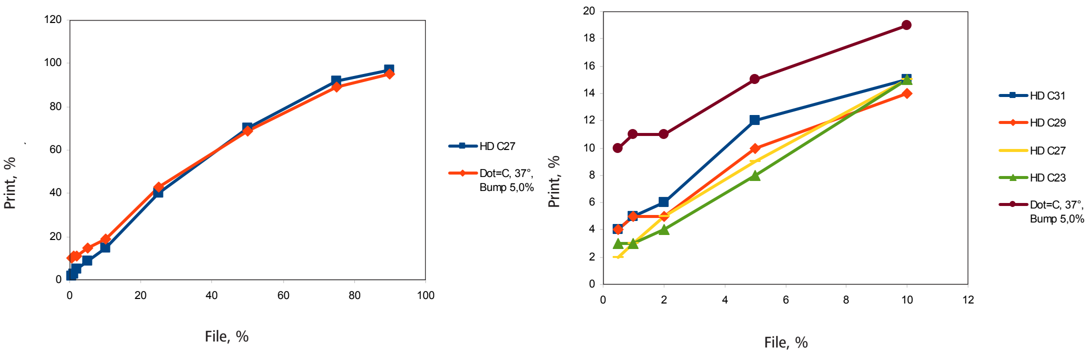


Figure 13: a) Gradation of the reproduction, b) Gradation of the reproduction in highlights; screen ruling: 198 lpi; substrate: paper; plate: thermal photopolymer plate

Comparison of the print quality for digital plate making with thermal plates, at screen ruling 174 lpi, with a selected value HD C46 and without applying HD Flexo is given on Figure 14.


**Figure 14:** Comparison of tested print samples, a) Conventional screen, b) Using HD Flexo C46

## 4. Conclusions

The conclusion is that the HD Flexo technologies are suitable for testing standard production conditions and allow for increasing the print quality of the image.

When using HD Flexo technology, the reproduction in highlights and transitions to zero is improved.

Increased screen ruling allow better reproduction in mid tones, neutralizing the negative effect of visible rosettes in grey and full color areas of the image.

The digital printing plates reproduce the tonal range better, with finer details and with a decrease in the dot gain.

Screen ruling selection must be based on particular print conditions, design characteristics, screen ruling for the image and for aniloxes, and should be specified in a way to achieve the best results when HD Flexo is used.

The higher screen ruling of the image leads to a higher quality only if the proper screen and anilox ruling combination is selected and necessary settings on HD Flexo are correctly applied.

It was established, that after the implementation of the new technology HD Flexo, the quality of the received imprints has been significantly ameliorated, and the smooth reproduction of the bright tones and the transition to zero is ameliorated as well.

Based on the recent research, the printed test trials and the print result evaluation, the best settings for solvent and thermal plates were specified for printing on two mostly used print substrates – polyethylene and paper.

For polyethylene and for paper, the best results were achieved for screen ruling 174 lpi and HD C46 when printed with solvent plates.

For thermal plates, best results were achieved for screen ruling 161 lpi and HD C27 for both substrates.

## References


[1] Computer to Plate for flexography: Key aspects of the technology, Moscow, 2001.

[2] Ganchev, A. (2004): New technologies for elaborating of plates for flexoprinting. Packing and printing, No.1.

[3] Sardjeva, R. (2009): Technologies for printing. Pub. Ciela, Sofia.

[4] Barco Graphics (2000): Samba Flex Screen User Manual. Gent, Belgium.

[5] Gantchev, A.: "Technology of the screening at flexoprinting"

[6] Company materials of DuPont

[7] Pavlova, N.; Bozhkova, T.; Gantchev, A. (2010): Digital technologies for elaborating of flexoprinting plates. Packing and printing, No.2, pp 7-12.

[8] Rozalinov, D. (2005): Technology of the packing from papers and cardboards. Sofia, Bulgaria.

[9] Kipphan, H. (2001): Handbook of Print Media, Technologies and Production Methods. Springer Verlag, Heidelberg, Berlin.

[10] Katchin, N.; Spiridonov, I. (2000): Printing processes Part 1: Theoretical bases. Sofia, Bulgaria.

[11] Rozalinov, D. (2004): Characteristics of anylox (screen) rolls. Printing and packing.

[12] Rozalinov, D. (2005): Control of anylox (screen) rolls. Packing and printing.

[13] Rochester Institute of Technology (2006): A Study of Producing Smoother Gradients in the Flexographic Process on Oriented Polypropylene with UV Ink by Varying Screening Techniques, Gradient Lengths and the Surrounding.

[14] http://www.kursiv.ru/kursivnew/flexoplus_magazine/

[15] http://gallery.unipack.ru/company_rubric/703/

[16] Esko Artwork- HD Flexo Application Guide

**Tatiana Bozhkova**

Department of Pulp, Paper
and Polygraphy,
University of Chemical
Technology and Metallurgy,
Sofia,
Bulgaria

mila.2005@abv.bg

**A. Ganchev**

Department of Pulp, Paper
and Polygraphy,
University of Chemical
Technology and Metallurgy,
Sofia,
Bulgaria

**Jana Kisova**

Department of Pulp, Paper
and Polygraphy,
University of Chemical
Technology and Metallurgy,
Sofia,
Bulgaria