



INVESTIGATION OF NEWSPAPER PRINTS PRINTED ON RECYCLED PAPER BY INKJET TECHNOLOGY

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Abstract:

The great achievements of the 21st century, like DM (direct marketing), transpromotion, the web-to-print, play an important role in the graphic communication industry; they are the most effective form of marketing communication.

Applying digital printing technologies for short print runs is thought to be the answer. It can produce copies in the range where traditional technologies would do it only at a high expense. The current trends, e.g. web-to-print printing on the Internet, personalization, print on demand favor digital technologies. Market environment made inevitable the developments which lead to the developments of ink-jet applications at an industry level within digital technologies. Digital press manufacturing corporations hope to develop systems competitive in productivity with the current leading offset printing presses.

In our research we analysed the print quality of copies of the Sydney Morning Herald newspaper printed on UPM Digi Brite 76 C recycled paper with Océ Jetstream 2200 inkjet press. Due to the variable droplet size very good absorptivity is achievable, a quality proper for a newspaper. During the product's visual control we analysed parts of text and line elements, tone range, quality of photos and uniformity of the process colours. Measurements covered measuring tone value increase, colour gamut and colour uniformity as well. Results were compared to the ISO 12647-3-2005 standard coldset offset values.

Keywords: recycled paper, recycled newspaper, inkjet printing

1 INTRODUCTION

According to 2008 surveys, from among the communicational channels used in Hungary direct marketing (DM) has just a 15% share. The corresponding rates in Western Europe and the USA are 25–30% and 52%, respectively. DM allows the conveyance of tailor-made messages to the addressees in a manner that allows the accurate measurement of their responses. The basis of the technique is the appropriate segmentation of the target group, continuously maintained databases and the technological background that is essential for implementation. Transpromo is in fact a transactional form that contains promotion, as well. For advertisement purposes, it exploits the attention that is usually paid to invoices, bank account statements or payment notices, with nearly 100% efficiency. It seems to be an excellent way of advertising for companies particularly in these difficult times in economy, because it requires minimum expenditure, reduces the number of the mails to be delivered, which may as well be important in view of environmental protection. The web-to-print technique is primarily recommended for use in the case of business publications, operating instructions, menu cards, leaflets, advertisement publications, business reports, DM products, books published in smaller series and transactional forms.

Worldwide, more than 20 million newspapers are produced by Océ printers, including 5 million copies of *Stroma* in London, the daily, weekly and monthly papers of the Spanish *Imcodávila* or the German “personalized newspaper” called *Niiu*, which is a digitally printed paper distributed via mail. Its contents can be compiled by the individual readers from a selection of Internet-based newspapers,



such as The New York Times or Pravda. Océ has a market-leading position in digital newspaper production with short lead times.

2 INK JET TECHNOLOGY

It was in 1946 when the Radio Corporation of America patented the first drop on demand piezo electric device, though the first commercially successful inkjet appliance is associated with C. R. Winston, and was introduced in 1962 under the name of Teletype Inctronik. The piezo electric inkjet printer available to users was Siemens PT-80 in 1977. Richard Sweet's – an electric engineer from Stanford – 1961 patent proved to be a milestone, as it helped A. B. Dick to invent the oscillograph, which could produce images from ink drops distributed under the effect of electric signals. In 1977, Canon's Product Technology Research Institute launched studies to find out how inkjet technology could be used in photocopying. Therefore, by the middle of the 1980s two distinct branches of inkjet printing technology had emerged. Thermo inkjet was clearly a domain for Canon and HP, while the piezo inkjet technology – in spite of the legal debates of the 1960s – was still an unoccupied area. In the first decade of the twenty-first century, inkjet printers became basic peripherals for personal computers. In parallel, the use of wide-format printers grew by leaps and bounds, and inkjet displaced a number of other technologies from the industry. Inkjet printing is based on the CtPrint technology, meaning that ink is carried directly to the print media from the nozzles, and therefore there is no need for printing forms. Digital information directly enters the imaging unit, i.e. the inkjet system in this case. Functional parts – imaging units, printing forms and the inking module – are comprised by a single unit to deliver the ink to the paper via the nozzles. Within this technology, two main types can be distinguished, as it is shown in Figure 1.

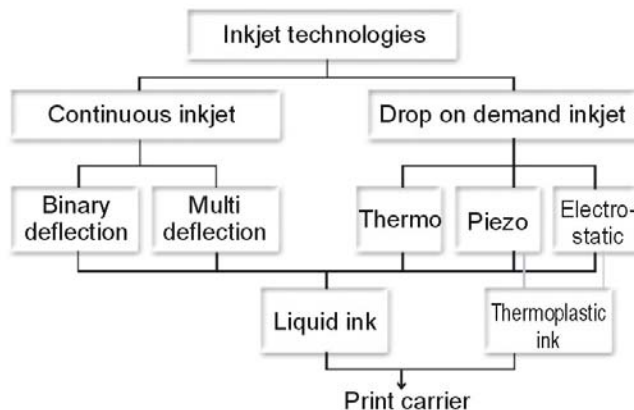


Figure 1: Types of the inkjet technology

3 EXPERIMENTAL

The purpose of this research work has been to study the print quality of newspapers produced with Océ Jetstream 220 inkjet roll printer, on recycled paper.

Visual (text and line elements, tone range, photos, examination of the colour uniformity of the basic colours) and instrumental (colour measurement) checks have been performed on the printed product.

The print carrier of the newspaper was UPM Digi Brite 76 C digital recycled paper (Table 1). Its surface is more porous due to the recycled fibers, and it is uncoated paper of yellowish colour and outstanding absorbance, which is not a favourable property for the inkjet ink of very small viscosity. In view of its quality and aesthetic properties, it is recommended for newspapers, brochures and greeting cards by manufacturers.



In the course of the production of the newspaper, roll paper was printed, and the prints were cut up into sheets only thereafter. When printing, the temperature was 22°C in the machine room, which corresponded to the 20–26°C optimal temperature interval suggested by OCE.

To determine density and colour uniformity, a GretagMachbeth X-Rite SpectroEye spectrophotometer was used. The device describes colours on a spectral basis, and thus it contains all the information typical of the given colours; as a consequence, any selected colour can be defined with high accuracy. The following measurement parameters were used: CIE D50 (5000 K) illumination, 2° normal detector, polar filter not used, measurements made on black backing.

Table 1: Parameters of the UPM Digi Brite 76 C digital paper as specified by the manufacturer

Properties of the paper	Type of the studied paper
Paper type	UPM Digi Brite 76 C
Ideal temperature of storage	22°C
Ideal relative air humidity of storage	40–50%
Grams per square meter	55 g/sq m
Thickness	74 ěm
Opacity	95%
Other property	Recycled

4 RESULTS

4.1 Visual studies

As the subject-matter of our studies has been a finished product, visual checks have been considered to be important, because it is visual presentation that primarily raises the attention of the reader. The aim of visual examinations has been to highlight errors, distortions, tonal deviations that are visible even to the naked eye.

Examination of text elements

One of the substantial criteria of newspapers is legibility, regular font images, because large volumes of texts have to be looked through when an article is read. As the print carrier of the newspaper was a paper containing recycled fibers of good absorbance, in textual parts minimal ink deviations, enclosures could be observed. Still, it did not influence legibility at all, even in the case of very small 3–4 point letters. In spite of the fact that varied fonts of different grading and tones were applied, both serif and non-serif fonts could be read clearly.

In lighter parts, texts could be perfectly read, yet towards the end of the darkening tone line colours tended to merge. Nevertheless, it can be attributed to editing mistakes rather than printing technology problems.

Examination of line elements

In general, it can be stated that from the very thin 0.25-point lines to lines over the thickness of 10 points all the line elements are clearly visible and distinguishable from the environment, continuous, and seem to be even to the naked eye. It is true for both horizontal and vertical elements.



Examination of photos

In spite of the yellowish print carrier and absorbance of the newspaper, images were of very good quality, rich in tones. Granularity could be seen in rather small photos more easily, but faces were all well detectable. Larger photos definitely satisfied the standards typical of newspapers. The colour of human skin looked to be natural, save for the yellowish print carrier, which obviously shifted colour rendering to the direction of yellow. Due to the absorbent paper, colours seemed to be a bit dull, with a smaller degree of saturation than in the case of matt coated papers. Photos were softer, no contrasts could be seen, which was the most clearly detectable in black and red tone fields. Colour transitions were even, no striation was observed.

Examination of the colour uniformity of basic colours

All along the short and long edges of the test chart, perpendicular cyan, magenta, yellow and black colour strips are provided to examine colour uniformity. For all the 10 prints, it can be stated that no tone irregularities were detectable to the naked eye. However, it is to be noted that owing to the clogging of the nozzle cyan and black colours appeared with hairline striation here and there, which considerably deteriorated the visual image of the prints.

Examination of the colour range

The test elements used for the examination of the tone range can be seen in Figure 2. This field represents a 10-grade scale of the four basic colours (cyan, magenta, yellow, black) and three secondary colours (red, green, blue) where the tone value is shown in 10% increments from 10% to 100%.

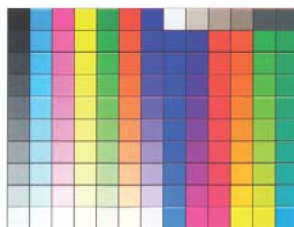


Figure 2: Test chart of field with 10%–100% tone values

The aim of this examination was to determine how many grades could be distinguished for each colour, because then it could be concluded how much the printer was suitable for rendering the details of half-tone pictures. For cyan, 9 tone grades could be seen, while the 80% and 70% fields could not be distinguished from each other. For magenta, 8 grades could be separated. The 100% and 90%, as well as the 70% and 60% fields merged into each other. The smallest number of tone grades was observed for yellow, where 7 fields could be separated.

Fields with tone values of 100%–90%, 80%–70% and 40%–50% could not be distinguished from each other. During the visual examination of black, all the 10 fields could be well distinguished.

4.2 Instrumental examinations of the prints

In the first phase of instrumental examinations, the colour coordinates of the print carrier of the newspaper were measured, and the corresponding values were included in Table 2. These values were compared with the values defined in Standard ISO 12647-3:2005 for coldset offset newspaper printing, and it was found that the digital paper was lighter than the standard offset newspaper printing paper, while its tone turned out to be a bit more yellowish.



Table 2: Colour coordinates of the UPM DigiBrite 76 C type paper

Paper type	Colour coordinates			Grams per square meter g/sq m
	L*	a*	b*	
UPM Digi Brite 76 C	90.04	0.91	9.04	55
Standard ISO 12647-3:2005	82.00	0.00	3.00	-
Deviation from the standard	±4	±2	±2	

Remark: the data for grams per square meter are only informative

4.2.1 Examination of colour uniformity

Colour uniformity was examined in the course of serial printing for the basic printing colours, in relation to 10 products. Every sheet of the newspaper was thoroughly scrutinized, and with the use of a magnifier such color surfaces were sought that had been printed with a single basic colour. The CIE L*a*b* values obtained in result of the measurements are summarized in Table 3.

Table 3: Colour coordinates of the print made on the UPM Digi Brite 76 C print carrier

Colours	Colour coordinates		
	L*	a*	b*
Cyan	64.20 (57.0)	-30.16 (-23.0)	-27.60 (-27.0)
Magenta	61.49 (24.0)	43.29 (44.0)	-1.78 (-2.0)
Yellow	81.93(78.0)	0.60 (-3.0)	48.01 (58.0)
Black	41.80(36.0)	-0.57 (1.0)	-3.87 (4.0)
Cyan+Yellow	65.25(53.0)	-32.20 (-34.0)	19.74 (17.0)
Cyan+Magenta	51.55(41.0)	-1.39 (7.0)	-25.30 (-22.0)
Magenta+Yellow	63.35(52.0)	40.13 (41.0)	20.54 (25.0)

Remark: the values in brackets are the values defined in Standard ISO 12647-3:2005

4.2.2 Definition of the reproducible colour range (colour gamut)

As the reproducible colour range could not be defined accurately without knowing the properties of the secondary colours, only an informative chart was made, including the precise presentation of the four basic colours and values for colours that looked to be red, green and blue; then, they were compared to the standard (Table 3).

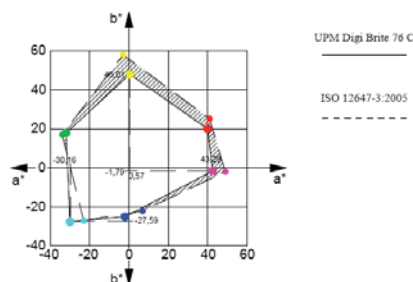


Figure 3: Reproducible colour range in prints made on UPM Digi Brite 76 C type paper



5 CONCLUSIONS AND DISCUSSION

Our visual examinations have found that the text parts can be well read on both print media, are clearly distinguishable from the background, even in the case of the very small sizes under 6 points. It is particularly important in the case of the newspaper, which was made on paper containing absorbent recycled fibers. Line elements are also represented appropriately in the prints, even in the case of the 0.011 mm 2400 dpi lines used in the test chart. When originals of good quality are printed, photos are rich in tones and details due to the variable drop size. It can be observed in the images of both the newspaper and test charts. Owing to the variable drop size, quite good quality as appropriate for newspapers can be achieved in the more absorbent paper. Our studies have embraced the measurement of colour uniformity and reproducible colour range, as well. The obtained results have been compared with the values defined in Standard ISO 12647-3-2005 for the coldset offset technique.

With respect to the examination of colour uniformity, it can be claimed that the colours are lighter than the values defined in the standard with small deviations in the actual colours. Cyan tends to be a bit greenish, while yellow is slightly reddish with a smaller yellow content. Black and magenta are in line with the values prescribed for offset printing.

The reproducible colour range approximates the values defined for the offset technology. The magenta range tends to be broader than in the case of matt coated papers, while the red–yellow–green range is smaller than in the standard. On the newspaper printing paper, the cyan range is significantly larger, whereas the yellow–range is smaller than in the standard again.

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