

## INFLUENCE OF THE OFFSET RUBBER BLANKETS COMPOSITION ON THE SCREEN ELEMENTS REPRODUCTION PRINTED ON DIFFERENT PAPERS

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**Abstract:** *The quality of the printed screen elements made by the application of two types of offset rubber blankets (ORB) have been investigated in this work. The force in the contact zone between the offset cylinder (ORB) and the printing cylinder (printing substrate) is decisive for making the prints. With the different structure of ORB the different deformation zone is created, which results in forming the different sizes of the screen elements. The printing substrate has also influence, and because of that 5 characteristic papers (fine art paper gloss, fine art paper mat, offset paper, calendered offset paper and recycled paper) have been analyzed. The results show that on the tested printing substrates, the both ORBs form the greatest dot gains in the following order: offset paper, recycled paper, calendered offset paper, fine art paper mat and fine art paper gloss. Such results are completely in accordance with the original roughness of paper.*

**Key words:** *offset, offset cylinder, deviation of the printed screen elements*

### 1. INTRODUCTION

For achieving the quality of the continuous tone print the exact reproduction of the smallest elements (screen dots) is essential. In regard to the printing form the sizes of the screen dots must not be significantly modified, i.e. they must not change either the size or their ideal geometrical shape (circularity). Many parameters can influence the dimensional deviation of the screen dots during printing. They are most often: the printing substrate, hardness of ORB, ink tackiness, damping liquid, circumferential speed during the rotation of the printing machine cylinder, etc.

The aim in this work is to test the influence of the printing substrates and the composition of the offset rubber blanket (ORB) on the ink transfer, i.e. the influence on the final reproduction of the offset lithographic printing. The image analysis of the prints

printed on 5 characteristic paper substrates as well as the application of the compressible and non compressible ORB produced by Dyegraphica are used in testing.

### 2. THEORETICAL PART

During the lithographic offset printing process the ink is transferred from the printing form first on the offset cylinder and further on the printing substrate. In order to enable the more qualitative transfer there are more ORB layers placed on the offset cylinder under which there is the corresponding substrate (Bolanča S., 1997).

By different choice of the substrate material (paper, fabric, board, paperboard rubber blanket) the hardness of ORB is influenced, i.e. the deformation zone of ORB – plate cylinder and ORB printing cylinder. In other words, the exact reproduction of the thinnest screen elements is achieved. (Walenski W., 1991).

There are high demands on the finishing layer of the offset cylinder. ORB must have the top-grade mechanical properties (it amortizes high pressure forces which are formed during the printing process) as well as the chemical properties (ink resistance, water resistance, alcohol and different organic solvent resistances). Such finishing layer can be compressible or non compressible (Riedl R., et al 1989)

The non compressible ORB is composed of three or four layers, of a specially woven material impregnated with elastomer mass and glue. The fabric layers limit the elasticity in order to control the ORB and to pull out regularly during the stretching on the offset cylinder. The elastomer mass impregnated in the fabric layers determines the total hardness and deformability. The surface layer is produced by rolling of specially prepared elastomer mass which is laminated with the impregnated fabric layers. Depending on the finishing phase the offset rubber is divided in the velvet (roughened) rubbers and in the polished (smooth) ones (Majnarić et al, 2008).

Non compressible ORB changes its contact surface in connection with the printing and plate cylinder causing

greater mechanical load. Because of that, for the achieving the satisfactory screen print the pressure is decreased (the deviation between offset and impression cylinder pressure is decreased for 0,05 mm less than with the compressible ORB). The compressible ORB contains the additional microcapsules filled with air or gas whose task is to make easy the mechanical compression of material. The surface contact layer in this case does not change its thickness and thus it ensures the printing with less deformation of the screen elements (Bosner Ž., Marošević G., 1991). Such behavior is enabled because of the existence of the compressible layer below the surface and the first fabric layer made of the cell processed “spongy” polymer mass (0,3 - 0,5 mm). It is formed during the production so, that the mutually separated gas bubbles are blown in the hot polymer mass which are then compressed under the pressure (Marošević G., Bauer G., 1991).

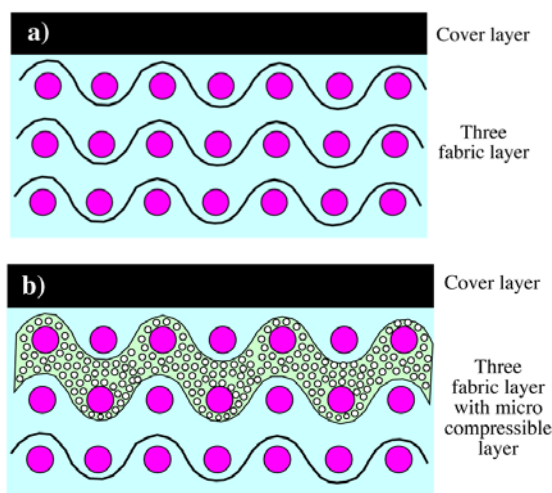


Figure 1. Structure of the offset rubber blanket:  
a) non compressible and b) compressible

### 3. EKSPERIMENTAL PART

Special printing form was constructed for this testing. Except the measuring stripes and the visual colour ones, there are greater printed CMYK colour tone patches with the corresponding colour photos. The printing was done on 5 usual papers often used in the Croatian printing industry (table 1).

Table 1.Characteristics of the papers used in experiment

Type of paper	Grammage (g/m <sup>2</sup> ) ISO 536	Opacity	Volume (cm <sup>3</sup> /g)	Gloss (ml/min)	Manufacture name of paper
Fine art paper gloss	135	95	0,74	>10	Prelude Gloss
Fine art paper mat	115	97	1,10	24	Sora Matt
Offset paper (calendered)	80	92	-	100	Neusiedler
Offset paper	80	92	1,26	150	UPM fine
Recycled paper	90	96	1,5	418	Pamoclassic

Experimental print samples were made on four colour printing machine Heidelberg Speedmaster 102, which

uses the following colour order in printing KCMY (printing wet on wet). During the printing two kinds of ORB were used: compressible (dyeGraphica 8213) and the non compressible one (dyeGraphica 3000). On the obtained prints, only the cyan characteristic screen patches were measured with the spectrophotometer X-rite DTP 41 which were presented as the function of the dot gain (Z%). With the equipment for image analysis Personal IAS the increased image of cyan separation was obtained on which the concrete size of the printed screen elements (dots) was measured as well as their oscillation caused by different printing substrates.

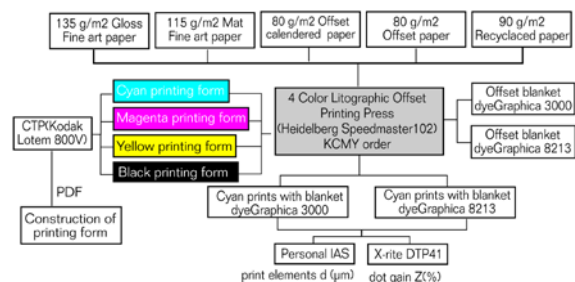


Figure 2. Schematic presentation of the performed experiment

### 4. DISCUSSION AND RESULTS

The results of the dot percentage reproduction (continuous tones), depending on the printing substrate types and the ORB types are presented as the dot gain Z (%). Only the cyan was analyzed (the first chromatic separation in printing). On all the obtained prints the greatest dot gain (Z) is noticed in the area of the medium tone values (the area between 40% and 60% dot percentage). The application of the compressible and the non compressible ORB gives the greatest dot gain on the offset and on the recycled paper, while the smallest dot gain has it on the fine art paper gloss. By the densitometric comparison of the dot gain (Z) it can be noticed that the non compressible ORB considerably increases the printed screen elements. The reason for that is the contact zone between the rubber and the paper (printing form) during which greater mechanical deformations appear in the rubber layer of the non compressible ORB. By changing the ORB and by further analysis of the reproduction in three different tone values (light, medium and dark one), it is possible to see the following deviations of the dot gain Z (%). In lighter tone value areas (20% dot percentages) the prints on the experimental printing surfaces have the following deviations: recycled paper ( $\Delta Z_{20\%} = 2,5\%$ ), offset paper ( $\Delta Z_{20\%} = 3\%$ ), calendered offset paper ( $\Delta Z_{20\%} = 4\%$ ), fine art paper mat ( $\Delta Z_{20\%} = 2,5\%$ ) and fine art paper gloss ( $\Delta Z_{20\%} = 3\%$ ). In the medium values (50% dot percentage) the following differences in the dot gain were realized: recycled paper  $\Delta Z_{50\%} = 2\%$ , offset paper  $\Delta Z_{50\%} = 2,5\%$ , calendered offset paper  $\Delta Z_{50\%} = 3\%$ , fine art paper mat  $\Delta Z_{50\%} = 3,5\%$  and fine art paper gloss  $\Delta Z_{50\%} = 4,5\%$ .

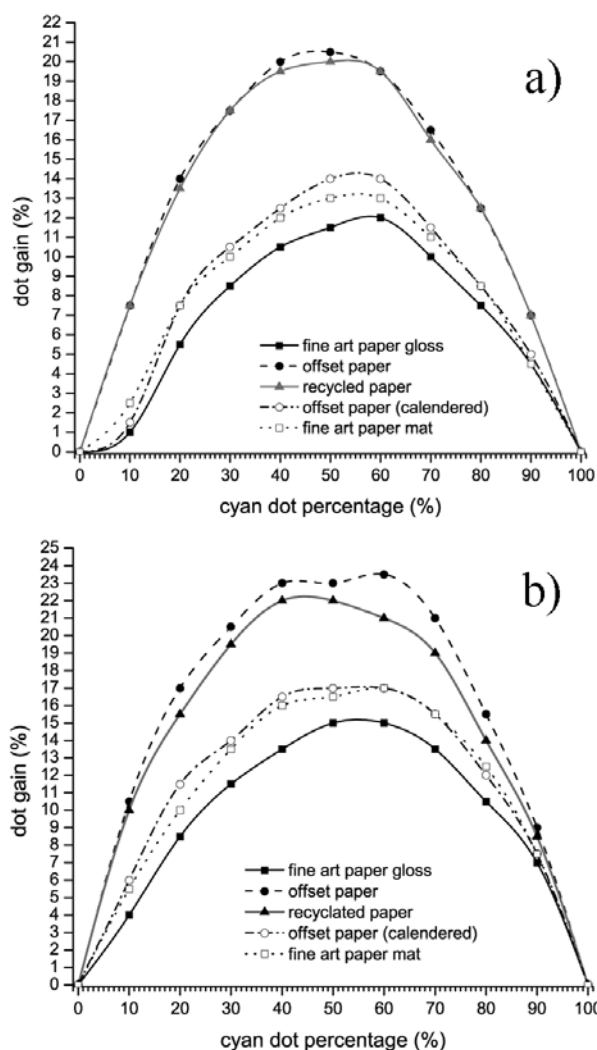


Figure 3. The dot gain of cyan made on 5 printing substrates with the application of the (a) compressible and the (b) non compressible ORB

In the dark tone value areas (80% dot percentage) the prints on the experimental printing substrates realize the following deviations: recycled paper ( $\Delta Z_{80\%} = 1,5\%$ ), offset paper ( $\Delta Z_{80\%} = 3\%$ ), calendered offset paper ( $\Delta Z_{80\%} = 3,5\%$ ), fine art paper mat ( $\Delta Z_{80\%} = 4\%$ ), and fine art paper gloss ( $\Delta Z_{80\%} = 3\%$ ).

More qualitative analysis of ORB and the printing substrates was performed by the method of image analysis (Personal IAS). For achieving the more precise results the light tone value areas in the range from 10 to 30% dot percentage were measured. In this area 600 printing elements were measured and only the average values were presented (figure 4).

The relation of the original dot percentage and the dot diameter can be described by the linear function. In printing the 5 tested substrates, the compressible ORB realizes smaller dot deviation than the non compressible ORB. There is the rule that the increase of the dot percentages causes the screen elements. In the lightest tested area (10% dot percentage) the application experimental ORB gives the following changes: the

recycled paper  $\Delta d_{10\%} = 0,93 \mu\text{m}$ , fine art paper  $\Delta d_{10\%} = 1,74 \mu\text{m}$ , offset paper  $\Delta d_{10\%} = 2,34 \mu\text{m}$ , offset gloss paper  $\Delta d_{10\%} = 5,75 \mu\text{m}$  and fine art mat  $\Delta d_{10\%} = 8,08 \mu\text{m}$ .

In the area of 20% dot percentage the following deviation are realized: recycled paper  $\Delta d_{20\%} = 1,03 \mu\text{m}$ , offset paper  $\Delta d_{20\%} = 1,19 \mu\text{m}$ , fine art paper gloss  $\Delta d_{20\%} = 6,56 \mu\text{m}$ , fine art paper mat  $\Delta d_{20\%} = 7,08 \mu\text{m}$  and offset gloss paper  $\Delta d_{20\%} = 7,2 \mu\text{m}$ .

In the darkest tested area (30% dot percentage) the application experimental ORB gives the following deviation: offset paper  $\Delta d_{30\%} = 1,03 \mu\text{m}$ , fine art paper  $\Delta d_{30\%} = 4,41 \mu\text{m}$ , offset calendered paper  $\Delta d_{30\%} = 5,38 \mu\text{m}$ , recycled paper  $\Delta d_{30\%} = 6,37 \mu\text{m}$  and fine art paper gloss  $\Delta d_{30\%} = 6,53 \mu\text{m}$ .

Such results are completely in accordance with the starting value of the paper roughness. It means that with higher roughness of the printing surface greater changes of the screen elements can be expected. The rough papers have more expressed capillary properties which lead to the dispersion of the liquid inks, i.e. the result is the additional dot gain.

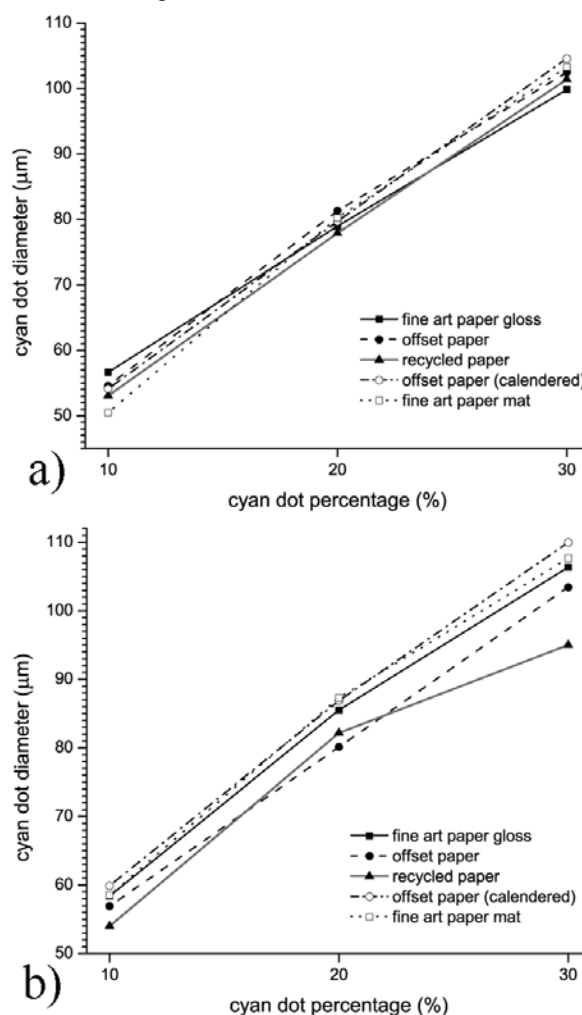


Figure 4. Dependence of the original dot percentage and the cyan dot diameter printed on 5 papers with the application of the (a) compressible and the (b) non compressible ORB.

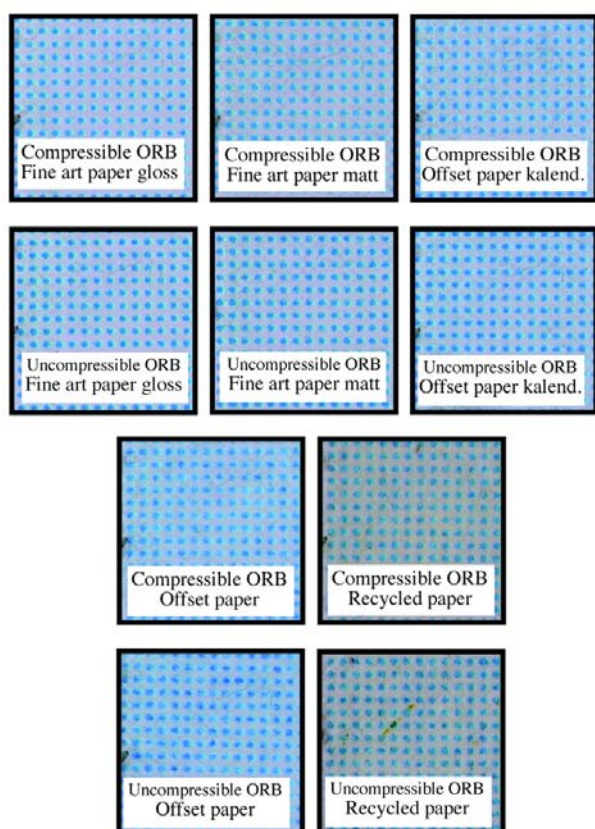


Figure 5. The magnified images of the analyzed samples printed with the compressible ORB (dyegraphica 3000) and incompressible ORB (dyegraphica 8213)

## 5. CONCLUSION

By the application of the two ORB types (dyegraphica 8213 and dyegraphica 3000) and the printing substrates (gloss and mat fine art paper, gloss offset paper, offset paper and the recycled paper) the cyan prints are obtained, the analysis of which give the following conclusions:

On the tested printed substrates, both ORB form the greatest dot gains in the following order (from the biggest to the smallest one): offset paper, recycled paper, calendered offset paper, fine art paper mat and fine art paper gloss.

This order is completely in accordance with the original printing substrate roughness. (gloss fine art paper = >10 ml/min, mat fine art paper =24 ml/min, gloss offset paper =100 ml/min, offset paper = 150 ml/min and the recycled paper = 418 ml/min).

From the above mentioned it can be concluded that the printing substrate with greater smoothness results also in greater changes in the printed screen elements. The change of the rubber blanket application is recommended only for printing on more qualitative papers (coated and calendered ones) which will give better print.

On 5 tested papers (the application of the compressible ORB) gives different dot gains. For the characteristic

areas the fine art paper gloss – offset paper:  $\Delta Z_{20\%} = 8,5\%$ ;  $\Delta Z_{50\%} = 9\%$ ;  $\Delta Z_{80\%} = 5\%$  are the extreme ones.

The compressible ORB and the used printing substrates differently influence the dot size. The greatest value oscillations:  $\Delta d_{10\%} = 6,24 \mu\text{m}$  (fine art paper gloss – fine art paper mat),  $\Delta d_{20\%} = 3,4 \mu\text{m}$  (offset paper – recycled paper),  $\Delta d_{30\%} = 4,78 \mu\text{m}$  (calendered offset paper – fine art paper gloss).

Printing on 5 used papers (application of the non compressible ORB) gives the following extremes:  $\Delta Z_{20\%} = 9,5\%$ ;  $\Delta Z_{50\%} = 8\%$ ;  $\Delta Z_{80\%} = 5\%$ . (fine art paper gloss - offset paper).

Non compressible ORB and the used printing substrates have greater influence on the dot gain change. The greatest value changes are:  $\Delta d_{10\%} = 5,87 \mu\text{m}$  (calendered offset paper – recycled paper),  $\Delta d_{20\%} = 7,1 \mu\text{m}$  (fine art paper mat – offset paper),  $\Delta d_{30\%} = 14,98 \mu\text{m}$  (calendered offset paper – recycled paper).

If we want the planned changes of offset rubber blanket (compressible – non compressible), in printing process we can expect increasing dot gain the screen elements of  $\Delta Z = 1\%$ .

This rule can apply only to areas which contain lower concentrations of the screen elements (light-tones areas 10-30% dot percentage and medium-tone areas 40-70% dot percentage).

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