CHAPTER IV

RESULTS AND DISCUSSION

4.1 Printing material properties

4.1.1 Printing plates

After plate arrangement process we bring each plate type to make a measurment and the results will be as show table 4-1.

Type of plate	Hardness	Relief	Contact angle
nyloflex® FAH 170	71 Shore A	815µm	32°
nyloflex® ACE 170	72 Shore A	852µm	38°
nyloflex® FAH DII170	71 Shore A	815µm	29°
nyloflex® ACE DII170	72 Shore A	815µm	34°
DuPont® DPU 67	74 Shore A	815µm	55°

Table 4-1 Characteristics of each plate.

4.1.2 Printing inks

The following is the viscosity and specific volume of BASF® Ultraking FLS Process Cyan VW 42501 ink from the producer to be used to calculate ink transfer factors.

Viscosity	0.30-0.90 Pa.s
Specific Volume	1.05-1.1 g/ml

Table 4-2 Characteristics of ink.

4.1.3 Printing substrate

In case of substrate characteristics we study the amount of ink transfer to substrate, which will be discussed in the next topic. From the measurement the contact angle between ink and substrate is 44°.

4.1.4 Ink transfer process of a plate in a condition of stability

The ink transfer process in flexography printing will be as follows: In the beginning stage ink cannot be completely transfered to the print area because the coefficient of ink transfer to plate is higher than with the substrate so the bulk of the ink will be transferred to the plate. The plate will absorb several times the total amount of ink from the anilox roll. Finally since the plate is now saturated the printing process will reach stability, namely how much ink is transferred to the plate from the anilox roll and to the substrate. (input = output)

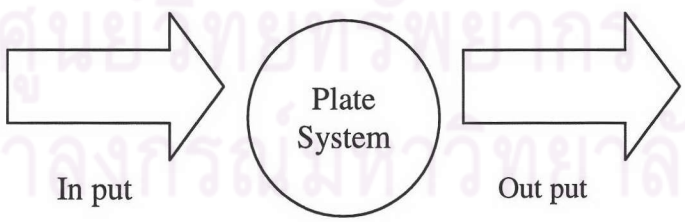


Figure 4-1 Ink transfer process of a plate in a condition of stability.

4.2 Effect of plate types on ink transfer

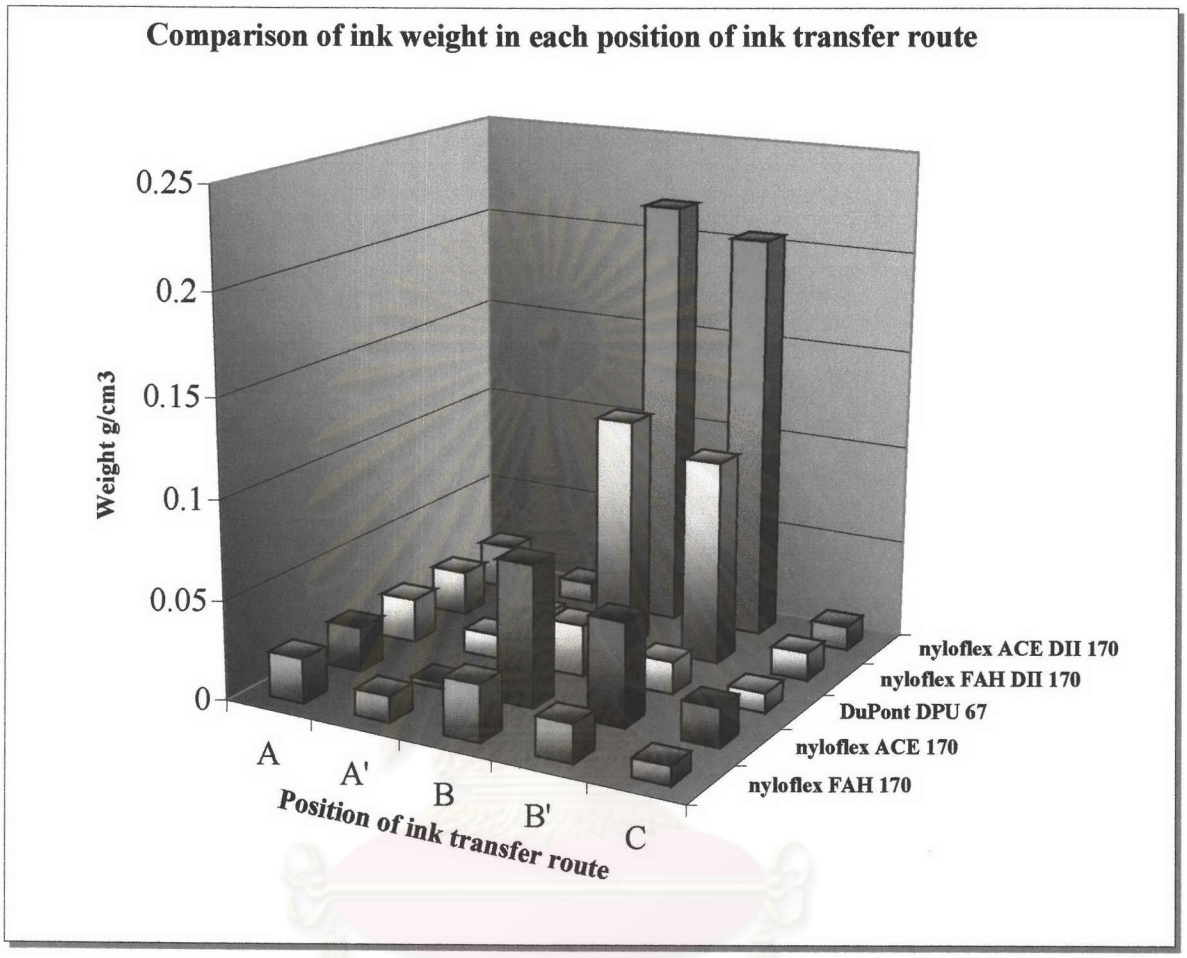


Figure 4-2 Comparison of ink weight in each position of ink transfer route.

From the measurement and calculation of the ink transfer factor in each element, we set anilox roll to be 400/3.0 l/cm. **(16)** and assume the amount of ink in anilox roll approximately 0.02268 g. **(17)** equally in each plate. After printing for a while, we found that ink transferred from the anilox roll to plate and from the plate to substrate respectively. We found that after printing, most of the ink had been transferred by the plate. The amount of ink retained on plate depends on the type of plate used. The transferred and retained ink in each type of plate will be nyloflex®

ACE DII 170 and nyloflex® FAH DII 170, nyloflex® ACE 170 respectively and the rest. nyloflex® FAH 170 and DuPont® DPU 67 have retained nearly the amounts as shown in figure.4-1 The storage amount of ink in the plate will effect to ink transfer from anilox roll to substrate as following details.

4.2.1 Ink transfer from anilox roll to plate

We can calculate the ink transfer factor from anilox roll to plate by considering the transfer at position A′ which is the area that some ink left after transfer to plate.

Thus the amount of ink transfer will reverse on ink transfer factor from A′ position as shown on figure 4-3.

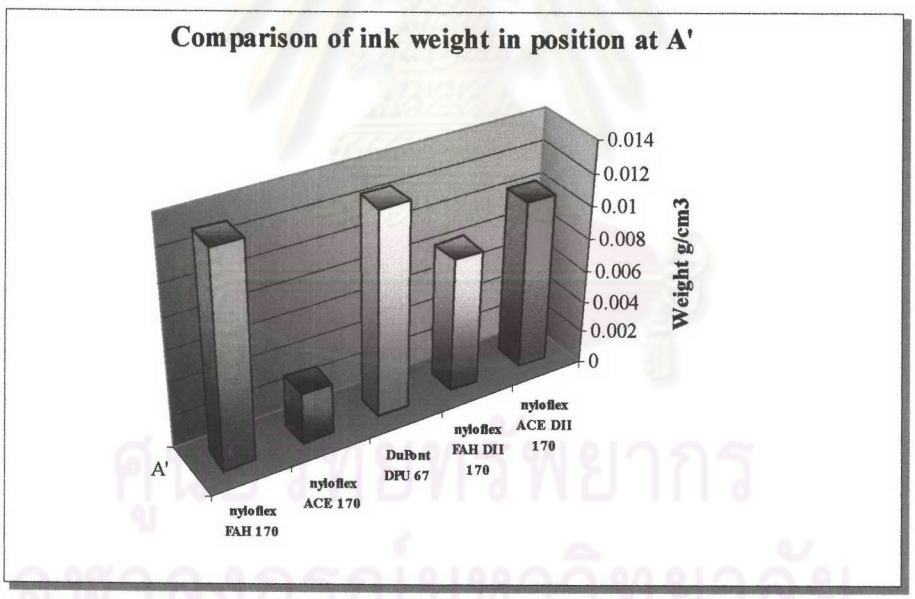


Figure 4-3 Comparison of ink weight in position at A'.

From figure 4-2 transfer factor from anilox to plate in each type are nyloflex® ACE 170, nyloflex® FAH DII 170, nyloflex® ACE DII 170 respectively but for nyloflex® FAH 170 and DuPont® DPU 67 have low ink transfer.

4.2.2 Ink transfer from plate to substrate

When analyzing ink transfer from plate to substrate it is important to consider the amount of ink at position C as figure 4-4.

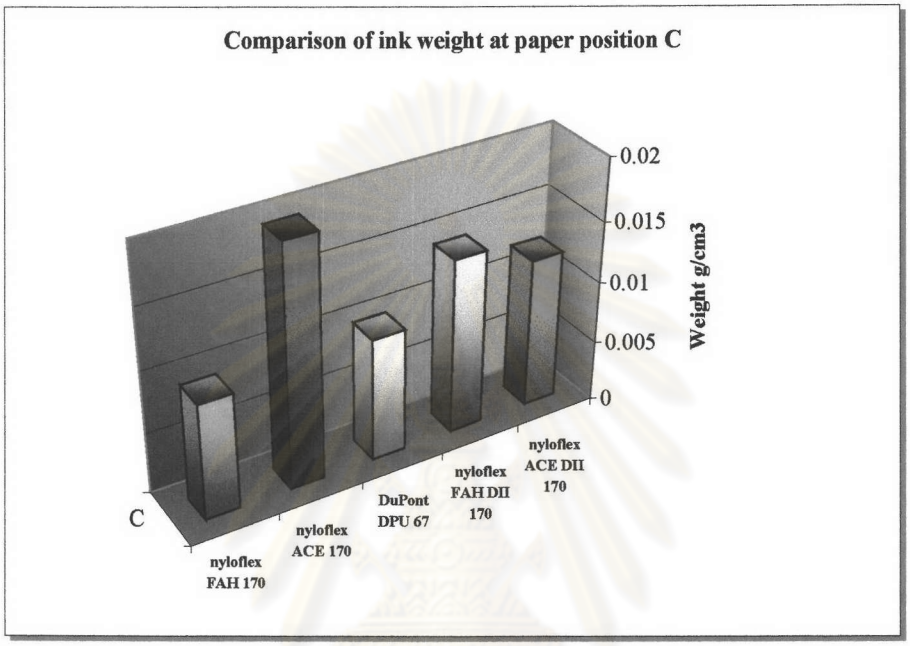


Figure 4-4 Comparison of ink weight at paper position C.

From fig 4-4 it was found that the amount of ink transferred from plate to substrate is nearly the same as ink transferred from the anilox roll to plate. The ink transfer factor from plate to substrate of each plate type are as follows: nyloflex® ACE 170, nyloflex® FAH DII 170 , nyloflex® ACE DII 170 respectively but nyloflex® FAH 170 and DuPont® DPU 67 have transfer a lesser amount of ink.

4.3 Effect of ink transfer on dot gain

It is necessary to find the effective amount of ink transferred to establish dot gain characteristics of each plate to determine the difference between digital and conventional plates. The difference is caused by changes in the plate making process.

These differences become obvious after printing when the dot gain characteristics are carefully examined. (The area on the plate compared with the same area on the substrate).

4.3.1 Conventional Plate

Dot gain in conventional plates varies and is related to the plate making process. After measurement the dot area it was found that nyloflex® FAH 170 have a greater amount of dot gain than nyloflex® ACE 170 with differences that increase in the highlight area as in figure 4-5

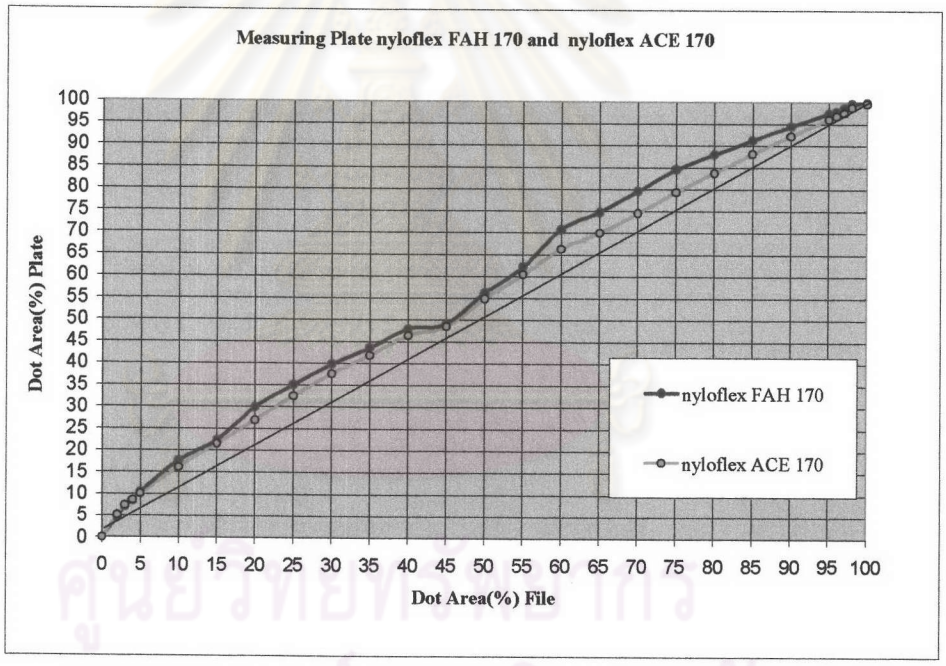


Figure 4-5 Dot area occurred in conventional plate.

From the measurement of dot area on the substrate it was found that nyloflex® FAH 170 have similar dot gain to nyloflex® ACE 170 in the shadow, midtone and highlight areas but have higher increasing in the shadows in figure 4-6

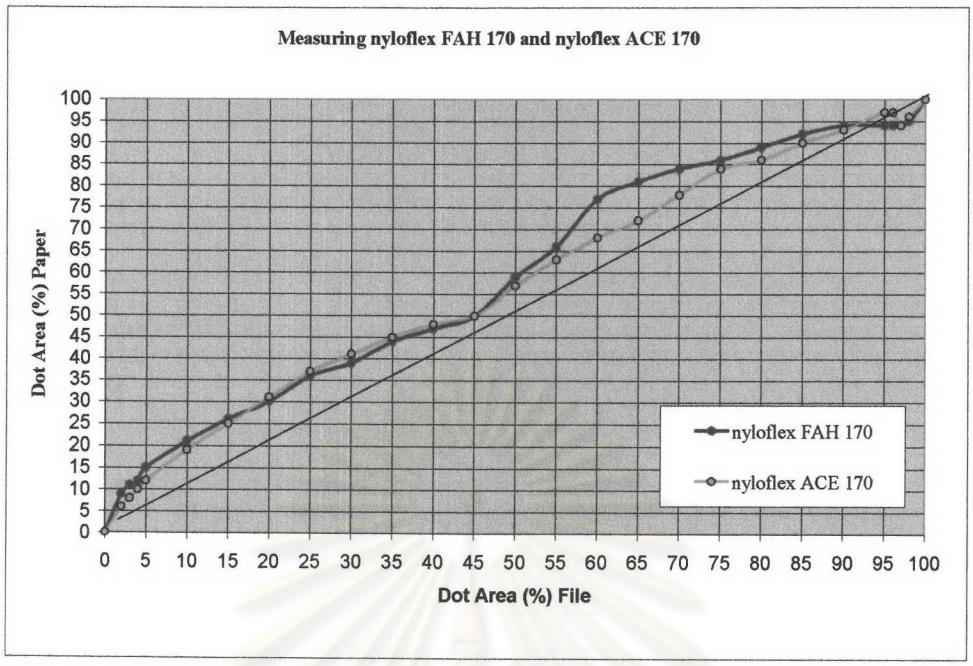


Figure 4-6 Dot area on printed substrate.

nyloflex® ACE 170 had the greatest amount of ink transfer while at the same time a low and acceptical level of dot gain.

4.3.2 Digital Plates

The dot area in digital plates are similar in each other and have more dot lost throughout the print area. nyloflex® FAH DII 170, nyloflex® ACE 170 and DuPont® DPU 67 have almost the same dot reduction in the midtone areas. As figure4-7

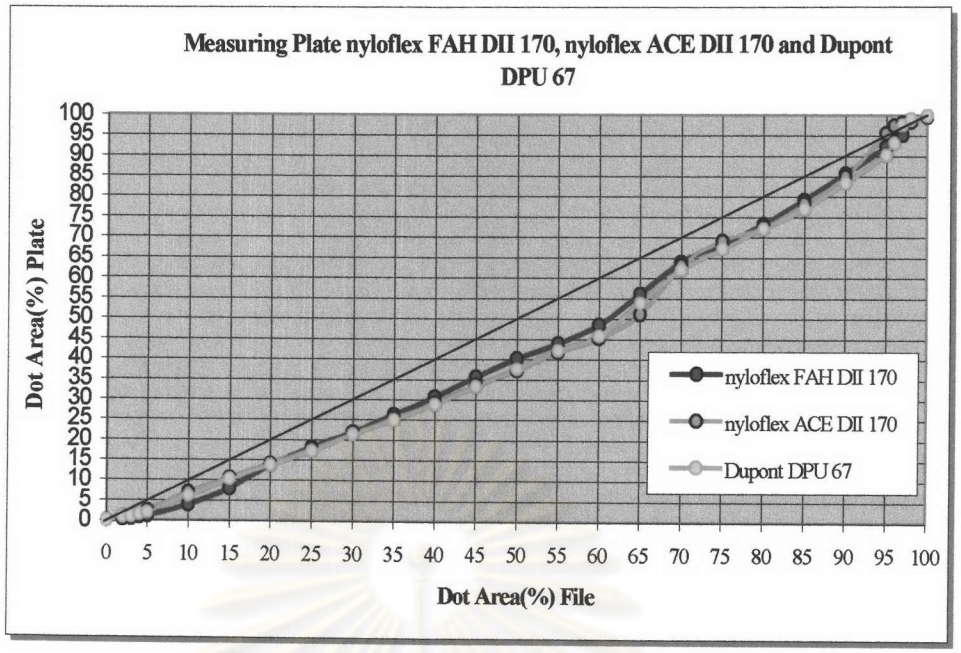


Figure 4-7 Dot area on digital plates.

Measurement of dot area of printing on the substrate found that nyloflex® FAH DII 170 have the highest dot gain, nyloflex® ACE DII 170 have a high level of dot loss after midtone and DuPont® DPU 67 has high dot gain in the midtone and shadow.

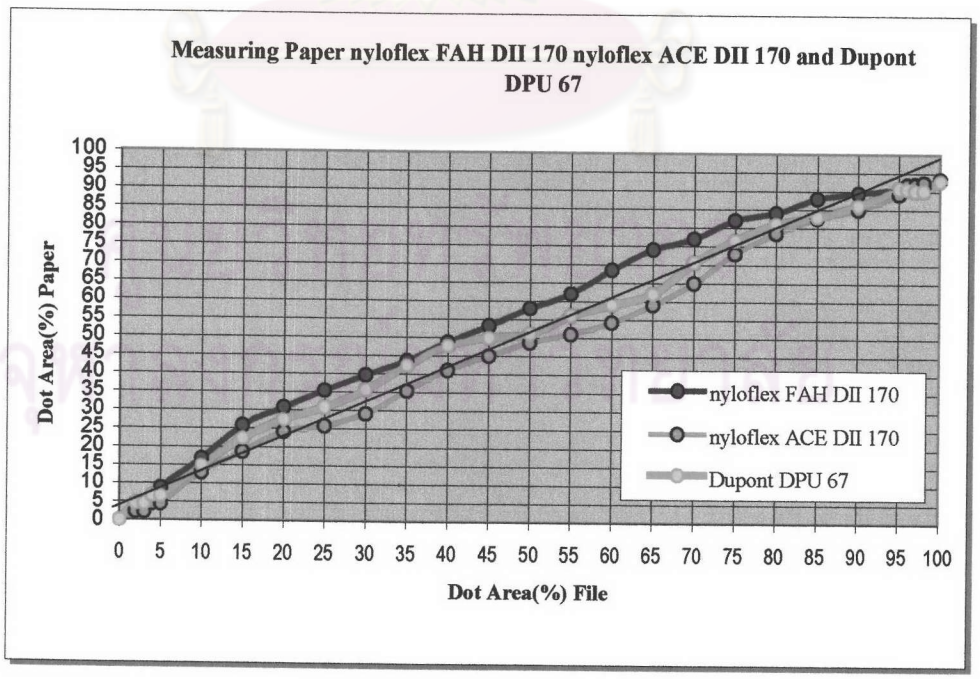


Figure 4-8 Dot area on printed substrate.

From the measurement of dot gain in two plate types both conventional and digital it was found that the dot gain phenomenon depends on two factors, plate surface hardness and the volume of ink transfer.

4.4 Effect of ink transfer on fine reverses

4.4.1 Conventional plate

nyloflex® FAH 170 nyloflex® ACE 170

Figure 4-9 Printed 5 point font size using conventional plates (x10).

nyloflex® FAH 170 has smoother ink lay down properties in the solid area than nyloflex® ACE 170. Because nyloflex® ACE 170 has greatest amount of ink transfer.

4.4.2 Digital Plate

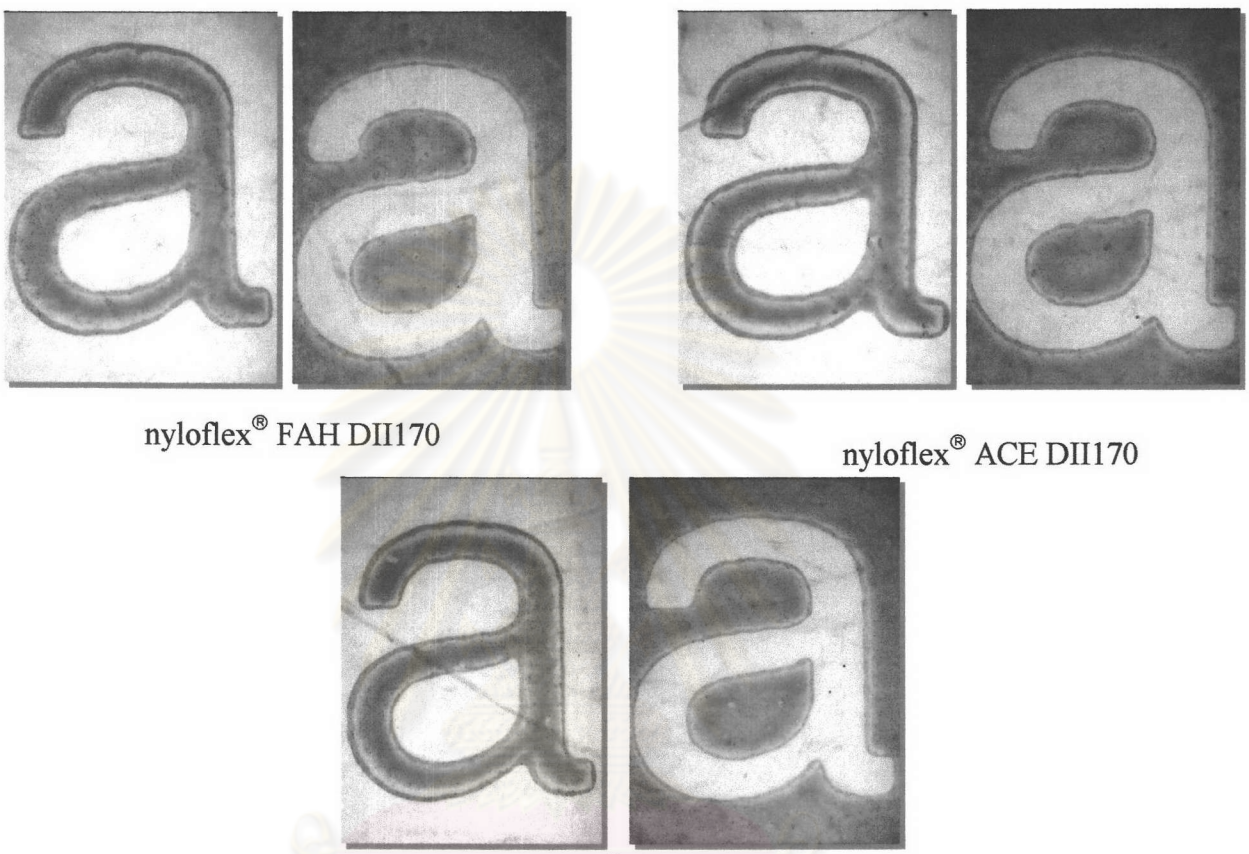
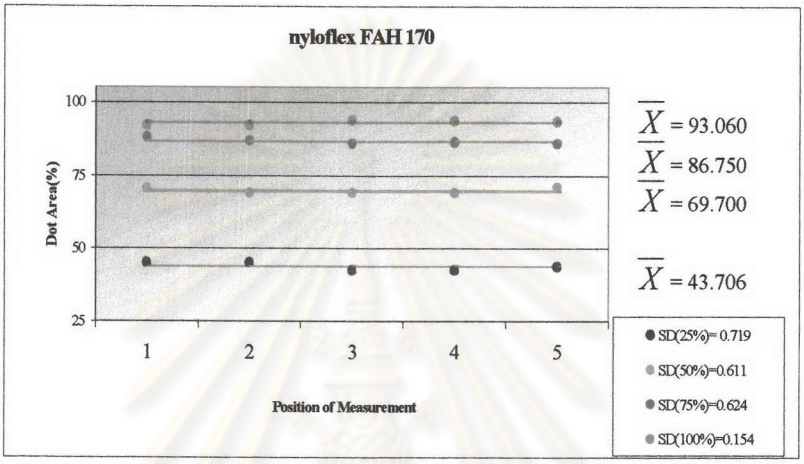


Figure 4-10 Printed 5 point font size using digital plates (x10).

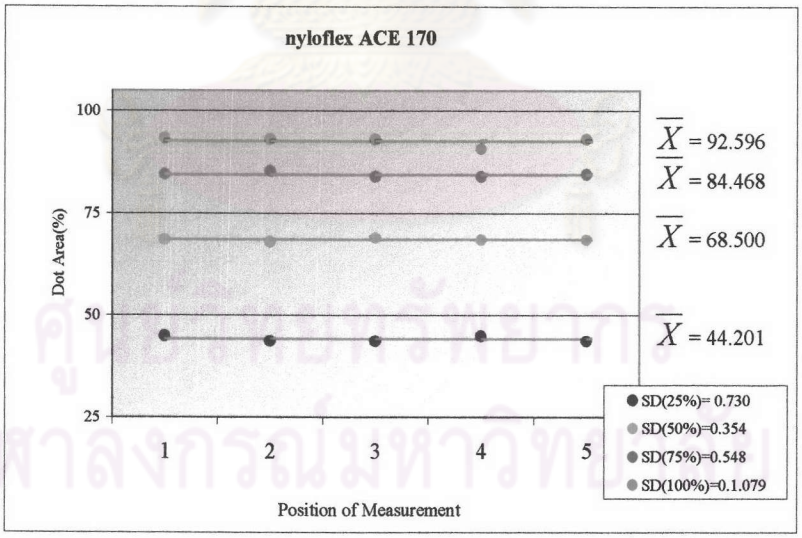
nyloflex® ACE DII 170 and DuPont® DPU 67 has darker edge fonts than nyloflex® FAH DII 170 in positive and negative prints because it has softness but is not different because DuPont® DPU 67 had the lower amount of ink transfer than nyloflex® ACE DII 170.

4.5 Effect of ink transfer on Print Uniformity

4.5.1 Determination of dot area profiles on print(print uniformity) using five types of plates

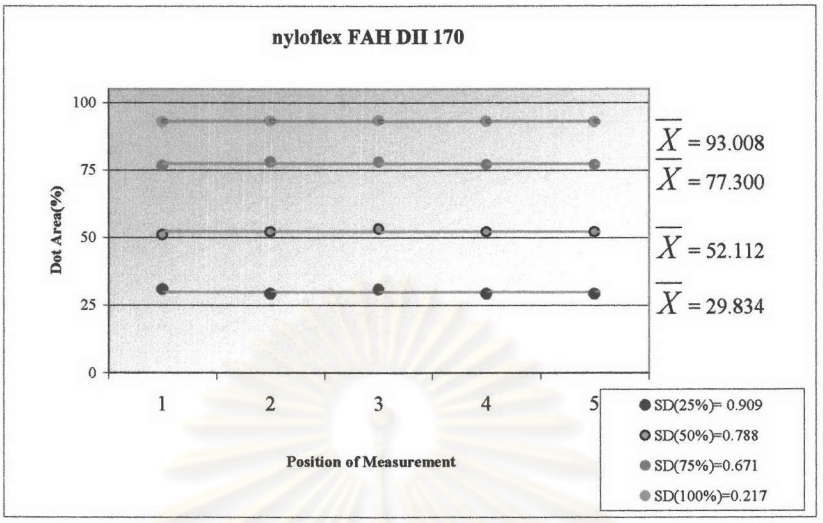


(a)

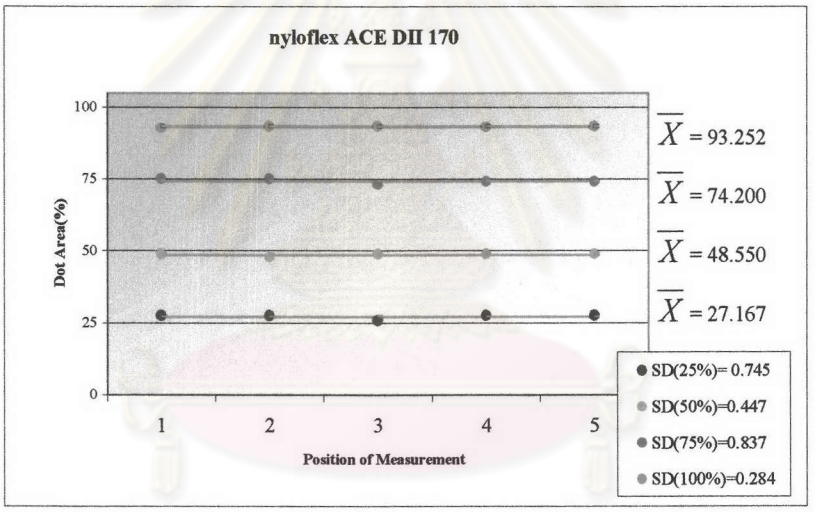


(b)

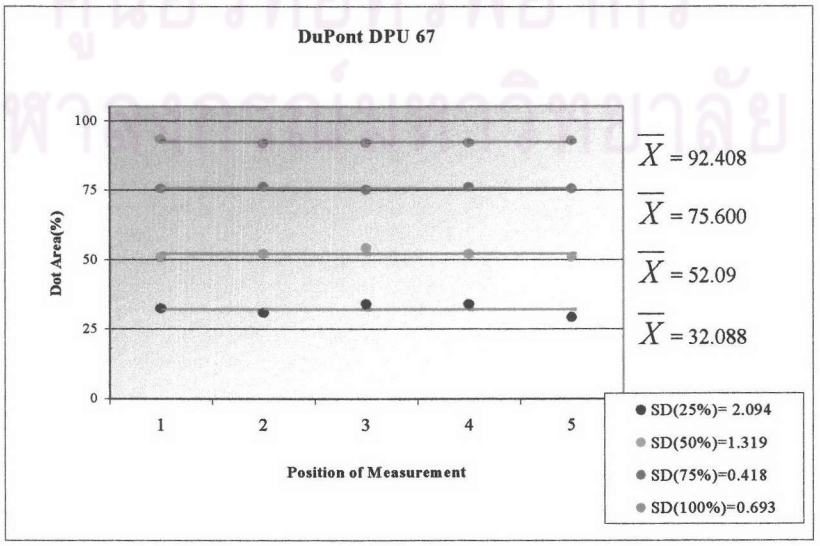
Figure 4-11 Determination of dot area profiles on print(print uniformity) using conventional plates.


nyloflex FAH DII 170
Dot Area(%)
100
75
50
25
0
1
2
3
4
5
Position of Measurement
$\overline{X}$ = 93.008
$\overline{X}$ = 77.300
$\overline{X}$ = 52.112
$\overline{X}$ = 29.834
SD(25%)= 0.909
SD(50%)=0.788
SD(75%)=0.671
SD(100%)=0.217

(a)


nyloflex ACE DII 170
Dot Area(%)
100
75
50
25
0
1
2
3
4
5
Position of Measurement
$\overline{X}$ = 93.252
$\overline{X}$ = 74.200
$\overline{X}$ = 48.550
$\overline{X}$ = 27.167
SD(25%)= 0.745
SD(50%)=0.447
SD(75%)=0.837
SD(100%)=0.284

(b)


DuPont DPU 67
Dot Area(%)
100
75
50
25
0
1
2
3
4
5
Position of Measurement
$\overline{X}$ = 92.408
$\overline{X}$ = 75.600
$\overline{X}$ = 52.09
$\overline{X}$ = 32.088
SD(25%)= 2.094
SD(50%)=1.319
SD(75%)=0.418
SD(100%)=0.693

(e)

Figure 4-12 Determination of dot area profiles on print(print uniformity) using digital plates.

As figure 4-10 for comparison in conventional plate type nyloflex® ACE 170 has good uniformity than nyloflex® FAH 170. For comparison in digital plates nyloflex® ACE DII170 and nyloflex® FAH DII 170 has good uniformity than DuPont ® 67.

4.6 Effect of ink transfer on tone gradation

(c)

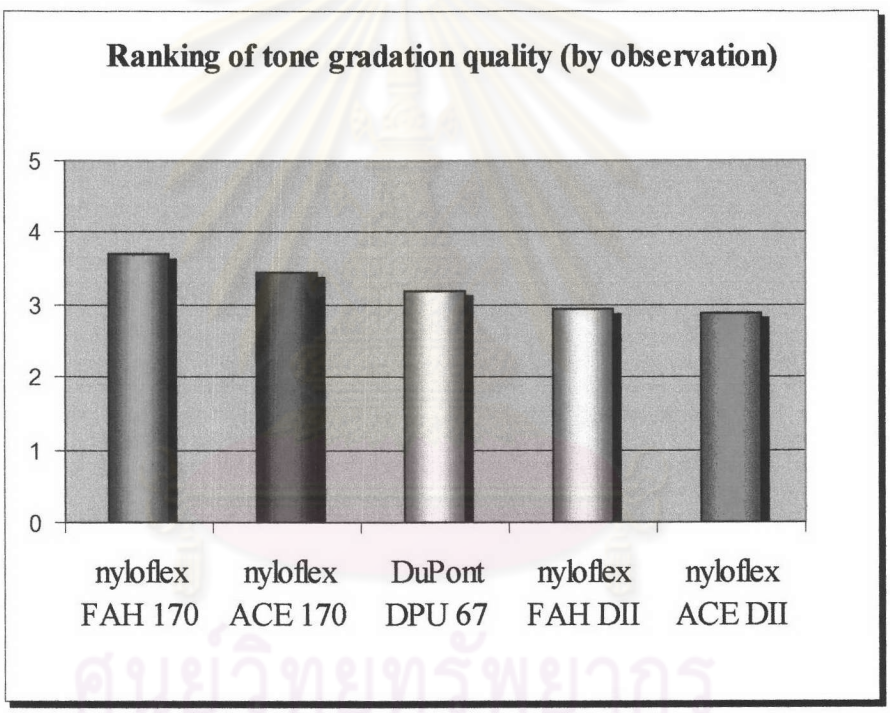


Figure 4-13 Ranking of tone gradation quality (by observation).

Conventional plates have superior qualities than digital plates. The greater amount of ink transferred, the gradient becomes worse.

4.6.1 Conventional plate

nyloflex® ACE 170 which transfer more ink will have a smoother gradient than nyloflex® FAH 170 in figure 4-13.

4.6.2 Digital plate

DuPont® DPU 67 has good smoother gradient nyloflex® FAH DII 170 and nyloflex® ACE DII 170. Summarize from the above figure 4-13 that less amount of ink transfer have good smooth gradient.