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Effect of Ink Tack Value on the Ink Trapping in Lithographic Printing

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ABSTRACT
This study investigated the effect of ink tack value on the ink transfer process in lithographic printing. The ink trapping is estimated optically with the use of densities. The ink trapping alters as a function of ink tack difference between the lower and upper ink. For the set of process colour inks that the tack difference between them is lower than 1 point, the ink trapping increases as the higher tack ink overprints lower tack ones. The proper ink sequence for the investigated system is M-C-Y.

Keywords: Lithographic printing; ink tack; ink trapping; ink sequence

I. INTRODUCTION

Ink trapping is defined as the amount of the second ink transferred on top of the first ink during the multi-colour printing process [1].In the printing process of pasty inks, such as lithography, the upper ink layers are never trapped with the full layer thickness compared to printed directly on paper. Hence, the ink trapping is evaluated or measured in terms of percentage. A high percentage is "good" because it gives the desired colour. A low percentage, which gives uneven or off colour, is "poor". A poor percentage narrows the printable colour gamut and may cause image problems [2].

A high percentage of trapping requires the right balance of three factors: Tack, Absorption, and Time. Tack is primarily a matter of ink. Absorption depends on the paper. Time is press-related [2]

Tack is the "stickiness" of ink, which can range in consistency from molasses to soft butter. Tack measures the force needed to split an ink film between two rotating rollers at a predetermined speed and temperature. Tack is a significant factor that enables inks to adhere to or trap one another; tack sequence allows us to control and achieve quality trapping [3, 4]. Finding a proper order based on the ink trapping ratio is required for the engineers and workers working in all the printing houses. Do note that the tack level can be changed at the moment of impression; therefore, an ink's "effective tack" need to be investigated for a specific printing system.

In our study, the effect of ink tack on the ink trapping was investigated for a commercially available ink set and a multi-colour litho-offset press.

II. EXPERIMENTAL

A. Materials

The experiment was carried out in CTP workflow. The test form Altona Test suit 1.1 (Fig. 1) was output by using AM technology with a resolution of 175lpi. Heidelberg SM 74-2 colours printing machine, as shown in Fig.2

Offset printing inks Nippon speed and Couche paper 150 g/m2 were used.

The experiments were carried out with ink sequences Cyan – Magenta (C-M), Magenta - Cyan (M-C), and Magenta - Yellow (M-Y).

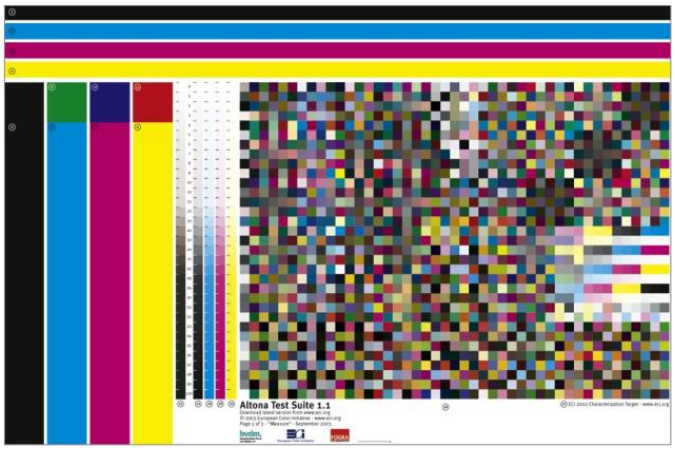

Figure 1: The CMYK test target

Figure 2: Offset printing machine SM74 – 2012

B. Ink tack measurement

Tack values of inks were measured by Inkometer Model No GTC- 2000, GO Technology- Ohio- USA at 30^0C and a speed of 800 rpm. The inks were run for 1 minute on the inkometer

C. Ink trapping measurement

The ink trapping was calculated between the density of the first and second colour sequence and the trapping of overlap two colours in wet-on-wet ink transfer as the formulas of Preucil [5]

$$FA(\%) = \frac{D_{12} - D_1}{D_2}$$

Here, D_1 is the solid tone density of the first-down ink; D_2 is the solid tone density of the second-down ink; and D_{12} is the density of the overprint solid. The dry densities are measured by an X_Rite SpectroDensitometer 504, Inc.Grandville, MI

III. RESULTS AND DISCUSSION

A. Tack values of the inks

Tack values of the set of process colour inks that were measured by the simulation they ran through the press and were applied to paper are reported in Table 1. In addition, some parameters of the inks are also given.

TABLE I

RHEOLOGICAL PARAMETERS OF THE INKS

Color ink	Tack value	Viscosity (P)	Yield
Cyan - C	13.8	474	3219
Magenta - M	13.4	375	3690
Yellow - Y	12.8	682	1595

It can be learned that the tack values of inks are slightly different, with a descending 0.4-to 0.6-point spread between them.

B. Effect of ink tack value on the ink trapping

The ink trapping FA (%) of ink transfer processes are presented in Table 2 and Fig. 3.

TABLE II

INK TRAPPING FA(%) OF TWO INK OVERLAPS

Sample	D_1	D_2	D_{12}
C-M			
1	0.51	1.72	1.70
2	0.50	1.74	1.71
3	0.51	1.74	1.70
4	0.51	1.73	1.71
5	0.51	1.74	1.70
Average	0.51	1.73	1.70
FA(%)	69		
M-C			
1	0.19	1.71	1.49
2	0.19	1.70	1.50
3	0.19	1.71	1.49
4	0.19	1.70	1.49
5	0.19	1.70	1.49
Average	0.19	1.70	1.49
FA(%)	74		
M-Y			
1	0.67	1.50	1.64
2	0.68	1.51	1.65
3	0.67	1.51	1.64
4	0.67	1.50	1.65
5	0.68	1.51	1.65
Average	0.67	1.51	1.65
FA(%)	65		

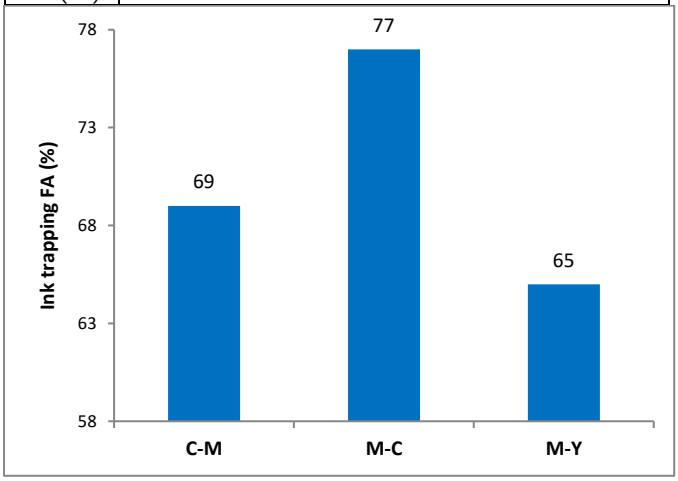

Figure 3: Ink trapping FA of different ink transfers

The results show that the ink transfer coefficient of the higher tack ink on the lower tack ink is better than the converse process. The ink trapping of C to M is 8% higher than that of M to C. The ink trapping of Y to M is 12 % lower than that of C to M. If the ink trapping coefficient is considered as a function of the tack difference between lower and upper ink, then this function is inversely proportional (Fig. 4).

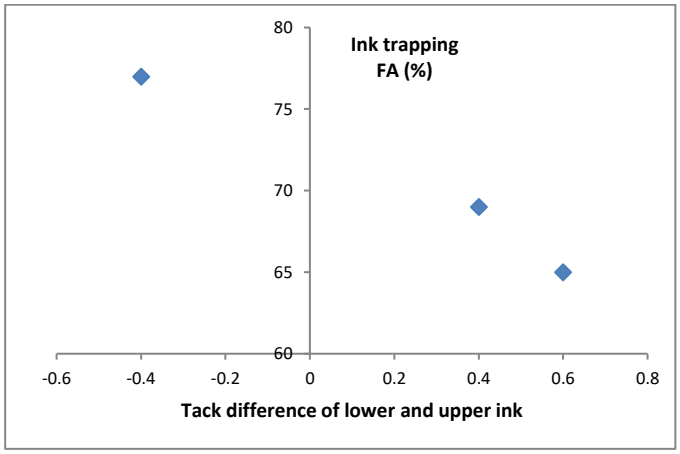

Figure 4: Ink trapping as a function of tack difference between lower and upper ink

The results are inconsistent with the typical tack sequence, in which the first ink must have the highest tack. Subsequent inks have lower effective tacks [2].

To explain, we consider two aspects. First, the inks investigated here have tack differences that are not big enough to classify them as graded tack inks. The tack difference in such an ink set is 2-4 points. This result means that changing the ink sequence does not significantly influence the ink transfer coefficient. Second, the effect can be attributed to the viscosity of the ink. The ink C has sufficiently high viscosity (474 P) compared to the M ink (375 P) that the C ink can transfer a thicker layer of ink onto the M.

IV. CONCLUSION

The results indicate that the ink tack strongly affects wet-on-wet ink trapping. The ink layer thickness, as well as the colour of the overprint, changes as a function of the ink tack difference between the lower and upper ink. In this study, where the tack difference between the inks is lower than 1 point, the ink

trapping increases as the higher tack ink overprints lower tack ones. The proper ink sequence is M-C-Y.

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