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HALFTONE IMPRINT'S PARAMETERS IN MODERN METHODS OF COLOR REPRODUCTION

На підставі дослідження колірних, градаційних і оптичних характеристик тестового тонового оригіналу визначено вплив технологій кольоровідтворення на стабільність якості тиражного відбитка плоского офсетного друку. Проведено аналіз точності відтворення нейтрально-сірих відтінків при різноманітних режимах кольоровідтворення. Проаналізовано динаміку зміни загального контрасту друку та визначено раціональні режими технологій кольоровідтворення для додрукарських процесів підготовки тонового оригіналу.

Ключові слова: офсетний друк; кольоровідтворення; відтінок; контраст друку; оптичні властивості відбитка.

I. Introduction

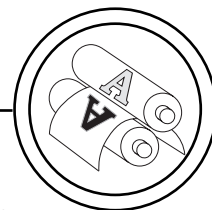
The most important stage in halftone reproduction is the electronic data translation from the original RGB layout to CMYK-color separations by Raster Image Processor (RIP). This will minimize color inks usage because of increasing black [1, 2], allowing to keep the neutrality of achromatic colors on reproduction, reduce moiré in the brown image areas, as well as expand the color gamut reproduction, which simplifies the color management process.

Minimization of total color ink amount in the full-color reproduction is achieved by two color separation technologies [1–3]: under color removal (UCR) and gray component replacement (GCR). Moreover, modern software tools allow to choose the existing color separation technology options, or create own black transfer curve

[3]. However, the presence of different modes of color separation does not ensure qualitative and stable printing process.

The stable printing process requires stable color and halftone reproduction; the controlled parameters like optical density (D), degree of dot gain (ΔS), and color differences (ΔE) are determined to analyze the standard quality indexes. Most of existing color reproduction parameters monitoring and control methods are like a process of measuring the control parameters on the control scale (test form) and their further comparison with reference values, wherein the control process itself is used when recording the graphic information to the plate material and in a printing process [2].

The current practical application experience of the new pre-



press technologies has sufficient scientific response. Thus, aspects of film and plate imaging devices, layout modeling parameters, and images encoding are widely represented in the latest developments [4–7]. However, the experience is not enough especially within hybrid screening algorithms or within correlating encoded image parameters with the color gradations characteristics on the reproduction. Therefore, it remains actual studying and modelling of the color reproduction system «original-imprint» to determine how its parameters are affecting the printing reproduction stability.

II. Experimental Setup or Materials and Methods

To determine the influence of color separation technologies like GCR (Heavy, None, Light, Medium, Maximum) and UCR on the optical properties of imprint, in this research there were various printing systems analyzed; also there were test films (with NS-2 Research Institute of Printing scale) using different imagesetters produced: ECRM, Scantex Othello, Scitex Dolev and Scantext Rondo 338. Press run was held on the offset printing machines: Adast Dominant 745, Manroland and Planeta-Variant in real production facilities.

Also, there were used various kinds of printing paper: 90 g/m² glossy coated paper, 120 g/m² coated and 120 g/m² uncoated offset printing paper, 280 g/m² coated chrome-ersatz cardboard.

Quality control was made by densitometry method, and statistic data was processed by Microsoft Excel software.

III. Results and Discussion

The printing of neutral gray tones with different color separations technology on NS-2 (Research Institute of Printing) scale revealed only minimal distortion in light tone areas (see, fig. 1).

For most color separation modes (except GCR Maximum and GCR None) the synthesis of neutral gray scale was provided preliminary by CMY-colors, black color (K) appeared in midtones and shadows. Therefore, the black ink affects the quality of reproduction of dark areas of the image, while others CMY-colors influence the transmission of small details in the light and medium tones of the imprint.

Reproduction of neutral gray scale with different color separation technologies also depends on the substrate. For example, the most close to the standard while using different color separations technologies were optical density values obtained on 120 g/m² coated offset printing paper (see, fig. 1, graph c).

As because all color separations technologies are the reason for achromatic colors deviations increase, there is an imprint saturation deviation along the entire reproduction tone transmission range while comparing to the standard curve (see, fig. 1). Thus, the usage of GCR None and GCR Maximum technologies, regardless either existing print-technical production conditions or printing papertypes, led to a saturation decrease in the middle tones and shadows of the reproduced image (see, fig., curves 2, 3).

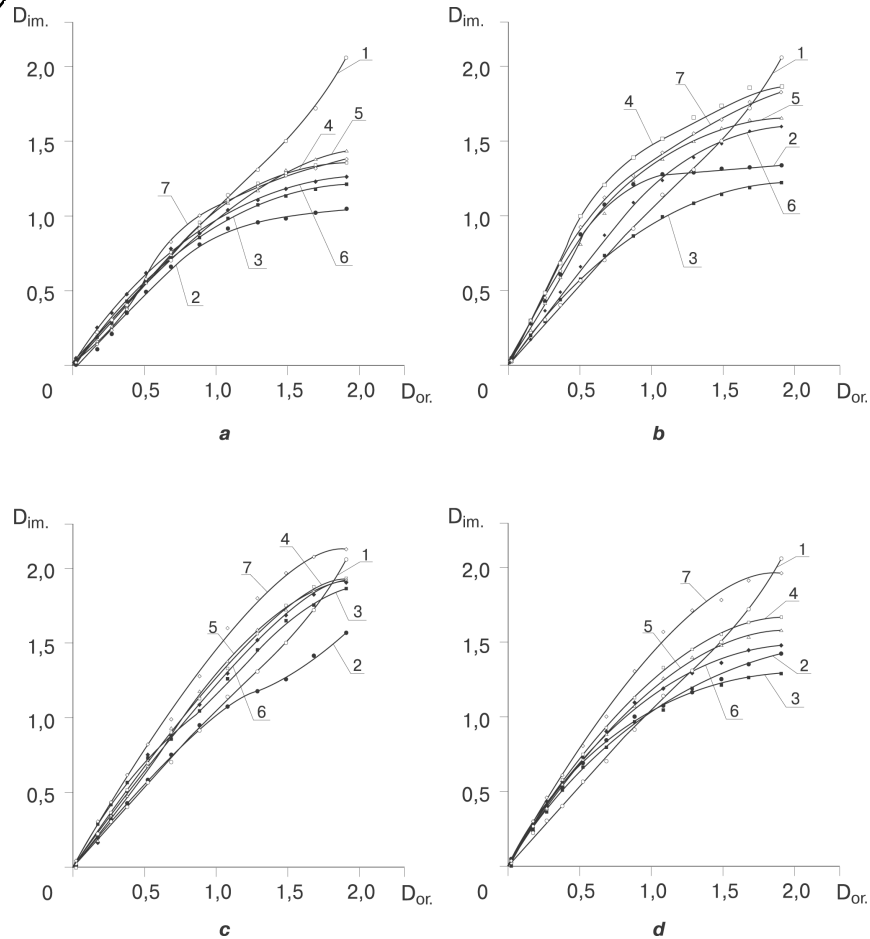
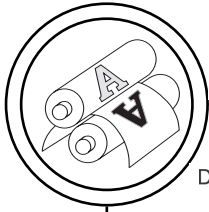
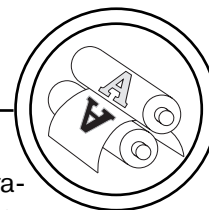


Figure 1. Halftone transfer curve achieved by various print-technical systems: a — coated glossy paper 90 g/m² (Adast Dominant 745); b — coated chromeersatz cardboard 280 g/m² (manroland); c — coated offset printing paper 120 g/m² (Planeta-Variant); d — uncoated offset printing paper 120 g/m² (Planeta-Variant). Color separation technologies: 1 — original (NS-2 Research Institute of Printing); 2 — GCR None; 3 — GCR Maximum; 4 — GCR Light; 5 — GCR Medium; 6 — GCR Heavy; 7 — UCR

Each color separation technology uses an incomplete set of inks that in most cases do not reproduce a perfect neutral gray color. Therefore, to achieve the most exact neutral gray tones reproduction the following modes should be used: GCR Light, GCR Medium and UCR. That should make it possible to use the whole

set of CMYK colors for neutral gray tones reproducing.

Relatively fewer distortions of neutral gray shades on the imprint are provided by such modes as GCR Light and GCR Medium (see. fig. 1, curves 4, 5). The optical density solids level for all kinds of papers stays respectively in range 1.3–1.8 D for GCR Light technolo-



gy and 1.4–1.9 D for GCR Medium technology. The UCR technology provided the best result for solid black within 1.3–2.0 D. However, the UCR-mode achieved imprints have significantly higher optical density (saturation) values if compared to the etalon curve values (see. fig. 1, curve 1).

The printing contrast coefficient for imprints was calculated by already known method [1–3]. Basing on the contrast calculations for imprints made during the first-eighth minutes of printing, there were built the dependences of contrast value changes from color separation technology (see fig. 2).

As because the calculated print contrast value is responsible for the optimal «ink-water» balance, the graphs on fig. 2 may

help in selecting the color separations technology to achieve a stable gray tones balance for different characteristics of a printed substrate. For 90 g/m² coated paper the best imprint's contrast will be achieved via UCR and GCR Medium technologies. However, 280 g/m² coated chrome-ersatz cardboard the higher contrast is achieved while using UCR and GCR Maximum modes. Also the print contrast stability within the entire pressrun can be ensured when the GCR Light technology is used (see. fig. 2, curve 4).

Consequently, according to the conducted research and also referring to the norms, the best achieved print contrast and stable print quality for all kinds of papers is provided by GCR Medium and UCR technologies.

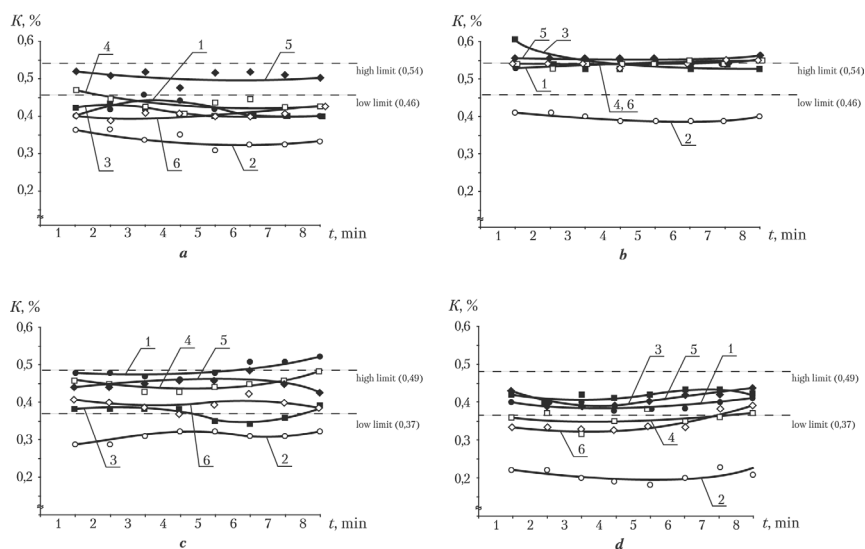
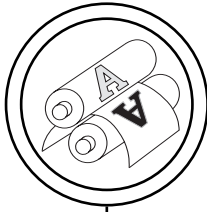


Figure 2. Dynamics of changes in the overall printing contrast of the imprint: a — coated glossy paper 90 g/m² (Adast Dominant 745); b — coated offset printing paper 120 g/m² (Planeta-Variant); c — uncoated offset printing paper 120 g/m² (Planeta-Variant); d — coated chrome-ersatz cardboard 280 g/m² (Manroland); The color separation technologies: 1 — UCR; 2 — GCR None; 3 — GCR Maximum; 4 — GCR Light; 5 — GCR Medium; 6 — GCR Heavy



IV. Conclusions and Summary

The research of color separation technology influence on the neutral gray tones balance of the imprint showed an overall saturation level reduction on the reproduced images.

The best qualitative results in terms of tone reproduction accuracy if compared to the standard were provided by GCR Medium, GCR Light and UCRcolor separation technologies. Where as in different printing and technical systems these technologies allow

getting the least distortions of neutral gray tones gradation transmission, they also provide an accurate light and mid-tone areas reproduction of the original.

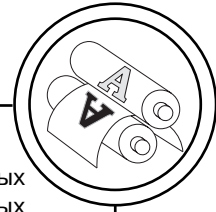
Due to managing the prepress settings and because of selecting the optimal color separations technology it becomes possible to achieve an acceptable black ink level on the imprint according to ISO 16247-2, and to normalize the printing process itself when having different equipment settings and printing conditions.

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The impact of prepress technology on the stability of the quality of production prints sheet at offset printing based on the research of colour, gradation and optical characteristics of the colour reproduction test tone original were determined.

The analysis of the precisely of grayscale tones in a variety of colour mode were considered. The dynamics of change in the overall print contrast and defined rational modes of colour reproduction technology for prepress preparation the tone of the original were determined.

Keywords: offset printing; color reproduction; hue; contrast of printing; optical properties of printed sheet.

На основании исследования цветowych, градационных и оптических характеристик тестового тонового оригинала определено влияние технологий цветовоспроизведения на стабильность качества тиражного оттиска плоской офсетной печати.

Проведен анализ точности воспроизведения нейтрально-серых тонов при разнообразных режимах цветовоспроизведения. Проанализирована динамика изменения общего контраста печати и определены рациональные режимы технологий цветовоспроизведения для допечатных процессов подготовки тонового оригинала.

Ключевые слова: офсетная печать; цветовоспроизведение; оттенок; контраст печати; оптические свойства оттиска.

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